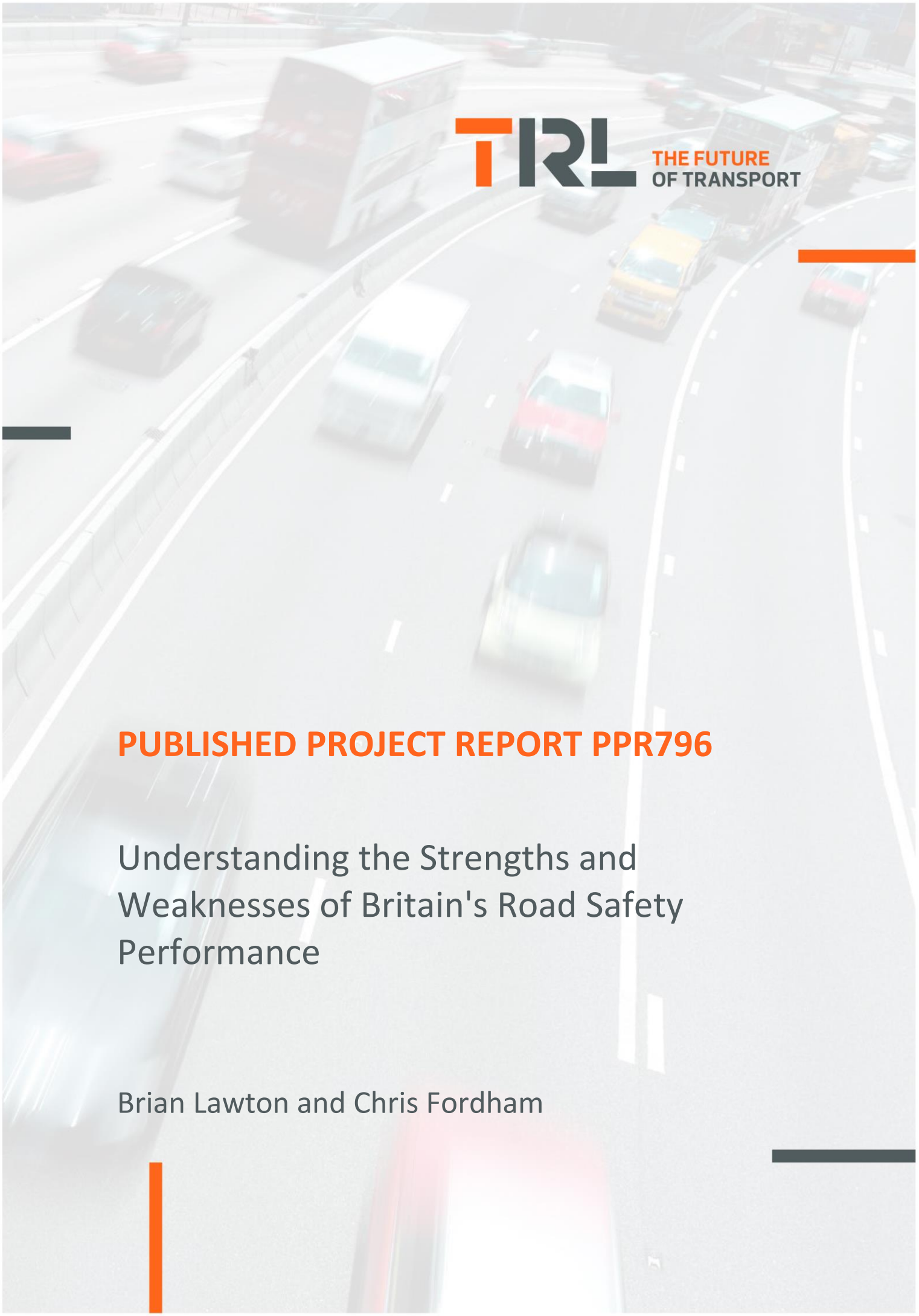

THE FUTURE OF TRANSPORT

PUBLISHED PROJECT REPORT PPR796

Understanding the Strengths and Weaknesses of Britain's Road Safety Performance

Brian Lawton and Chris Fordham

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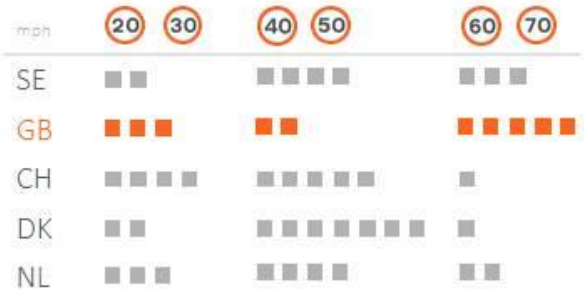
Understanding the Strengths and Weaknesses of Britain's Road Safety Performance

Britain has one of the lowest numbers of road deaths per head of the population. But international comparisons suggest that there is potential to improve safety on Britain's higher speed roads and in its vehicle fleet, and investment in the safety of pedestrians, pedal cyclists and motorcyclists is recommended.

Roads

Percentage of road deaths by speed limit: ■ ≈ 10%



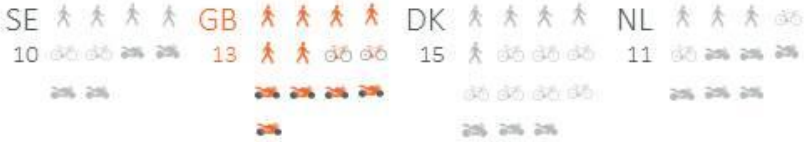
Deaths per 1,000 km of motorway:

SE 11 GB 27 DK 10 NL 22

Road deaths are more likely to be recorded as occurring at junctions in Britain than is the case in most other EU countries in which this information is recorded.

Road Users

Pedestrians, pedal cyclists and motorcyclists deaths per million people:



The overall fatality rate among 18-24 year olds is higher in Britain than in Sweden, Denmark and the Netherlands.

Vehicles

Proportion of new cars with Euro NCAP 5 star safety ratings:

The British Euro NCAP pedestrian protection scores are 19th of 28 European countries.

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Technical research for PACTS

Foreword

David Davies, Executive Director, Parliamentary Advisory Council for Transport Safety

British road safety ministers are fond of saying that the UK has amongst the safest roads in the world. This is based on the UK having fewer road deaths relative to its population than other countries. But what lies beneath this high-level statistic? Do we have the safest roads or perhaps the safest vehicles or the safest road users? Is this due to our road safety performance or to some feature of Britain's travel patterns or demography or other context? If we are to make further progress in reducing road casualties, it is important to know where scarce resources should be focused.

The *British Road Safety Statement* of December 2015 is intended to guide activity for the Government during this Parliament. It endorses the Government's Manifesto commitment to reduce the number of people killed and injured on our roads every year. The Statement sets out an ambitious scope of actions for the UK Government to follow in partnership with others, within a *safe systems* framework.

Following publication of the Statement PACTS applied to the DfT for a grant and commissioned TRL to explore these issues. We asked TRL to compare the UK's road safety performance to those of other high performing countries – those with similarly low rates of road deaths relative to their population. We asked them to focus on safety outcomes rather than differences in laws or policies. In particular, to identify areas where UK performance appeared to be less good than the best in class or where, even if good, more effort might have particular benefit, but to avoid detailed policy recommendations.

The study was high-level. We agreed a "magpie" methodology – collecting material from any available, reputable source that might shed light on these questions, rather than following a single data set or definition of safety, or a fixed set of comparators. The scope was ambitious and TRL are to be congratulated on what they have achieved within the budget and timescale. It is frustrating that more comparable data are not available, even among European countries with similar levels of income and road safety performance. Different countries measure different things and may use different definitions. For example, few countries measure with any accuracy, if at all, the amounts of walking or cycling. But each country is unique and may have developed systems to suit its own circumstances and priorities.

TRL confirms that, on available measures, the UK does indeed have one of the best overall road safety records – though the safety of some individual road user groups compares less well. TRL recommends a focus on the safety of vulnerable road users, including motorcyclists, and raising standards of vehicle safety in the UK fleet. Young drivers and their passengers are a further priority area. TRL also points to the potential casualty reduction that could be achieved from a review of safety standards on roads of 60 mph and above, including motorways.

Different governments, agencies and stakeholders may see other implications in this report. The UK is not a homogenous unit with respect to road safety. Many responsibilities and functions are devolved, especially to Northern Ireland. This devolution is set to continue,

from the UK Parliament in Westminster to governments and assemblies in Belfast, Edinburgh and Cardiff, and to administrations within England.

PACTS is happy to acknowledge the UK's good road safety record. It reflects the high-quality, evidence-based approach to road safety followed over many years by central and local government and a wide range of other stakeholders. But the "safest roads" epithet carries a danger of complacency. If we are that good do we need to give it further priority at a time of economic austerity and uncertainty, with so many other competing claims? We are glad that the UK government has confirmed its commitment to continuous improvement in road safety. Road deaths are still the major source of death for young people in the UK and the biggest danger that most of us face in our adult daily lives. There has been no significant change in total UK road deaths since 2010.

Europe is the region of the world with the best road safety record. Within Europe, apart from the UK, Norway, Sweden, Switzerland, Denmark and the Netherlands have the lowest rates of road deaths. Three of these countries are EU member states and two are not. This study was undertaken before the UK referendum of 23rd June on EU membership. A majority of people voted to leave and Theresa May, the new Prime Minister, has firmly stated that "Brexit means Brexit". PACTS will be urging the UK government and UK institutions to continue to collaborate actively and positively with partners and institutions in Europe. With our Brussels counterpart, the European Transport Safety Council, we will also be urging the European Commission and other European institutions to permit the UK to participate wherever this will benefit road safety.

PACTS decided against publication in the run up to the referendum and TRL has updated the draft with more recent data as a result.

We are very grateful to DfT for enabling this work to go ahead and to TRL for undertaking this ambitious project in a relatively short time. We believe it has produced interesting and potentially important findings. Inevitably it gives rise to more questions – other criteria to explore, how to interpret the results and what actions should follow. PACTS members have contributed through discussions of the interim findings. PACTS would welcome further comment.

PACTS

The Parliamentary Advisory Council for Transport Safety (PACTS) is a registered charity. Its objects are to protect human life through the promotion of transport safety for the public benefit. It supports the All-Party Parliamentary Group for Transport Safety. For further information about PACTS see http://www.pacts.org.uk/

Executive Summary

Overall fatality rates

There are fewer road deaths per head of the population in Britain than in almost any other country in the world. With minor variations in international rankings, this has been the case consistently for many years. The most recent data (2015) show that Norway and Sweden both have fewer road deaths per head than Britain while Switzerland, Denmark and the Netherlands have more. The work reported here has attempted to disaggregate this important but high-level statistic and to explore the relative safety of Britain's roads, road users and vehicles in order to see if there are areas where renewed focus might deliver significant safety benefits. In areas where Britain's road safety record is even better than those of other countries, it may be possible to improve Britain's roads further still through measures which have been found to be effective elsewhere, though these areas were not the focus of the study reported here.

Britain's relative position is broadly consistent when the road fatality rate is expressed in terms of road deaths per head as above, road deaths per person-kilometre, or road deaths as a proportion of all deaths. Britain's relative performance may partly be due to higher levels of compliance, for example with mobile phone and drink-drive legislation.

The comparisons used to assess the relative safety of different countries' roads described above necessarily involve using figures which are averaged across each country as a whole. These can disguise the variation within each country and differences in different aspects of the road safety system. Nonetheless, some indicative differences between Britain and other countries with similar numbers of road deaths per head emerge in relation to the safety of each of the three aspects of roads, road users and vehicles.

Roads

Differences in road type classifications in different countries make comparisons on this basis more challenging than many other comparisons. Nonetheless, some differences emerge. For example, comparisons with other countries with similar numbers of road deaths per head indicate that:

- A greater proportion of British road deaths are on roads with speed limits of 60 mph or more (90 km/h or more). (Proportionally fewer British road deaths are on roads with speed limits of 50 mph (80 km/h) or less.)
- Britain has more deaths per unit length of motorway, though not necessarily per vehicle-kilometre, than the average motorway in the EU.
- Deaths on roads in urban areas are more likely to be male in Britain, and in rural areas more likely to be female, than in other countries.
- Road deaths are more likely to be recorded as occurring at junctions in Britain.
- In rural areas in Britain, pedestrians constitute a larger proportion of road deaths, and car/taxi occupants a smaller proportion.

Road users

Although there appear to be fewer vehicle occupant deaths per head in Britain than in other countries which have similar numbers of road deaths per head in total, there appear to be more vulnerable road user deaths per head in Britain than in these other countries: pedestrians, pedal cyclists and motorcyclists constitute almost half of Britain's road deaths, but fewer than two-fifths in Sweden. This does not appear to be because there are proportionally more vulnerable road users in Britain than in other countries; there are limited amounts of comparable data on this but the indications are that, if anything, there are proportionally fewer vulnerable road users in Britain than in other countries.

The likelihood of a pedal cyclist being killed per distance travelled in the UK is approximately twice that in the Netherlands, Denmark or Norway. When pedestrians are killed in Britain, the collision is more likely to involve a car or taxi than is the case in other countries which have similar numbers of road deaths per head, despite marginally lower car ownership levels in Britain. Pedestrian and pedal cyclist fatalities are more likely to be male in the UK than in other countries; again, this may reflect differences in the amount of cycling and walking; for example, differences in the amount of walking and cycling undertaken by women and by men may be greater in the UK than in other countries. While motorcyclists account for just 1% of UK traffic, almost one in five UK road deaths are motorcyclists; the motorcyclist fatality rate per person-kilometre in the UK is 35% higher than that in the Netherlands.

18-24 year olds are at more risk of being killed on the road in most countries than the average person. However, this difference in risk per head is proportionally larger on British roads than on the roads of most other EU countries, including those in the Netherlands, Sweden and Denmark.

Vehicles

The proportion of new cars which have a 5-star European New Car Assessment Programme (Euro NCAP) rating is smaller in the UK than in Sweden, and the proportion of new cars which have a 2-star Euro NCAP rating is larger in the UK than in the Netherlands. In addition, the average pedestrian protection score on new cars is lower in the UK than across the EU as a whole, and lower than in Norway, Sweden, Switzerland and the Netherlands, though higher than in Denmark. These points suggest that the number of road deaths per head in the UK could be reduced further if Britain's new vehicles were as safe as those of other countries with similar numbers of road deaths per head; however, all of these differences are small.

The number of killed or seriously injured car occupants has been falling in Britain; some of this trend can be attributed to secondary safety design improvements in the last two decades, encouraged by Euro NCAP and mandated by EU type-approval. However, these benefits appear not to have been shared by pedestrians and other vulnerable road users: the proportion of injured pedestrians who are killed or seriously injured in impacts with the front of cars has not experienced the same reduction as is the case for car occupants. Nonetheless, the design changes made to the front of cars to protect pedestrians may be having positive effects; for example, there may have been a reduction in the absolute severity of injuries to vulnerable road users, but within the 'serious' category in police STATS19 collision records. Further evaluation is needed to understand the injury types

amongst vulnerable road users to ensure future collision and injury mitigation strategies are effective.

Background factors

Based on the findings within this study, Britain's relatively low fatality rate could be partly explained by various background factors including differences in national demographics and travel patterns. For example, Britain may have less travel by pedestrians and cyclists than some other comparator countries, though it was not possible to obtain comparable data on these metrics.

Britain's population density is lower than that of the Netherlands but higher than those of Switzerland and Denmark, and substantially higher than those of Sweden and Norway. Britain's population is slightly younger, and a higher proportion of its population is female, than those of Sweden, Denmark and the Netherlands. For example, a larger proportion of Britain's population is under 25 than is the case in all three of these countries. The effect of these differences on road safety outcomes is currently unclear, and more work is required to identify, quantify and analyse these differences if Britain's road safety record is to be understood and improved still further.

Reliability of comparisons

Although countries within the EU use a common definition for road deaths, there are many differences in the way in which other measures related to road safety are measured. These differences include not only the classifications of non-fatal road injuries, but also the ways in which exposure data are collected and classified. Comparable data for various measures for Norway and Switzerland are harder to obtain than those of other countries on account of these two countries not being EU member states.

Subsequently, it is very challenging to compare the road safety records of different countries meaningfully and to understand the reasons for differences and similarities reliably. For example, the number of road casualties is sensitive to the distances travelled by pedestrians and pedal cyclists yet the standard way in which these distances are measured appears to vary by country; this means that apparent differences in vulnerable road user casualty rates may not reflect genuine differences in safety. More harmonised approaches to data collection and classification in different countries would therefore be beneficial in identifying the effectiveness of different approaches and, ultimately, to improving road safety in all countries including Britain.

Recommendations

Britain's road safety outcomes do not always appear to be as good as those of some other countries and therefore there is potential to learn from their experience to reduce road casualties further. Recommendations for the UK include:

- Reviewing the safety of roads with speed limits of 60 mph and above, including motorways.
- Further investment in motorway safety.

- Ensuring that junctions are designed as safely as possible, particularly in respect of vulnerable road users.
- Implementing measures to improve the safety of pedestrians, pedal cyclists and motorcyclists.
- Implementing further measures to improve the safety of young drivers.
- Modernising the car fleet in the UK, replacing the oldest cars with today's highest Euro NCAP performing cars.
- Implementing higher standards of protection for vulnerable road users in vehicle safety regulation and Euro NCAP.
- Obtaining and classifying casualty and exposure data in more consistent ways in different countries to enable more robust international comparison and evaluation.

To help address these issues, questions which need further investigation include:

- Why are there proportionally more road deaths on roads with higher speed limits in Britain than in other countries?
- Why do Britain's motorways have more deaths per unit length than motorways in other countries? (If this is simply because traffic volumes are higher, is more effort to improve motorway safety warranted in Britain than is the case in other countries?)
- How do travel patterns vary in different countries by area type? For example:
    - In Britain, do males travel more in urban areas and females travel more in rural areas, proportionally speaking, than in other countries?
    - In rural areas in Britain, are pedestrians and motorcyclists proportionally more common, and cars/taxis proportionally less common, than in other countries?
- How are junctions classified differently in different countries, in terms of where road deaths occur, and what impact do these differences have on the relative proportions of road deaths at junctions?
- Why are there proportionally more vulnerable road user deaths in Britain than in other countries?
- Why are there proportionally more fatalities among 18-24 year olds in Britain than in other countries?
- How many collisions could be prevented and how many casualties mitigated, particularly among vulnerable road users, if cars on Britain's roads have higher Euro NCAP star ratings?

1 Introduction

1.1 "Safest roads in the world"

The British Road Safety Statement (The Department for Transport, 2015a) states that "Britain has some of the lowest road casualty rates in the world, with only Sweden being a safer place to travel by road". This is based on a comparison of the number of road deaths per head in a variety of countries and is often paraphrased as "Britain has amongst the safest roads in the world".

Differences in road casualty rates may be explained by differences in road infrastructure standards, vehicle standards and driving standards. For example, Britain may have a safer vehicle fleet, or a safer road infrastructure, or higher driving standards than other countries, or some combination of all three. This report therefore aims to understand how Britain's relative road safety performance compares to those of other countries with similar numbers of road deaths per head of the population, going beyond the headline road death figures.

The intention is to explore whether Britain has the safest roads, the safest vehicles or the safest road users, or whether there are other background factors such as population distribution and geography that explain Britain's relative road safety performance. This approach is intended to help highlight areas which are worthy of further investigation in terms of identifying the specific policy interventions used in other countries that could be used to reduce Britain's casualty rate further.

1.2 Road deaths per head of the population

The World Health Organisation (WHO) has calculated the average number of road deaths per head in each of six regions (The World Health Organisation, 2015). The European region has the fewest road deaths per head of the population (93 per million people, compared with a world average of 174 per million people).

The European region comprises all EU countries, Iceland, Norway, Switzerland, Turkey and all of the countries which were formerly parts of Yugoslavia or of the Soviet Union. The average number of road deaths per head of the population in Europe is substantially lower than across the World Health Organisation's European region as a whole, and Figure 1 breaks down the figures for many European countries for both 2014 and 2015. (The countries are referred to here by their ISO codes, a full list of which is contained in Appendix B.)

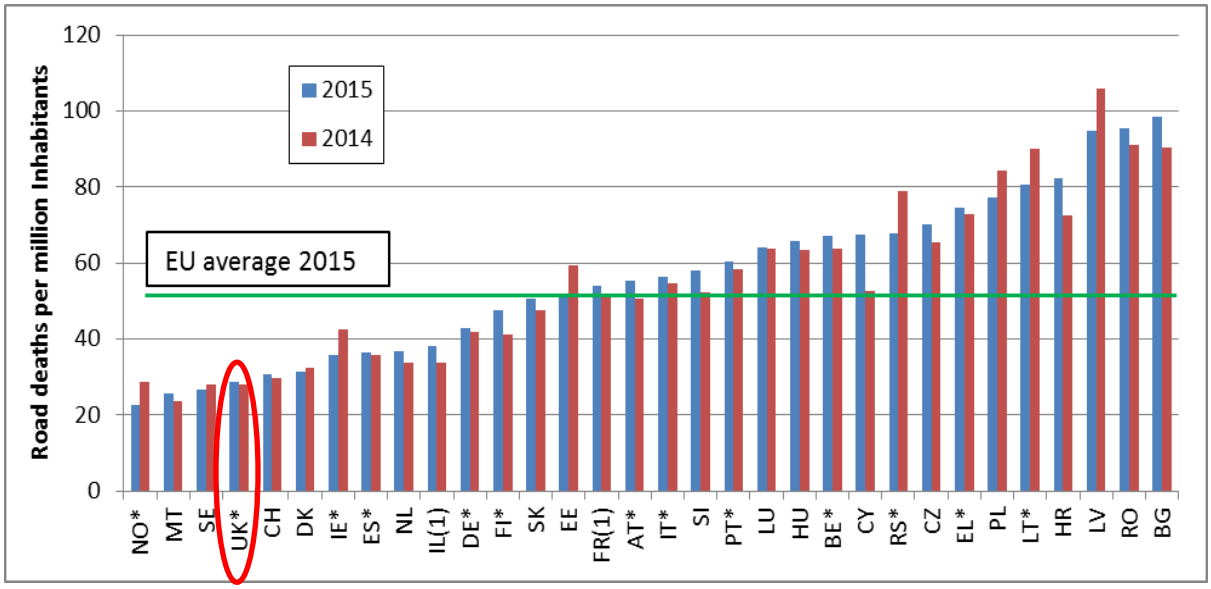


Figure 1: Road deaths per million people by country

(The European Transport Safety Council, 2016a) / (The European Transport Safety Council, 2015a) * National provisional estimates as the final figures were not available at the time of going to print. (1) National population data.

The UK figure for 2015 (28 deaths per million people) (The Department for Transport, 2016) was just over half of that of the EU as a whole (52); only Norway (23), Malta (26) and Sweden (27) had fewer road deaths per head. Switzerland (31) and Denmark (31) had slightly more road deaths per head than the UK, while the Netherlands (37) was the only other European country for which 2015 data are available with fewer than 40 road deaths per million inhabitants. Other sources (The European Commission, 2016a) record lower figures for the Netherlands, ranking them alongside the UK, because they do not correct for police underreporting (The European Transport Safety Council, 2016a). In the Netherlands, the reported number of deaths is checked by Statistics Netherlands (CBD) and compared individually to the death certificated and court files of unnatural deaths.

Figures for Malta are highly susceptible to natural statistical variation because of its particularly small population. Appendix A orders selected countries by the number of fatalities per head in each of the years from 2006 to 2014, and shows that Britain consistently has amongst the lowest numbers of fatalities per head (The Department for Transport, 2015b).

Comparable data for various measures for Norway and Switzerland are harder to obtain than those of other countries on account of these two countries not being EU member states[1]. Nonetheless, comparisons with Norway, Sweden, Switzerland, Denmark and the Netherlands are particularly informative in understanding different aspects of road safety:

[1] At the time of writing, the UK is an EU member state and this is expected to continue for at least a further two years. The UK public recently voted to leave the EU in a referendum and "Brexit" is now the policy of the UK Government.

the data above demonstrate that, along with the UK, these countries consistently have some of the lowest numbers of road deaths per head in the EU and hence in the world.

The number of road deaths per head is very slightly lower in Great Britain than in the United Kingdom as a whole, though comparisons with the UK are likely to be as meaningful as those with Great Britain in most cases: Northern Ireland accounts for approximately 3% both of the UK population and of UK road deaths.

1.3 Road deaths per vehicle-kilometre and person-kilometre

While the number of road deaths per head of the population is one of the most straightforward metrics to use to compare road safety standards between different countries, it may not be the most informative. It takes no account of differences in the amount or modes of travel in different countries and, as an average, may disguise some aspects of road safety in which a country's relative performance is quite different from that implied by this single measure.

The relatively few road deaths per head of the population in Britain may be because, for example, people do not travel as far or as often by road as people in other countries rather than because road travel in Britain is intrinsically safer than elsewhere. If this is the case, the likelihood of a road user being killed on a trip or a journey of a given length on Britain's roads could actually be higher than that of a trip or a journey of the same length on other countries' roads. The amount of road travel is therefore a more informative measure of exposure than the population when assessing the relative safety of different roads. The volume of road travel may be expressed in terms of vehicle-kilometres or person-kilometres, or simply in terms of the number of road trips people make. Differences between vehicle-kilometres and person-kilometres are attributable to differences in vehicle occupancy (e.g. the amount of car-sharing and bus occupancy levels) and in the volume of walking – a pedestrian walking a kilometre is counted as a person-kilometre but not as a vehicle-kilometre.

Figure 2 presents the average number of road deaths per billion vehicle-kilometres for 18 European countries for the last three years for which both road deaths and estimated data on distance travelled are available.

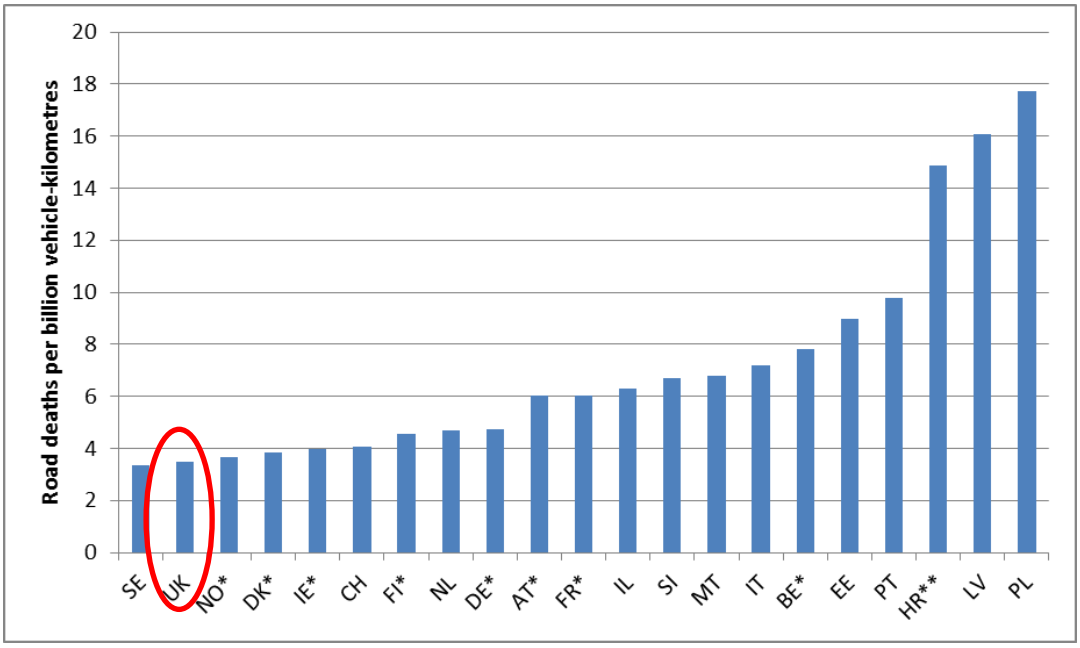


Figure 2: Road deaths per billion vehicle-kilometres, latest three years for which data are available

(The European Transport Safety Council, 2016a) The latest three years for which data are available are 2013-2015 (HR, LV, SE, CH), 2012-2014 (AT, SE, DK, FI, FR, IE, NL, PT, UK, IL, NO), 2011-2013 (BE, PL), 2014-2015 (MT).*Provisional figures for road deaths in 2015. **Road deaths per billion vehicle-km travelled by cars only

On this measure, the UK has relatively few road deaths (3.5 per billion vehicle-kilometres); only Sweden has fewer (3.3). The countries of Scandinavia and the British Isles (UK and Ireland) have the fewest road deaths per vehicle-kilometre, interspersed by Switzerland (4.1) and followed by the Netherlands (4.7).

When measured in terms of road deaths per person-kilometre, 2013 figures (The European Commission, 2016b) suggest a slightly different pattern, Denmark having the fourth lowest number of road deaths per billion person-kilometres in the EU (3.6) after the Netherlands (3.3), the UK (2.8) and Sweden (2.4), the Dutch figure here not being corrected for underreporting. Using this measure of exposure, the gap between Sweden and the UK is greater, either because Sweden has a higher average number of occupants per vehicle, or proportionally more walking, or a combination of the two. Unfortunately, it has not been possible to identify data on the amount of walking in the two countries, measured on a comparable basis, to investigate this further within the study reported here.

1.4 Road deaths as a fraction of all deaths

An alternative measure of road safety is the percentage of all deaths (i.e. regardless of the cause) which are attributable to road collisions, as shown in Figure 3.

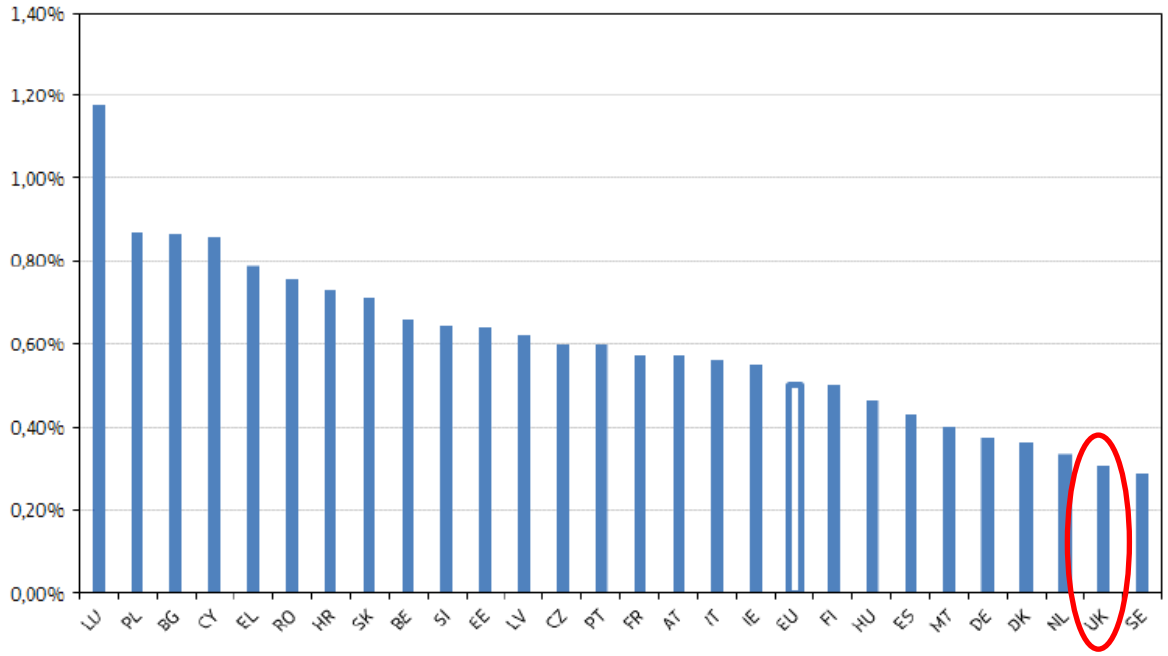


Figure 3: EU road deaths as a percentage of all deaths, 2013 or latest available year

Reprinted from the European Commission (2015a)

Across the EU in 2013, road deaths accounted for 0.5% of all deaths and, in the UK, this figure is 0.3%. On this measure, the UK has fewer road deaths than all other EU countries with the exception of Sweden.

1.5 Factors affecting road casualty rates

Road casualty rates in different countries may vary due to differences in the amounts of travel. Per distance travelled or trip, for example, child cyclists and elderly pedestrians may be more likely to be killed on Britain's roads than on other countries' roads, and/or the likelihood of being killed while travelling by car on Britain's motorways may be lower than on motorways in other countries.

Whereas the number of casualties per person-kilometre or vehicle-kilometre may be the most informative measure of risk to an individual road user, the number per unit road length may be the most useful measure of safety for a road authority interested in where the most casualty reduction benefit might be gained by spending a given amount of money. Where comparable data exist, different exposure measures are used to compare the fatality rates between countries throughout this report.

There are various contextual factors which are likely to affect road casualty rates, such as the population distribution, schooling, housing and employment patterns, and road legislation and compliance. Some of these are beyond the control of road authorities and/or

cannot be altered easily, while others may affect road casualty rates but in a way which is not easily detectable from the statistics. This report introduces the possible effects of differences in demographics, geography and travel patterns, though it has not been possible to investigate these in detail here.

1.6 Reliability of comparisons

The focus throughout this report is on road fatality rates rather than on those associated with all injuries or collisions: the definition of a road death is consistent across most European countries[2] whereas different countries currently have different ways of classifying non-fatal road casualties, making comparisons on these measures less informative.

Different exposure measures have different advantages and disadvantages when comparing road casualty rates, including data accessibility and comparability. The number of road deaths is highly dependent on the amount of travel, for example. Unfortunately, obtaining comparable exposure data was one of the most challenging aspects of this project. If traffic volume is measured in different ways in different countries, for example the sampling technique and weightings used to estimate traffic volume, using this as a measure of exposure to calculate road casualty rates may give misleading results. In the absence of comparable data for travel volumes, the number of registered vehicles or registered drivers may be a useful proxy for exposure: the more motor vehicles or drivers there are per head of the population, the greater the amount of travel per head is likely to be.

Given the challenges associated with obtaining up-to-date comparable data, the focus in this report has been on collating comparable data for countries which have similar numbers of road deaths per head against which it is reasonable for Britain to be benchmarked, these being Sweden, Denmark, the Netherlands and, where possible, Switzerland and Norway. The most recent available comparable complete data for these countries often relates to 2013, although some 2014 data are available and, for example, 2015 casualty data for Britain were published at the end of June 2016. However, the same countries have had relatively few road deaths per head for many years so comparisons based on data from three years ago remain relevant.

To gain a better understanding of the relative road safety performance of different countries, a more harmonised approach to collecting exposure data – as well as non-fatal collision data – in different countries would be helpful. While, for example, the distance cycled by the population in different countries is measured in different ways, it is inevitable that some apparent differences in risk will not be a reflection of genuine differences in risk.

[2] In essence, a death resulting from the injuries sustained in a collision on the public highway, whether immediate or within 30 days of the collision, excluding suicides involving the use of road motor vehicles.

2 Roads

2.1 Introduction

In 2013, Sweden was the only country which had fewer road deaths per unit of distance travelled than the UK, as seen in section 1.3. However, the relative records of different countries are likely to vary by speed limit and road type, for example. Table 1 breaks down the numbers of road deaths in 2013 in the Netherlands, Switzerland, Denmark, Sweden and the UK by speed limit.

Speed limits (km/h)	Netherlands	Switzerland	Denmark	Sweden	UK	Speed limits (mph)
30, 40, 50	44%	39%	25%	18%	31%	20, 30
60, 70, 80	43%	51%	69%	49%	17%	40, 50
90, 100	6%	4%	2%	26%	**39%**	60
110, 120	5%	6%	3%	7%	**13%**	70
>120	3%	0%	3%	0%	**0%**	>70

Table 1: Percentage of road deaths by speed limit in the Netherlands, Switzerland, Denmark, Sweden and the UK in 2013

(The European Commission, 2016c)

Unlike Sweden, Denmark, Switzerland and the Netherlands, more than half of Britain's road deaths are on roads with speed limits of 60 mph (90 km/h) or more, indicated in the bold red text above. This may be because a greater proportion of travel in Britain is on roads with higher speed limits than is the case in other countries, though it has not been possible to identify comparable data on this.

Most countries categorise their roads into motorways, urban (or built-up) roads and rural (or non-built-up) roads. Figure 4 presents the proportions of road deaths in 2013 which were in urban areas, rural areas and on motorways.

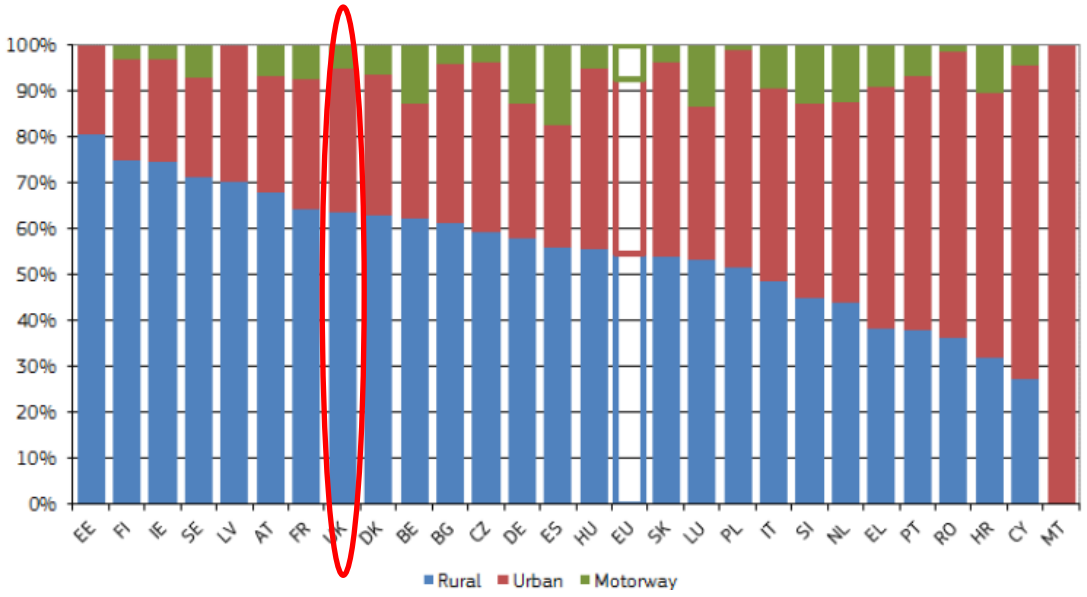


Figure 4: Road deaths by road type and country in 2013

Reprinted from the European Commission (2015a)

Across the EU as a whole, 39% of road deaths in 2013 were on urban roads, 54% were on rural roads, and 7% on motorways, compared with 31%, 63% and 6% respectively in the UK. The proportion of road deaths in rural areas was higher in the UK than in Denmark and the Netherlands, but lower than in Sweden. However, these differences may be partially or totally attributable to the different classifications and proportions of roads of each type in different countries. For example, Sweden's lower population density may mean it has proportionally more rural roads and hence rural road deaths than is the case in the UK. Each of these three types of road is considered separately in the subsequent sub-sections.

2.2 Motorways

Motorways are well-recognised as the safest type of road for motorised users, in spite of their high speeds, because junctions are grade-separated, traffic in opposing directions is separated, removing much of the potential for junction and head-on collisions, and vulnerable road users are prohibited. In 2014, there were 88 injury collisions per billion miles on British motorways, compared with 340 injury collisions per billion miles on rural British roads and 819 injury collisions per billion miles on urban British roads.

Although a lower proportion of road deaths are on motorways in the UK than is the case in many countries, including Sweden, Denmark and the Netherlands – see Figure 4 – this may simply reflect differences in the proportions of roads which are motorways in different countries. Figure 5 therefore shows the proportion of the road network in each EU country which is classed as motorway.

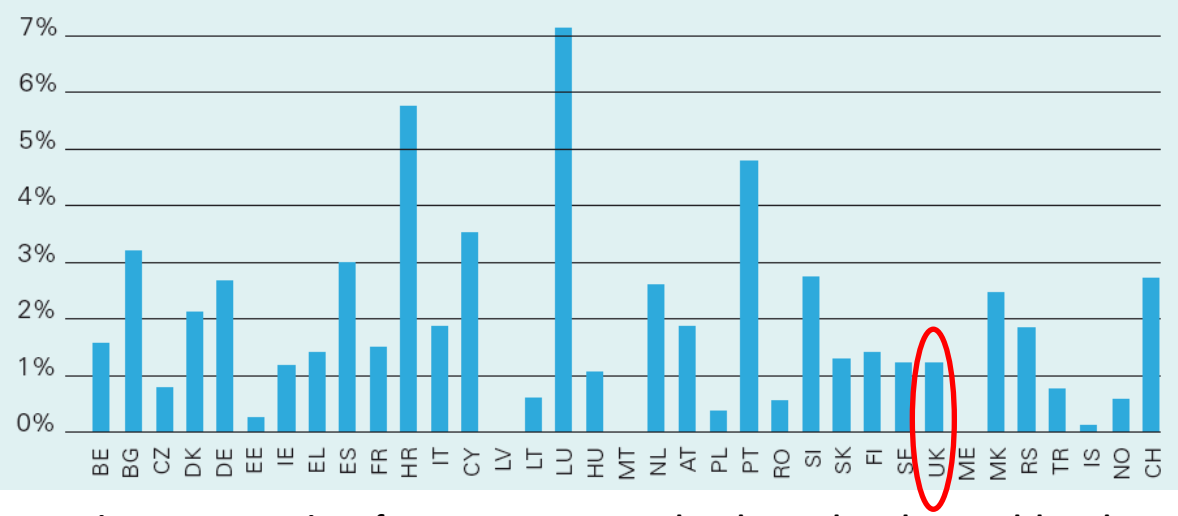


Figure 5: Proportion of motorways compared to the total road network length

Reprinted from the European Union Road Federation (2015)

Amongst countries with similar numbers of road deaths per head as Britain, motorways typically represent between 0.8% and 2% of the total road network length. The UK is at the lower end of this range, with a similar proportion as in Sweden, while approximately twice the proportion of road length is motorway in Denmark and the Netherlands.

Although motorways represent only a small fraction of the entire road network in terms of length, they account for a substantial proportion of total road traffic. Therefore, even seemingly small differences in relative motorway length are likely to affect a country's road casualty rate. Figure 6 therefore presents the numbers of motorway deaths per unit length.

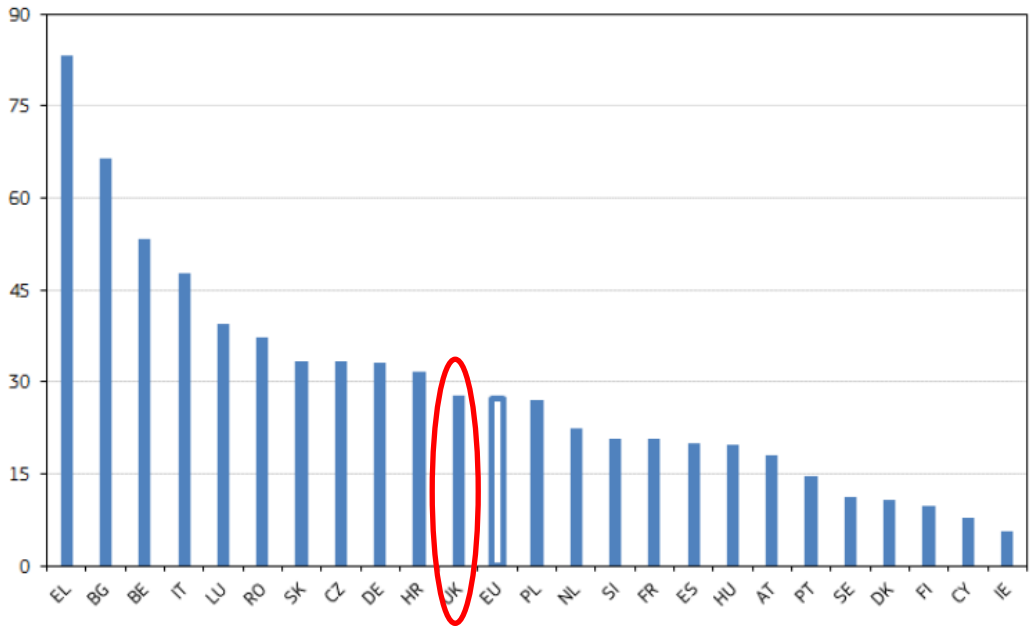


Figure 6: Motorway deaths per 1,000 km of motorway by country, 2013 or latest available year

Reprinted from the European Commission (2015a)

The number of road deaths in the UK per unit length rank alongside the EU average, and is higher than those of the Netherlands, Sweden and Denmark. The UK's relatively short length of motorways compared to the Netherlands more than explains the relatively few road deaths which are on motorways. Although the UK's higher number of road deaths per unit length of motorway may be explained by the UK's motorways having higher traffic flows, this might imply that reducing the casualty rate on motorways is likely to be more cost-effective in Britain than in other countries.

Another explanation for the higher number of road deaths per unit of length of motorway may relate to traffic speed. For example, motorway speed limits in other countries with similar numbers of road deaths per head are more variable than in the UK: in both Sweden and the Netherlands, motorway speed limits are more likely to be 100 km/h (62 mph); in Britain, motorway speed limits of 60 mph are less common. Motorway speed limits in Norway, another country with relatively few road deaths per head, are typically set at 90 km/h or 100 km/h (56-62 mph) (The European Union Road Federation, 2015). Although there are some exceptions to the default motorway speed limit of 70 mph in the UK, it is notable that other countries with similar numbers of road deaths per head have lower speed limits on more of their motorway networks. This difference in speed limits might also partly explain why the proportion of road deaths with speed limits of 70 mph in Britain is higher than in Sweden, Norway, and the Netherlands, as presented in Table 1.

2.3 Urban roads

Figure 7 presents the breakdown of urban road deaths by sex for each EU country.

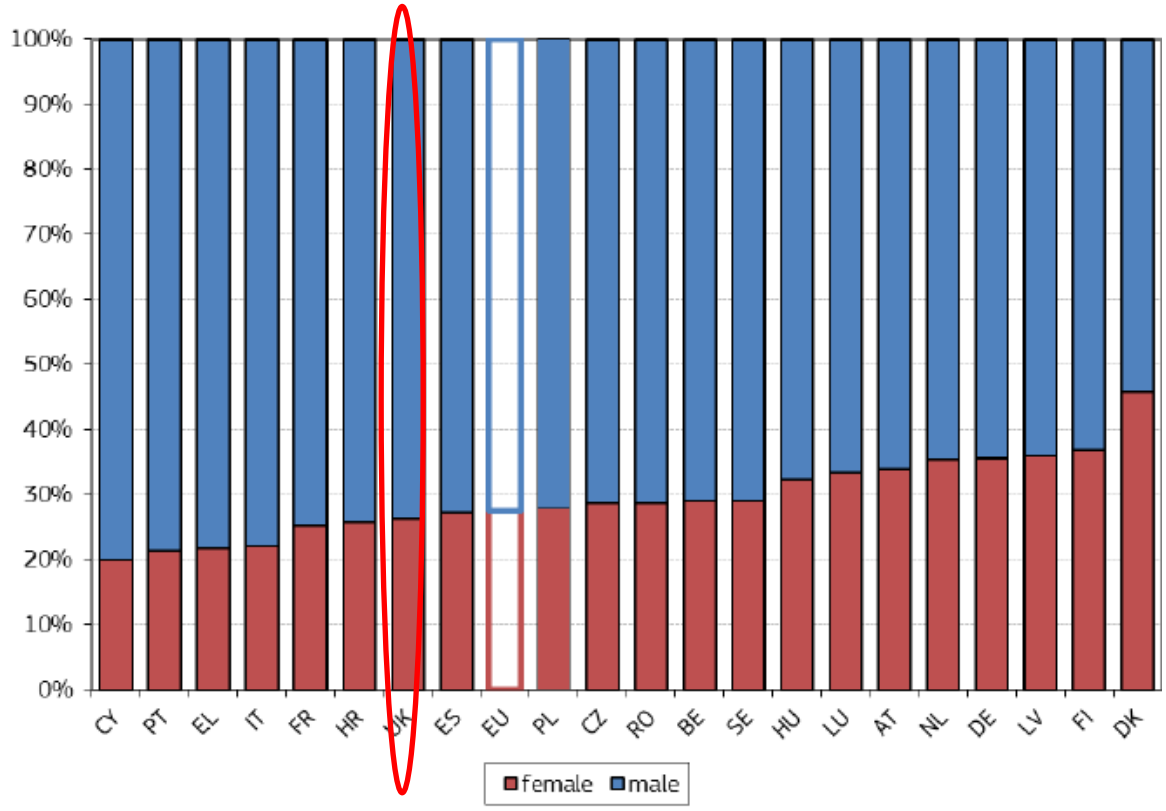


Figure 7: Road deaths in urban areas by sex and country in 2013

Reprinted from the European Commission (2015b)

A higher proportion of road deaths in urban areas are male than female in all countries. However, this difference is particularly acute in the UK: road deaths are more likely to be male in the UK than in Sweden, the Netherlands, and on average across the EU.

Figure 8 presents the breakdown of road deaths in urban areas by whether or not they are at a junction for each EU country.

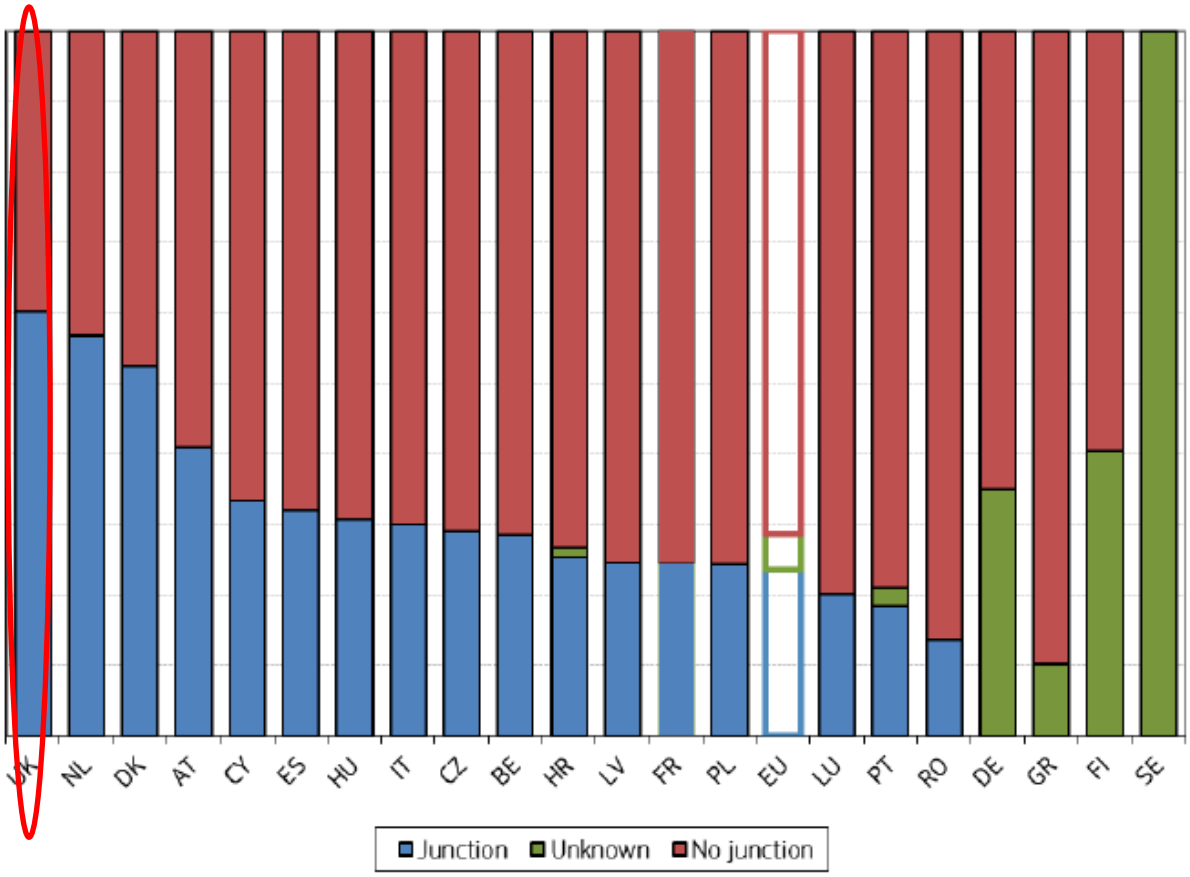


Figure 8: Distribution of urban road deaths by country and whether or not at a junction, 2013

Reprinted from the European Commission (2015b)

The UK has a higher proportion of urban road deaths at junctions than any other country for which this information was recorded. More than half of road deaths in urban areas are at junctions in the UK, the Netherlands and Denmark.

2.4 Rural roads

53% of traffic in Britain in 2013 was on rural roads, but rural roads accounted for 66% of reported road deaths (The Department for Transport, 2015b), meaning that rural road risk is around 25% more than the average road risk.

Figure 9 presents the distribution of road deaths outside urban areas broken down by sex for each EU country.

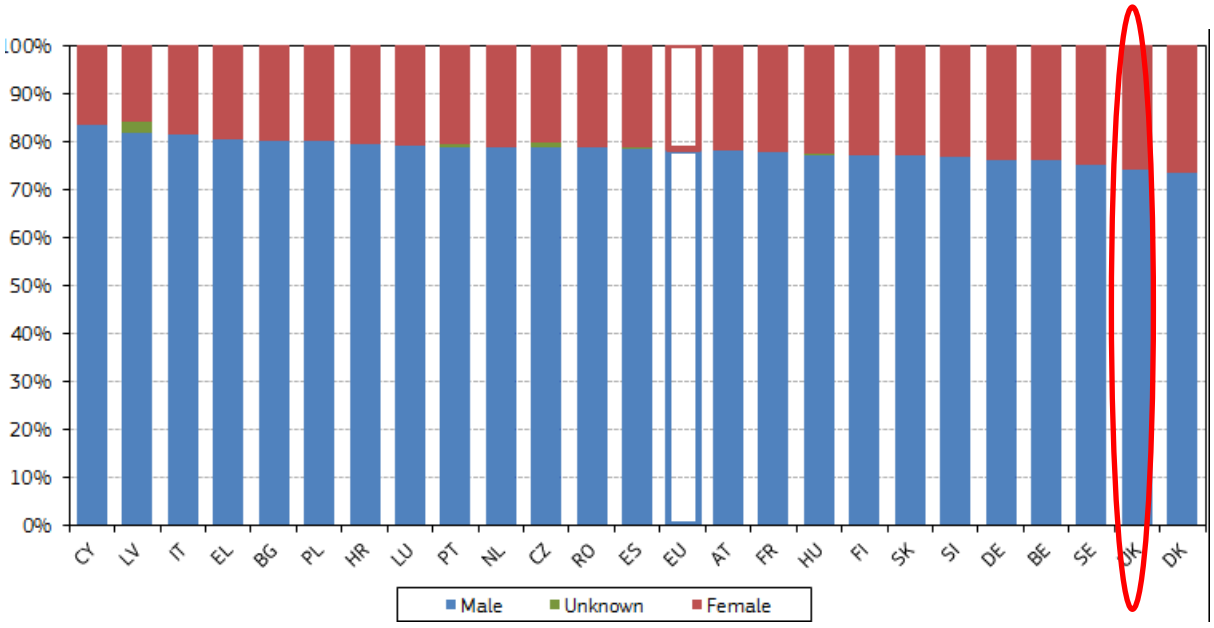


Figure 9: Distribution of deaths on roads outside urban areas by country and sex, 2013

Reprinted from the European Commission (2015c)

In all EU countries, deaths on roads outside urban areas tend to be male. However, the difference is less acute in the UK than in all other countries except Denmark: a death on a rural road is more likely to be female than almost anywhere else in the EU.

Figure 10 presents the breakdown of road deaths outside urban areas by whether or not they were at a junction for each EU country.

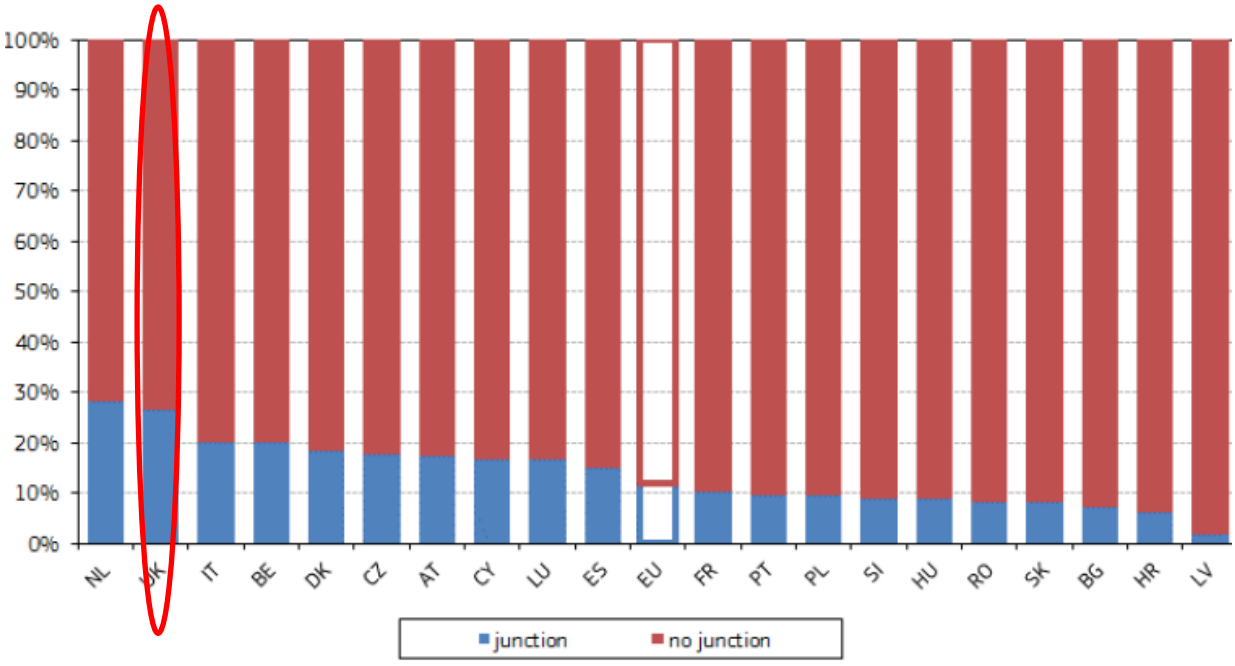


Figure 10: Distribution of deaths on roads outside urban areas by country and whether or not at a junction, 2013

Reprinted from the European Commission (2015c)

The majority of deaths on roads in rural areas are not at junctions in all EU countries. However, of those countries which record this information, the UK has a higher proportion of rural road deaths at junctions than any other country but for the Netherlands.

Figure 11 presents the breakdown of road deaths outside urban areas by vehicle type for each EU country.

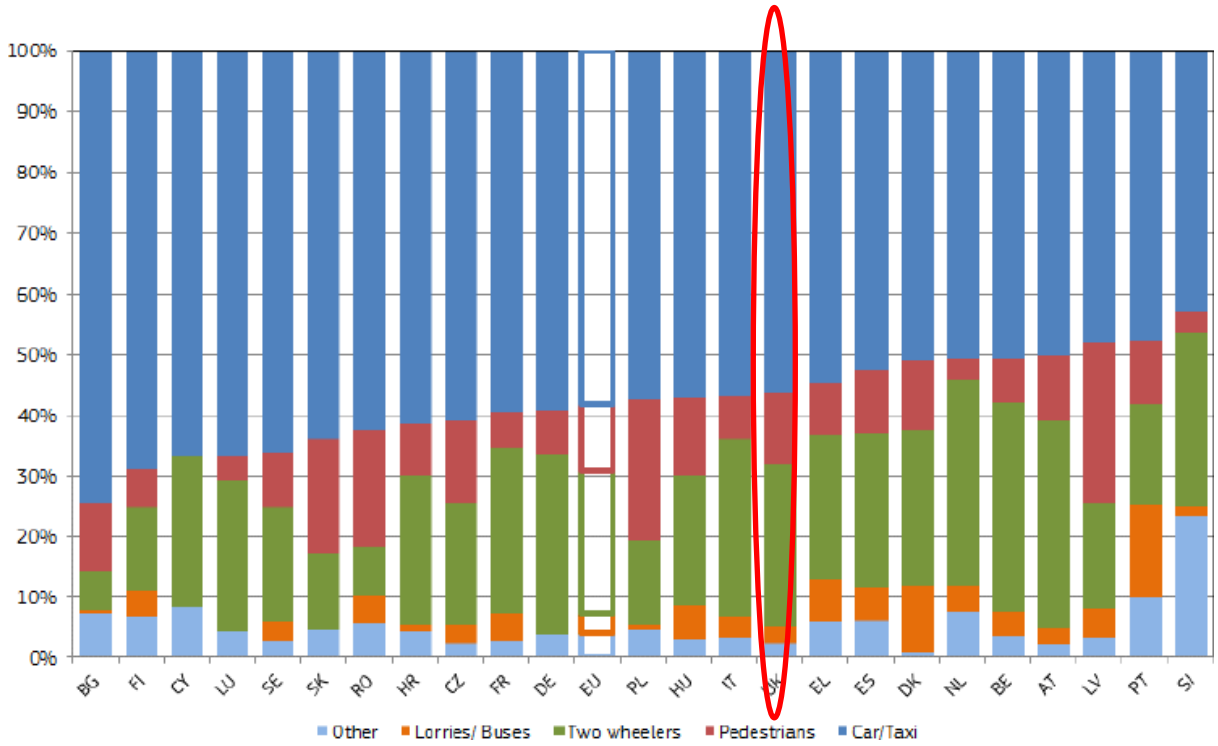


Figure 11: Distribution of deaths on roads outside urban areas by country and vehicle type, 2013

Reprinted from the European Commission (2015c)

On roads outside urban areas, a smaller proportion of road deaths in Britain are car/taxi occupants than is the case in Sweden and across the EU as a whole. The Netherlands and Sweden both have smaller proportions of road deaths who are pedestrians than the UK does outside urban areas.

Again, this may partly be explained by traffic speeds: on roads outside urban areas, speed limits in the UK are typically 60 mph (96 km/h) on single carriageways or 70 mph (112 km/h) on dual carriageways; Belgium is the only other EU country with similarly high speed limits on rural roads, with typical speed limits of between 90 km/h and 120 km/h (56-75 mph). The Netherlands has typical speed limits of between 80 km/h and 100 km/h (50-62 mph) on rural roads while Sweden's rural speed limits are typically between 70 km/h and 90 km/h (44-56 mph). Denmark, another country with similar numbers of road deaths per head as Britain, has typical speed limits of 80 km/h (50 mph) on rural roads (The European Union Road Federation, 2015). Compared with other countries with similar numbers of road deaths per head, the UK has high rural speed limits.

Consideration was given to using European Road Assessment Programme (EuroRAP) star ratings to compare safety between different countries' networks, as these take speed limits

or, more recently, travel speeds into account along with other factors. EuroRAP is a programme of systematic assessment of risk. However, in Britain, the EuroRAP star rating protocol has been applied only to a small sample of roads beyond those for which Highways England is responsible, and the star rating protocol has been applied to a different proportion of roads selected on a different basis in each country. A first benchmarking exercise of SRN performance against other countries is currently underway. Subsequently, the EuroRAP star ratings of different countries' road networks which are available are not yet comparable.

2.5 Summary

Differences in road type definitions in different countries make comparisons on this basis more challenging than many other comparisons. Nonetheless, some differences emerge. For example, comparisons with other countries with similar numbers of road deaths per head indicate that:

- A greater proportion of British road deaths are on roads with speed limits of 60 mph or more (90 km/h or more). (Proportionally fewer British road deaths are on roads with speed limits of 50 mph (80 km/h) or less.)
- Britain has more deaths per unit length of motorway, though not necessarily per vehicle-kilometre, than the average motorway in the EU.
- Deaths on roads in urban areas are more likely to be male in Britain, and in rural areas more likely to be female, than in other countries.
- Road deaths are more likely to be recorded as occurring at junctions in Britain.
- In rural areas in Britain, pedestrians constitute a larger proportion of road deaths, and car/taxi occupants a smaller proportion.

3 Road users

3.1 Introduction

Table 2 presents the number of fatalities in 2013 for Denmark, the Netherlands, Sweden and the UK, disaggregated by road user type.

	Car or taxi	Heavy goods vehicle	Lorry <3.5 tonnes	Moped	Motorcycle	Pedal cycle	Pedestrian	Other	Total
DK	79	1	17	11	15	33	34	0	190
NL	180	7	15	41	29	112	51	0	435
SE	144	5	5	3	40	14	42	2	255
UK	815	22	39	4	337	113	405	17	1752

Table 2: Number of fatalities in 2013 disaggregated by road user type

(The European Commission, 2016c)

The differences in the numbers of fatalities of any given road user type in each country are not particularly meaningful in this format, given that the UK's population is larger than those of the other three countries presented here. Therefore, Table 3 presents the figures above as rates per million people.

	Car or taxi	Heavy goods vehicle	Lorry <3.5 tonnes	Moped	Motorcycle	Pedal cycle	Pedestrian	Other	Total
DK	14.1	0.2	3.0	2.0	2.7	5.9	6.1	0.0	33.9
NL	10.7	0.4	0.9	2.4	1.7	6.7	3.0	0.0	25.9
SE	15.1	0.5	0.5	0.3	4.2	1.5	4.4	0.2	26.7
UK	12.7	0.3	0.6	0.1	**5.3**	1.8	**6.3**	0.3	27.3

Table 3: Number of fatalities in 2013 per million people disaggregated by road user type

The number of fatalities per head of the population amongst motorcyclists and pedestrians appears to be higher in the UK, indicated in bold red text above, than is the case in other countries with similar overall numbers of fatalities per head. Figure 12 presents the distribution of road deaths in each EU country by vulnerable road user type.

(When presented in this format, it is, of course, inevitable that, if one group of road users constitute a higher than average proportion of road deaths, other groups of road user constitute a lower than average proportion of road deaths.)

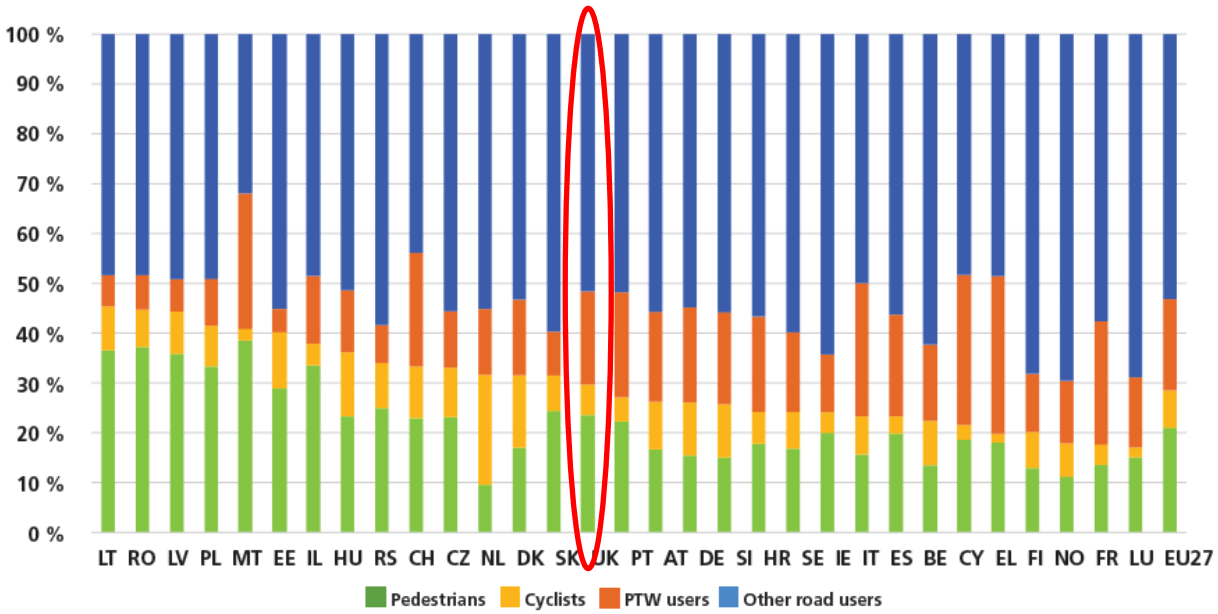


Figure 12: Pedestrian, cyclist and powered two-wheeler user deaths as a percentage of all road deaths (2011-2013 average)

Reprinted from the European Transport Safety Council (2015b)

In total, vulnerable road users (pedestrians, pedal cyclists and powered two-wheeler users) accounted for almost half of the UK's road deaths between 2011 and 2013, a greater proportion than in Sweden, Denmark and the Netherlands (The European Transport Safety Council, 2015b). This is also a proportion that has been increasing in Britain in recent years (The Department for Transport, 2015b).

Figure 13 shows the reductions in the numbers of killed and seriously injured pedestrians and car occupants in collisions involving cars in Great Britain since 2004.

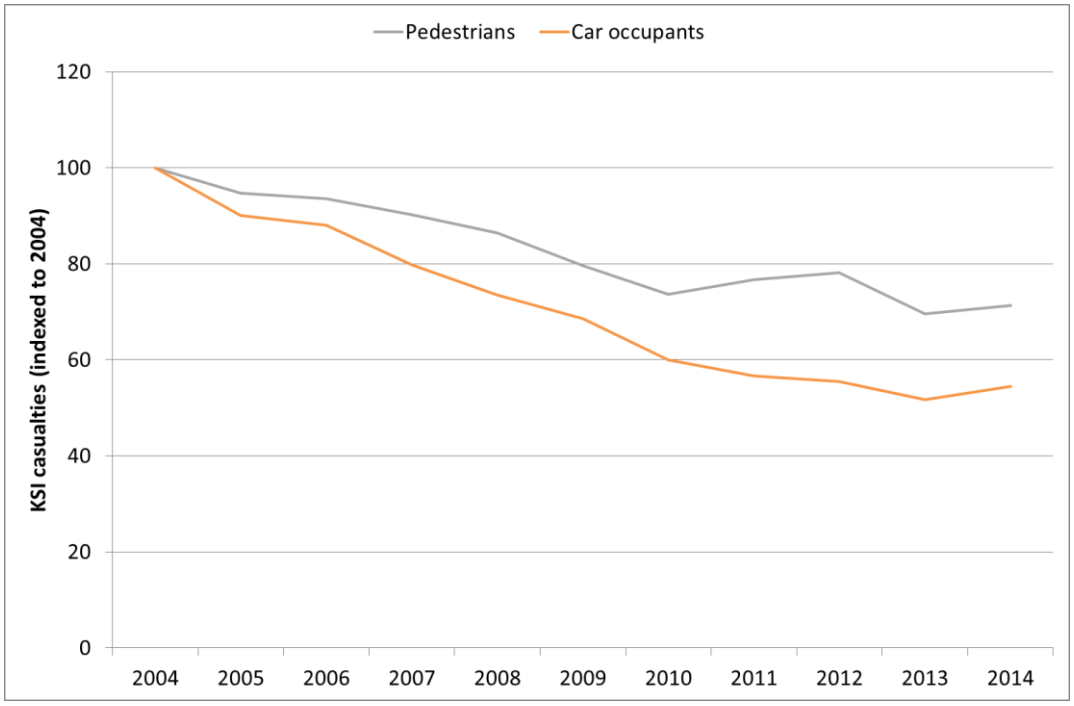


Figure 13: GB killed and seriously injured pedestrians and car occupants

Data sourced from STATS19

This indicates that improvements in road safety over the last ten years in Britain have not been evenly spread: the annual number of car occupants who were killed or seriously injured has been reduced by more than 45% over this period, compared with a 29% reduction in the number of pedestrians who were killed or seriously injured.

The levels of risk associated with different road users are now explored in more detail.

3.2 Pedestrians

23% of road deaths in the UK in 2013 were pedestrians compared to 17% in Denmark, 16% in Sweden, 11% in the Netherlands, and an EU average of 22% (The European Commission, 2015d). Figure 14 shows the proportion of road deaths which were pedestrians for all EU countries. It is clear that the proportion of road deaths which are pedestrians is particularly high in Britain compared with other countries even beyond those which have similar numbers of road deaths per head.

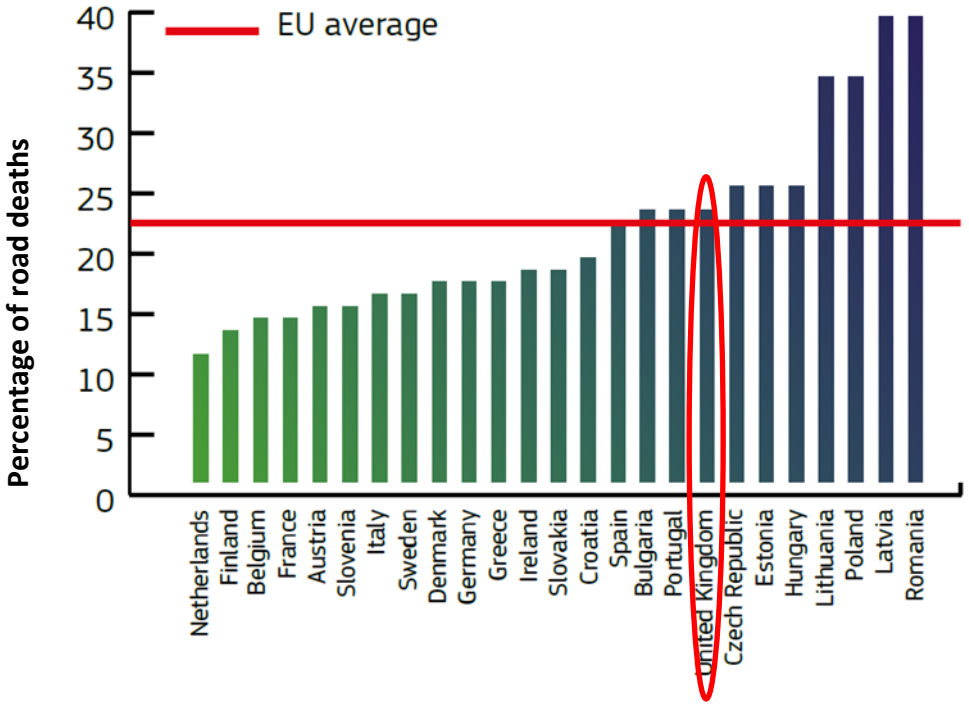


Figure 14: Pedestrians' share of all road deaths per country in 2013

Reprinted from the European Commission (2015d)

The UK had an average of 6.8 pedestrian deaths per million people in 2013, compared with 5.8 in Denmark, 5.1 in Sweden, 3.7 in Norway and 3.6 in the Netherlands (The European Transport Safety Council, 2015b). The UK's higher pedestrian fatality rate is not explained by higher levels of walking in Britain: there were 26 pedestrians killed per billion person-kilometres in Britain in 2009, compared with 17 pedestrians killed per billion person-kilometres in the Netherlands (Santacreu, 2016).

Figure 15 displays the road types on which pedestrian deaths occur in each EU country.

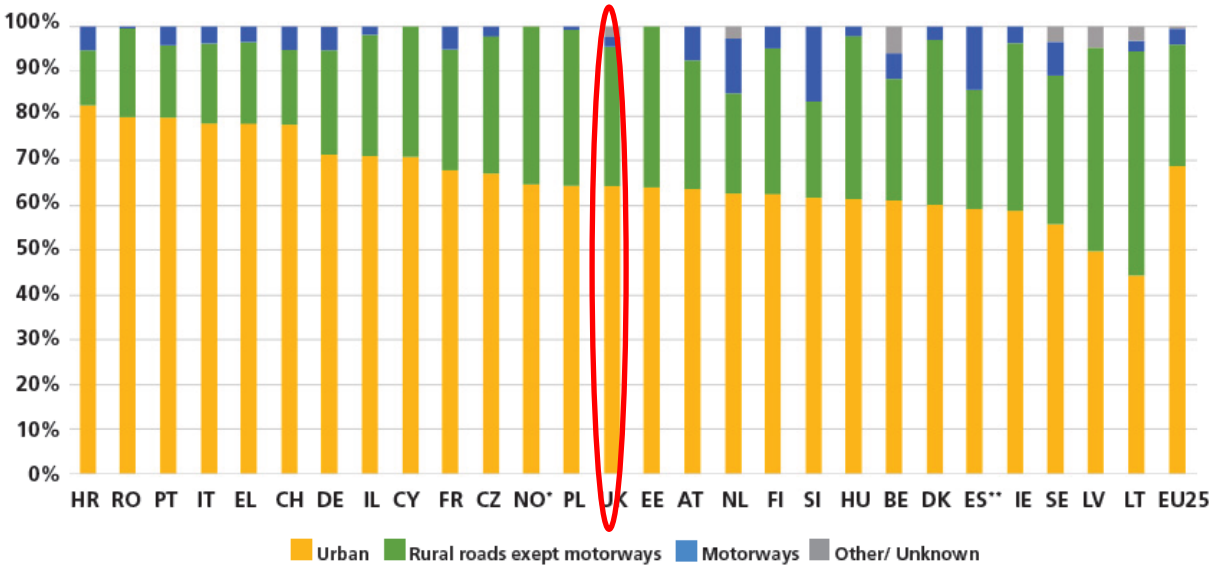


Figure 15: Percentage share of pedestrian deaths by road type 2011-2013

Reprinted from the European Transport Safety Council (2015b)

Although pedestrians are not permitted to use motorways, there are still some pedestrians amongst those who are killed on the motorway. This proportion of pedestrian deaths on the motorway in the UK is much smaller than in Sweden, which has a similar relative length of motorway – see Figure 5. On the other hand, the proportion of pedestrian road deaths on urban and rural roads combined is greater in the UK than in Sweden. Given that urban and rural roads are accountable for the majority of pedestrian deaths (i.e. that motorways are not), this appears to suggest that pedestrians are at more risk on roads which are not motorways in Britain than in Sweden. (Differences in the proportions of roads which are urban and which are rural have not been explored specifically here as the differences between them in different countries are less consistent than is the case with motorways.)

Figure 16 presents the breakdown of pedestrian deaths by sex.

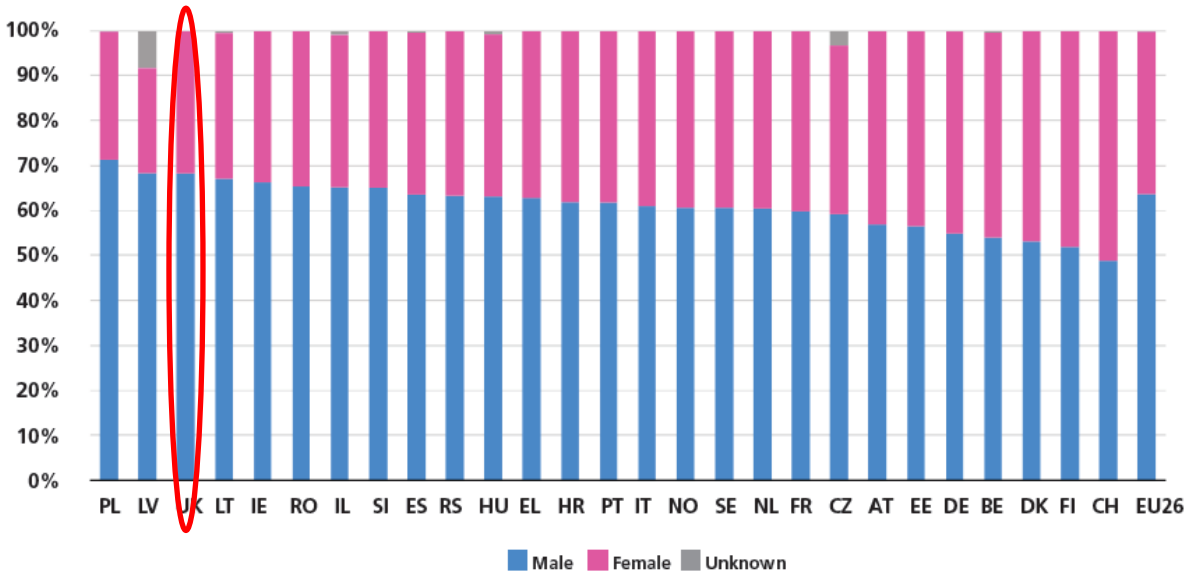


Figure 16: Percentage share of pedestrian deaths by sex 2011-2013

Reprinted from the European Transport Safety Council (2015b)

In most countries, more male pedestrians are killed than female pedestrians. In the UK, this difference is particularly acute, with proportionally more male pedestrians killed than in most other countries, including Sweden and the Netherlands and Denmark.

Figure 17 presents the breakdown of pedestrian deaths in each country by age group – children, adults and the elderly.

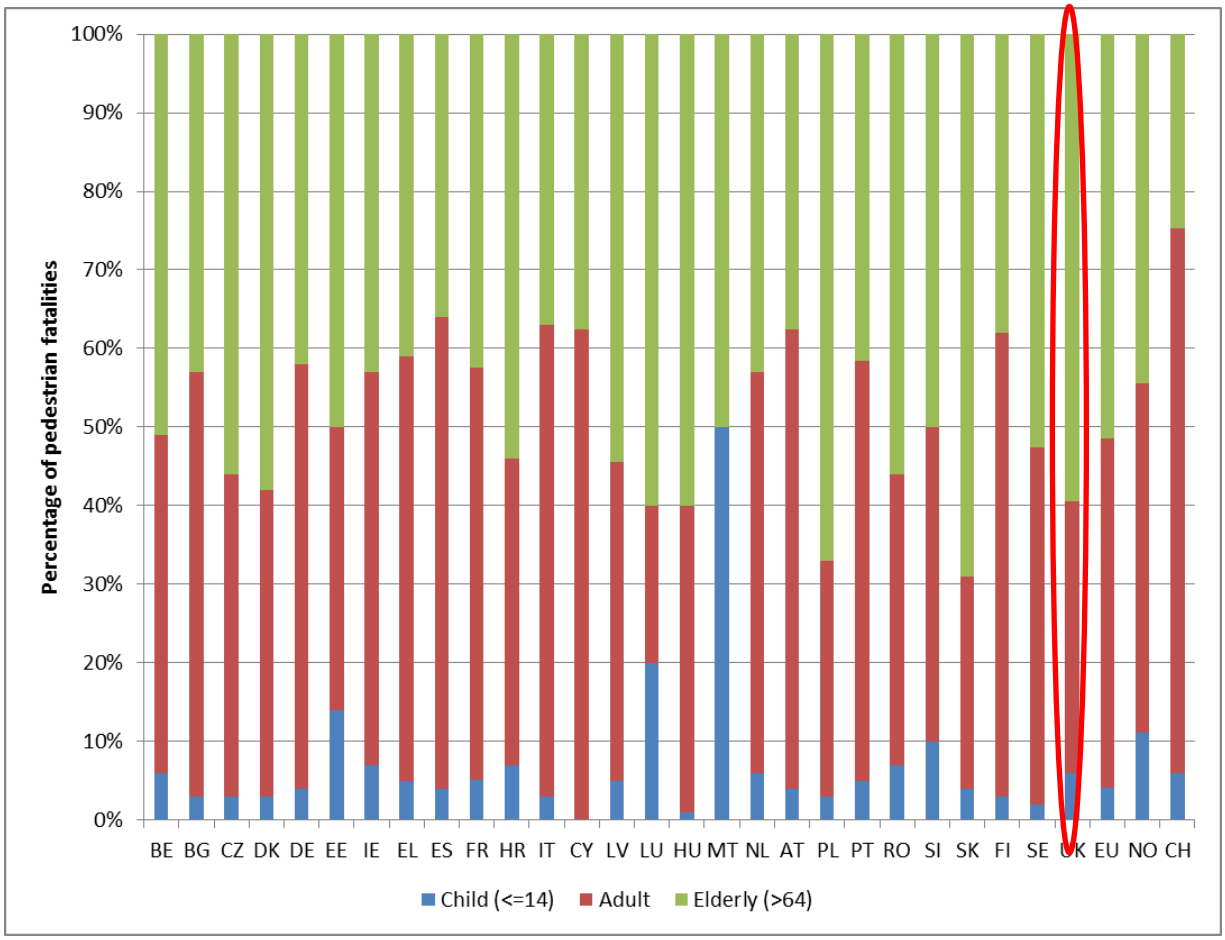


Figure 17: Percentage share of pedestrian deaths by age group, 2013 or latest available year

Reprinted from the European Commission (2015e)

The proportions of pedestrian deaths who are children and who are elderly are greater in the UK than on average across the EU. The UK has a substantially larger proportion of road deaths who are children than Sweden has, and only Poland and Slovakia have proportionally more elderly pedestrian deaths than the UK.

Figure 18 shows the breakdown of pedestrian deaths by the motorised vehicle types involved.

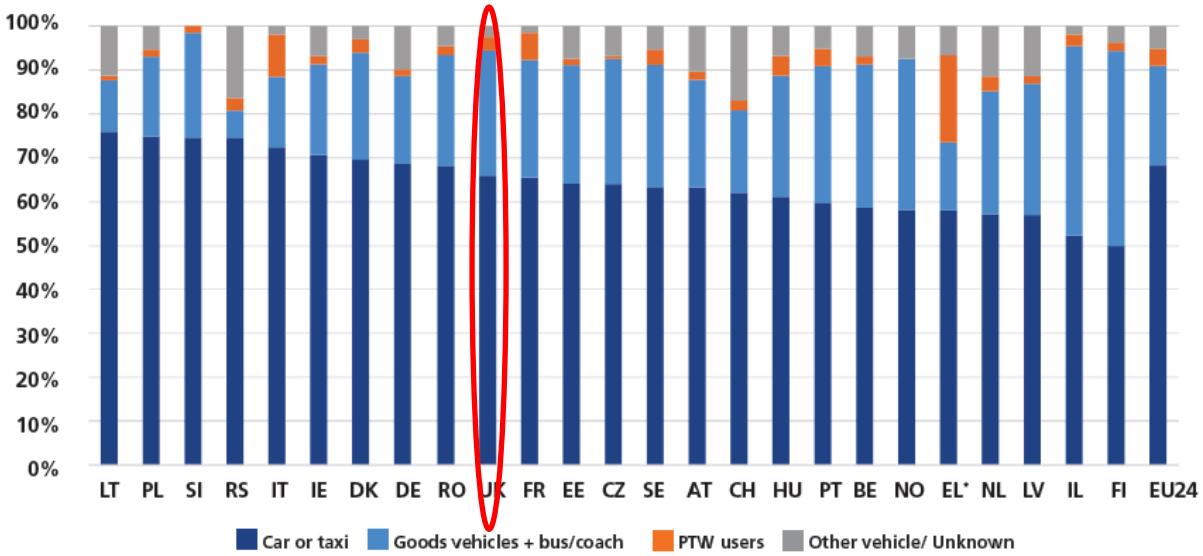


Figure 18: Percentage share of pedestrian deaths occurring in collisions with different types of vehicles 2011-2013

Reprinted from the European Transport Safety Council (2015b) *2011-2012

Pedestrians are more likely to be killed by cars or taxis in the UK than in Sweden or the Netherlands, though less likely than in Denmark.

In summary, for pedestrians, Britain's roads appear to be more dangerous than those of most other countries with similar numbers of road deaths per head, with male pedestrians and collisions involving motorised vehicles a particular concern.

3.3 Pedal cyclists

Pedal cyclists represented 8% of road deaths in the EU in 2013, but accounted for 24% of all road deaths in the Netherlands in 2013 and 17% in Denmark, compared with 5% in Sweden and 6% in the UK (The European Commission, 2015d). Cycling accounts for 25% of trips made by the Dutch and 8% of the total distance travelled (OECD/ITF, 2015), which explains why such a large proportion of road deaths in the Netherlands are pedal cyclists: the Dutch cycle an average of approximately 800 km per head per year, compared with an average of approximately 100 km per head per year in the UK (Wardlaw, 2014).

Figure 19 presents the number of cyclist deaths per unit distance travelled and the rate of cycling per person.

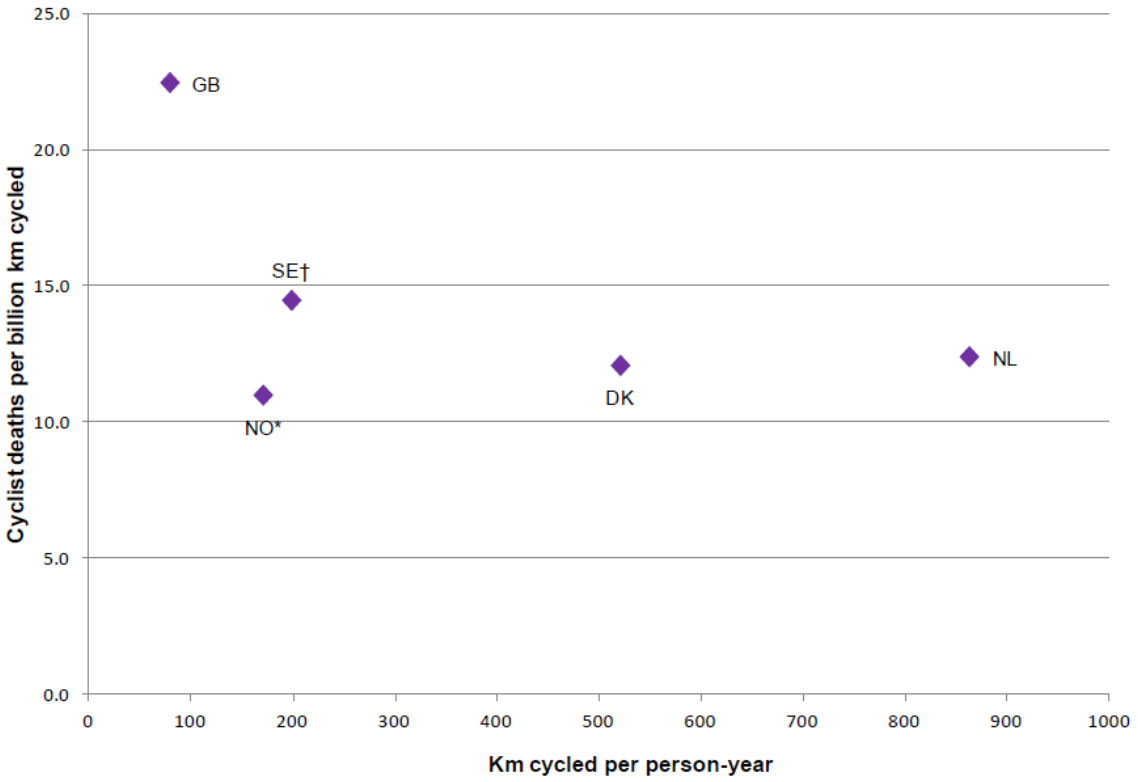


Figure 19: Number of cyclist deaths per billion km ridden plotted against the rate of cycling per person

Reprinted from the European Transport Safety Council (2012) NL (2008-2010), GB (2008-2010), DK (2008-2010), NO* (2009 ages 13 and over), SE† (2006)

This indicates that, per unit distance travelled, pedal cyclists in Britain are at approximately twice the level of risk of being killed than is the case in the Netherlands and Denmark where cycling is far more common. Cycling levels in Sweden and Norway are far more similar to those in Britain, yet the cycling fatality rates in both these countries are again much lower than that in Britain.

Britain had 21 pedal cyclists killed per billion person-kilometres in 2009, compared with 9 pedal cyclists killed per billion person-kilometres in the Netherlands (Santacreu, 2016). For many years, the average pedal cyclist risk in terms of distance travelled in the UK has remained consistently about twice that for the Netherlands (Wardlaw, 2014). However, the percentage reduction in pedal cyclist risk between 1980 and 2011 was greater in the Netherlands than in the UK: in the Netherlands, pedal cyclist risk reduced approximately in line with the average reduction in risk for all road users; in the UK, the reduction in pedal cyclist risk over the same time period has been more gradual than the average reduction in risk for other road users (Wardlaw, 2014). English cyclists are exposed to higher risk in terms of distance travelled than those in the Netherlands at every age; the difference appears to be most acute for children (Wardlaw, 2014).

Figure 20 presents the percentage of road deaths which are pedal cyclists in each EU country.

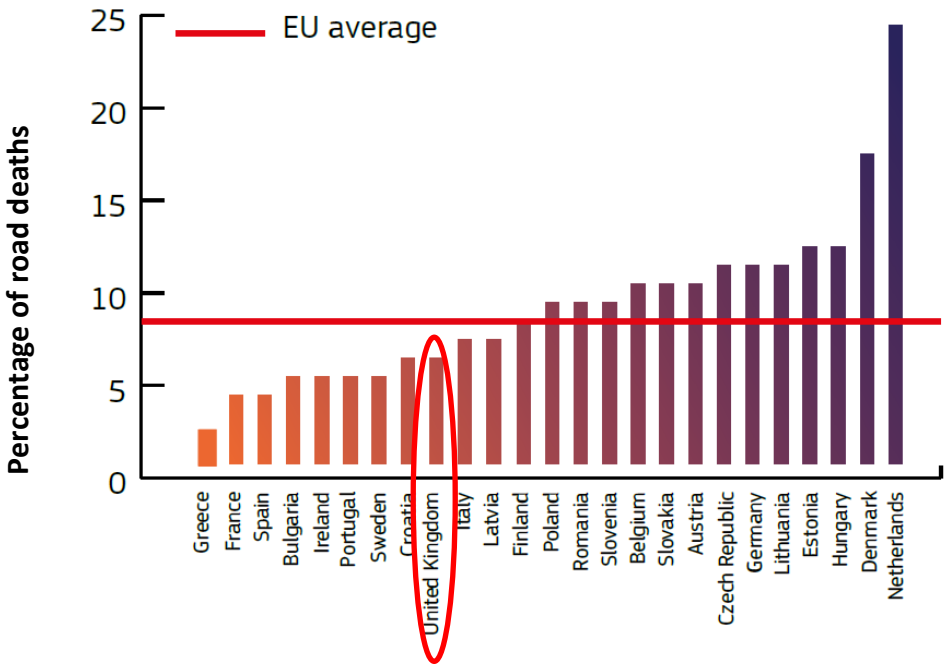


Figure 20: Pedal cyclists' share of all road deaths by country in 2013

Reprinted from the European Commission (2015d)

Although there are relatively fewer pedal cyclist deaths in the UK than in Denmark, the Netherlands and, on average across the EU, the UK has relatively more pedal cycle deaths than Sweden. This is despite Sweden having almost twice as many pedal cycles per head than the UK (Statistics Netherlands, 2015). It would be desirable to compare the number of pedal cyclist fatalities per unit distance travelled in each country, but it has not been possible to source comparable data on the distances travelled by pedal cyclists in each country. Figure 21 presents the breakdown of pedal cyclist deaths by road type in each EU country.

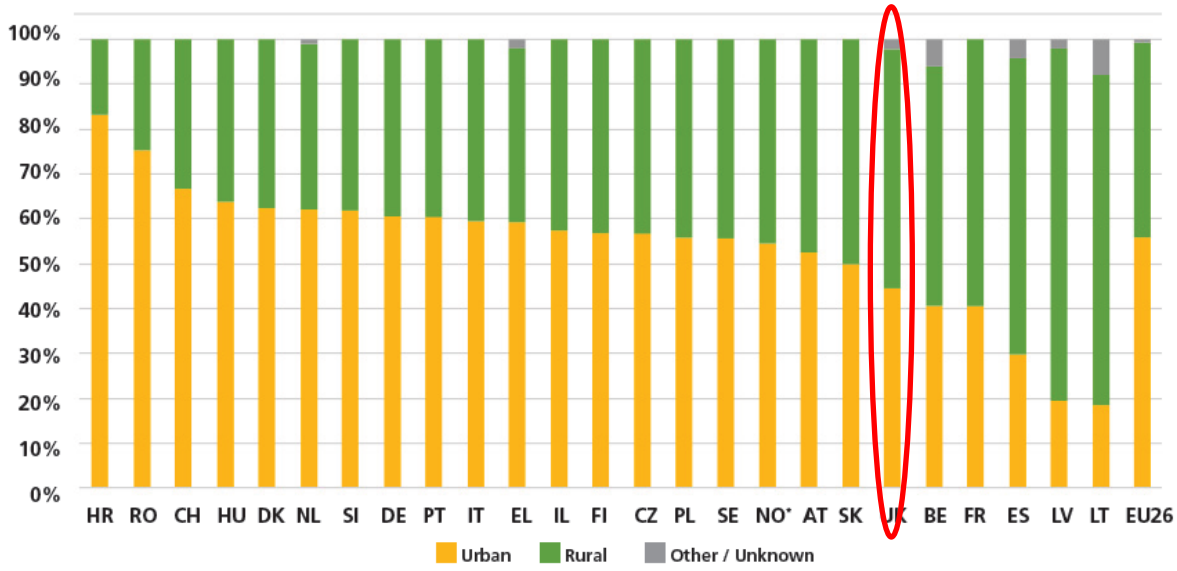


Figure 21: Percentage share of pedal cyclist deaths by road type 2011-2013

Reprinted from the European Transport Safety Council (2015b) *2011 and 2013

Pedal cyclists in the UK are more likely to be killed on rural roads than on urban roads, unlike in the majority of EU countries including Sweden, Denmark and the Netherlands.

Figure 22 presents the breakdown of pedal cyclist deaths by sex in each EU country.

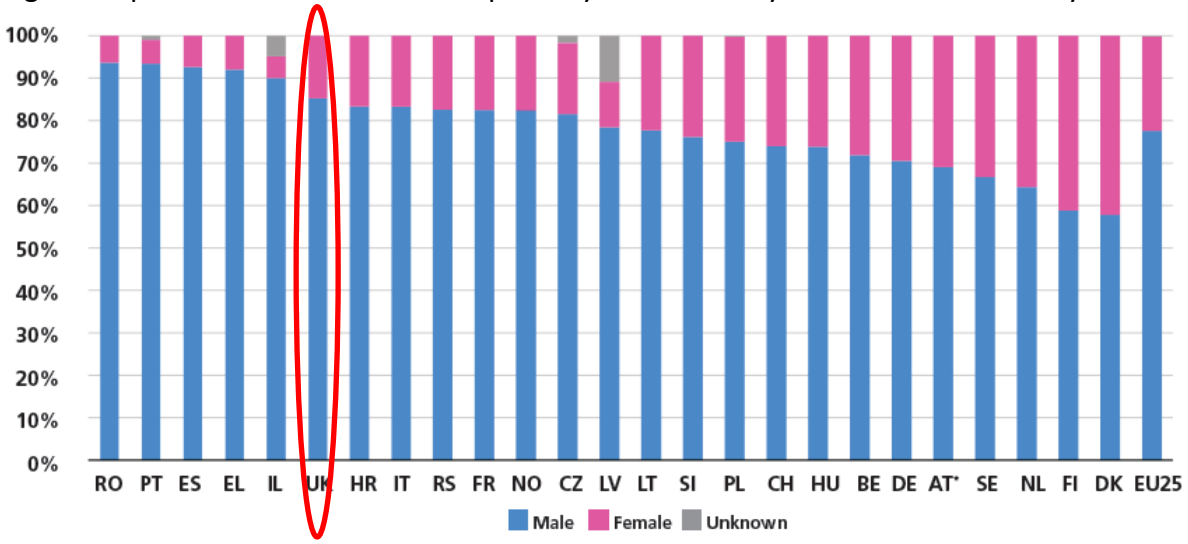


Figure 22: Percentage share of pedal cyclist deaths by sex 2011-2013

Reprinted from the European Transport Safety Council (2015b) *2011-2012

Pedal cyclist deaths are more likely to be male than female in all EU countries; again, however, this difference is particularly acute in the UK with proportionately more pedal cyclist deaths being male in the UK than in other countries with similar numbers of road deaths per head such as Sweden and the Netherlands and Denmark.

Figure 23 presents the breakdown of pedal cyclist deaths in each EU country by the motorised vehicle types involved.

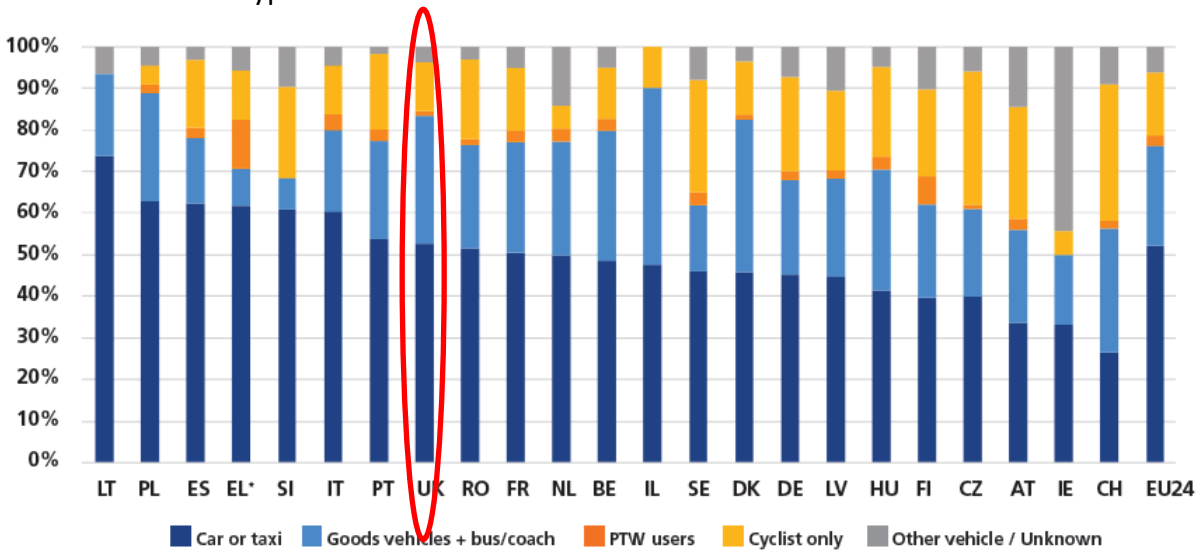


Figure 23: Percentage share of pedal cyclist deaths occurring in collisions with different types of vehicles 2011-2013

Reprinted from the European Transport Safety Council (2015b) *2011-2012

Pedal cyclists are more likely to be killed by cars or taxis in the UK than in Denmark, Sweden or the Netherlands.

In summary, for pedal cyclists, Britain's roads appear to be more dangerous than those of other countries with similar numbers of road deaths per head: on rural roads, male pedal cyclists and collisions involving motorised vehicles are particular concerns.

3.4 Motorcyclists and moped users

An average of 15% of road deaths in the EU in 2013 were motorcyclists (The European Commission, 2015d), but this figure was 19% for the UK (where motorcyclists account for just 1% of traffic), compared with 6% in the Netherlands, 8% in Denmark, and 15% in Sweden. Amongst larger countries, only France, Italy and Greece had proportionally more motorcyclist deaths. In 2009, Britain had 84 motorcyclists killed per billion person-kilometres, compared with 62 motorcyclists killed per billion person-kilometres in the Netherlands (Santacreu, 2016).

Given that moped use may be more common in other countries than in the UK, Figure 24 presents the percentages of all road deaths that were motorcyclists or moped users for each EU country.

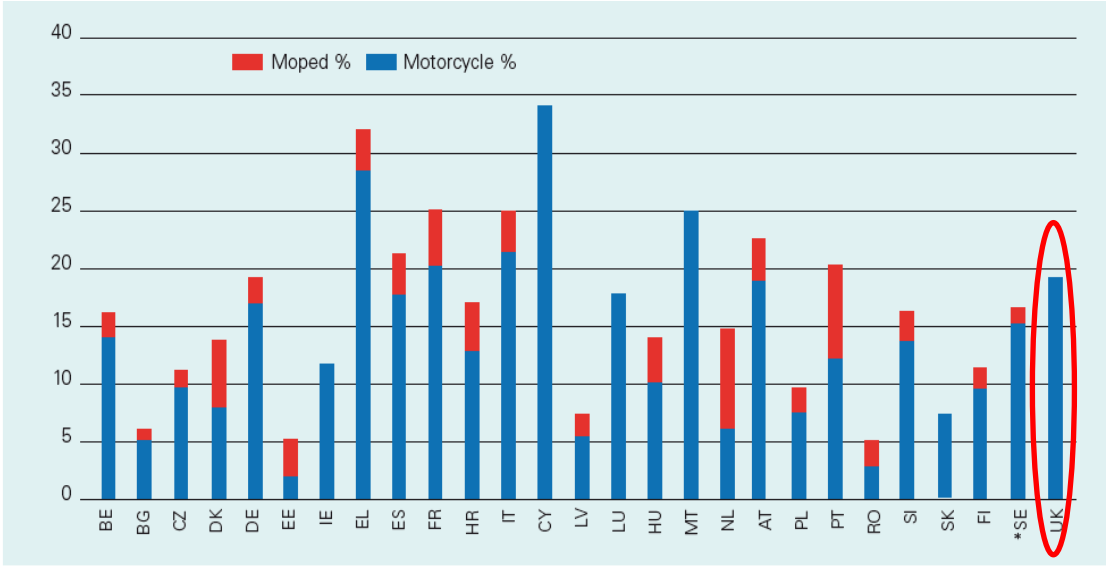


Figure 24: Motorcyclists' and moped users' share of all road deaths by country in 2013

Reprinted from the European Union Road Federation (2015)

Including moped users in the figures does not increase the percentage of road deaths attributable to powered two-wheelers in the UK, unlike in the majority of other EU countries. Powered two-wheeler users constitute a larger proportion of road deaths in the UK than in many other countries, including Denmark, Sweden and the Netherlands, even including moped users in the figures. This is despite these countries having many more such vehicles: motorised 2- and 3-wheelers (i.e. mostly motorcycles and mopeds) constitute approximately 3.5% of Britain's registered vehicles, but more than 6% of those in Denmark, Sweden and

the Netherlands (The World Health Organisation, 2015). Despite less stringent laws on motorcycle helmet use in the Netherlands, the percentage of road deaths which are powered two-wheeler users in the Netherlands is lower than in the UK, even including moped user deaths – see Figure 25.

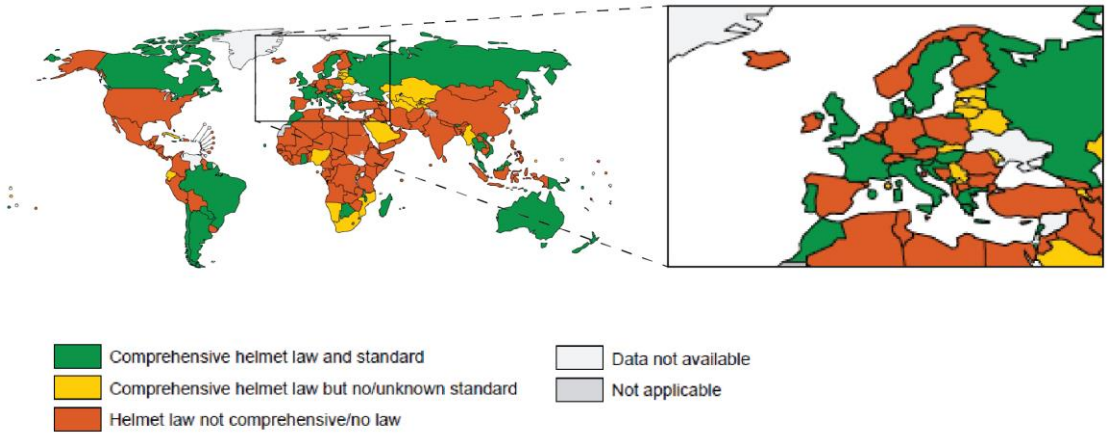


Figure 25: Motorcycle helmet laws and helmet standards, by country/area

Reprinted from the World Health Organisation (2015)

Helmets are compulsory for all motorcyclists in Britain, unlike in other countries with similar numbers of road deaths per head: the helmet law in the Netherlands does not apply to all engine types and, in Switzerland, helmets do not have to be fastened.

Figure 26 presents the powered two-wheeler user fatality rates per million people in 2004 and 2013 (or latest available year) for a variety of countries. The UK has proportionally more powered two-wheeler user fatalities than several other countries including the Netherlands, Sweden and Denmark.

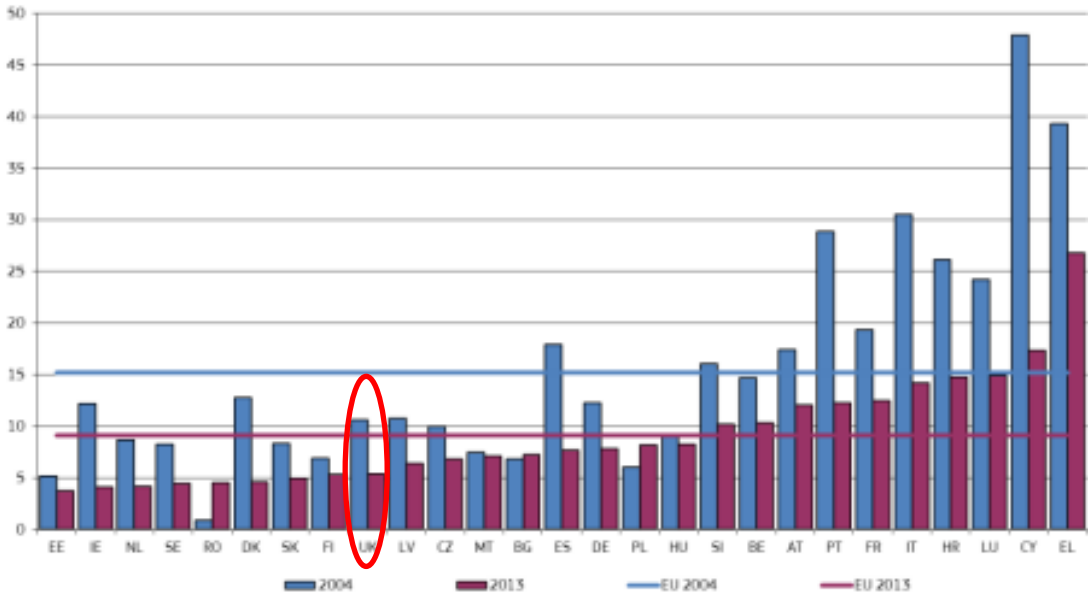


Figure 26: Powered two-wheeler user fatality rates per million population by country, 2004 and 2013 or latest available year

Reprinted from the European Commission (2015f)

Figure 27 presents the proportions of powered two-wheeler fatalities by area type in each EU country.

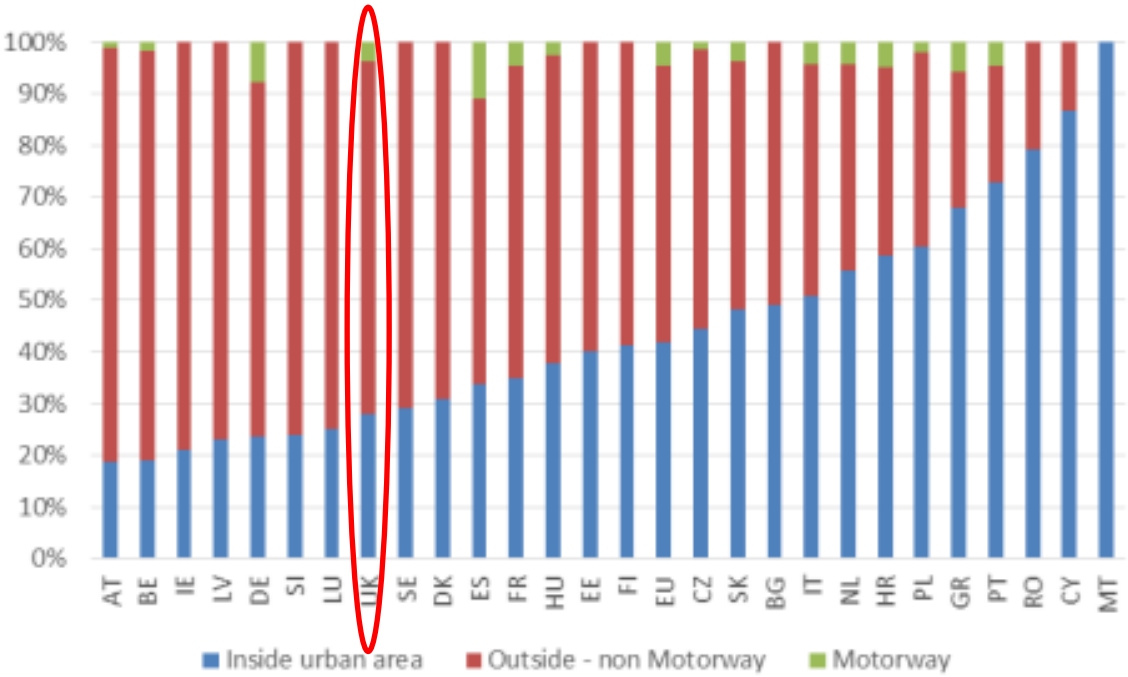


Figure 27: Distribution of powered two-wheeler user fatalities by country, area and road type, 2013 or latest available year

Reprinted from the European Commission (2015f)

Britain appears to have proportionally more powered two-wheeler fatalities on rural roads than many other countries, including Sweden, Denmark and the Netherlands. Figure 28 presents the breakdown of motorcyclist fatalities by age group.

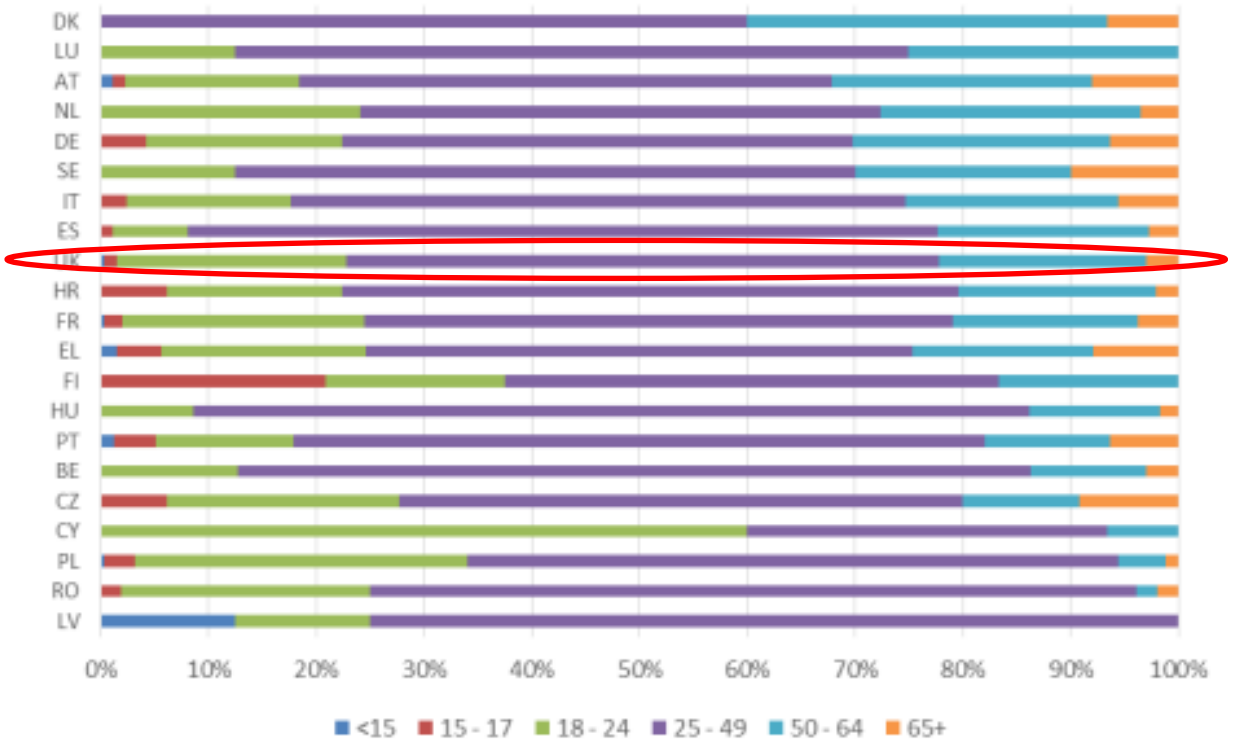


Figure 28: Distribution of motorcycle fatalities by country and age group, 2013

Reprinted from the European Commission (2015f)

Almost twice the proportion of motorcyclist fatalities in the UK are under 25 compared with Sweden, and proportionally more motorcyclist fatalities in the UK are between 25 and 50 in the UK than in the Netherlands.

3.5 Car occupants

3.5.1 Overall casualty rates

As discussed in section 1.5, the number of vehicles can be a useful measure of exposure, with passenger cars being a good indicator of the level of motorisation of a country. In Britain, there are 0.562 vehicles registered per head (The Department for Transport, 2015b), slightly lower than the numbers in the Netherlands (0.573) and Sweden (0.597), and substantially lower than in Norway (0.707) and Switzerland (0.708), though more than in Denmark (0.523) (OECD/ITF, 2015). (The latter report actually has a lower figure for the UK, of 0.551 registered vehicles per head.)

Amongst EU countries in 2013, only Sweden (58) had fewer road deaths per million passenger cars than the UK (59), with the Netherlands (60) again amongst the top three. Beyond these three, there was a gap, Malta then appearing again with 71 road deaths per million passenger cars; Denmark had 85 road deaths per million passenger cars (The European Commission, 2016b). In 2009, Britain had 1.6 car occupants killed per billion person-kilometres, compared with 2.1 car occupants killed per billion person-kilometres in

the Netherlands (Santacreu, 2016): unlike the three vulnerable modes, the number of road deaths per person-kilometre was lower in Britain than that of the Netherlands.

3.5.2 Drink-driving

In both the Netherlands and Sweden, 19% of road deaths are in collisions involving alcohol; in Norway, this figure is 17%. (The World Health Organisation, 2015). In Britain and Switzerland, 16% of road deaths are in collisions involving illegal alcohol levels.

However, the current Blood Alcohol Concentration (BAC) limit for drivers in England and Wales is 80mg per 100ml of blood (or 35mg per 100ml of breath) and the drink-drive limit in Scotland was reduced on 5th December 2014 from 80mg to 50mg per 100ml of blood (or from 35mg to 22mg per 100ml of breath). (In 2016 in Northern Ireland the limit will be reduced from 80mg to 50mg per 100ml of blood and reduced further, to 20mg per 100ml of blood, for commercial and novice drivers.) Most European countries, like Denmark, the Netherlands and Switzerland, have a limit of 50mg per 100ml of blood, and some have adopted a lower limit still. For example, Norway, Sweden and Estonia have limits of 20mg per 100ml of blood.

Collisions involving alcohol levels within the British limit but which would be classed as alcohol-involved collisions in other countries with similar numbers of road deaths per head are therefore not included in the figures for Britain. The variety of limits (even within Britain) makes obtaining comparable data on the numbers of collisions attributable to alcohol challenging. However, it is estimated that just fewer than 18% of drivers and riders killed in road crashes in Britain had a level of alcohol in their body which would have been illegal in most other European countries (Allsop, 2015). Britain therefore appears to have a similar proportion of drivers with an alcohol level of above 50mg per 100ml of blood as other countries with similar numbers of road deaths per head.

3.5.3 Drug-driving

There do not appear to be comparable collision data relating to drug-driving, so it is not possible to tell whether drug-driving is more of a problem in Britain than in other countries. Most countries have legislation prohibiting drug-driving, but many do not define which substances are included as drugs. Many therefore default to the same drugs that are prohibited by more general laws in terms of possession and consumption. Luxembourg and Great Britain are notable exceptions to this: in Luxembourg, it is illegal to drive under the influence of five specific drugs and, in Britain, there are specific limits for eight illegal drugs, eight medicinal drugs, and one drug which can be used for medicinal purposes (at a low level) but can also be abused (at a high level).

3.5.4 Mobile phone use

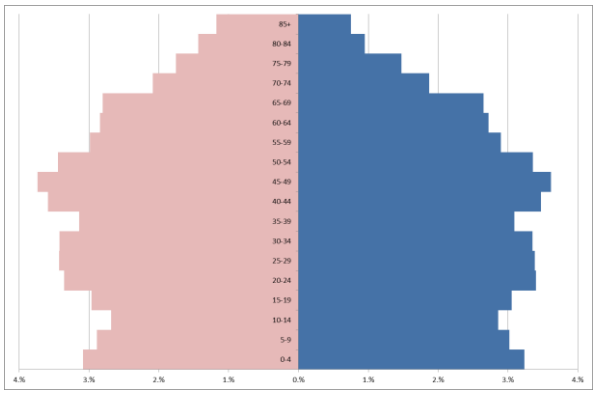
There do not appear to be comparable collision data relating to mobile phone use, so it is not possible to tell whether mobile phone use is more of a problem in Britain than in other countries. Hand-held mobile phone use while driving is illegal in Britain, as it is in many

other countries. Thirty one countries have gone further than this, banning hands-free mobile phone use while driving as well[3].

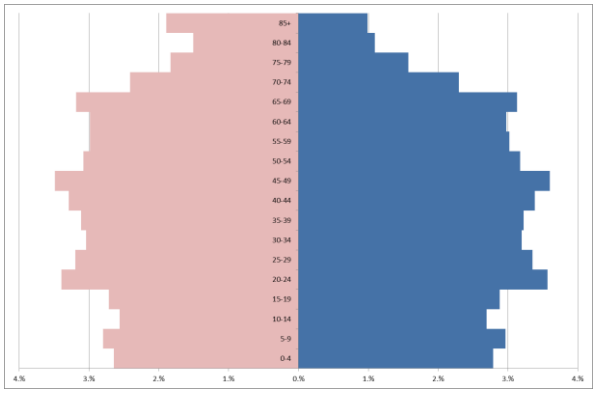
3.6 Population demographics

3.6.1 Age profile

The shape of the population distribution is likely to affect the road casualty rate: a country with a higher than average proportion of elderly people, for example, might be expected to have more road deaths per person-kilometre even if the relative number of road traffic collisions was the same, due to the increased fragility of those who are elderly. Figure 29 presents population pyramids for a selection of countries which have similar numbers of road deaths per head. The bar lengths represent the percentage of the total population that is constituted by females (pink) or males (blue) in the given age group. For example, males between 5 and 9 years old represent 3% of the total UK population.

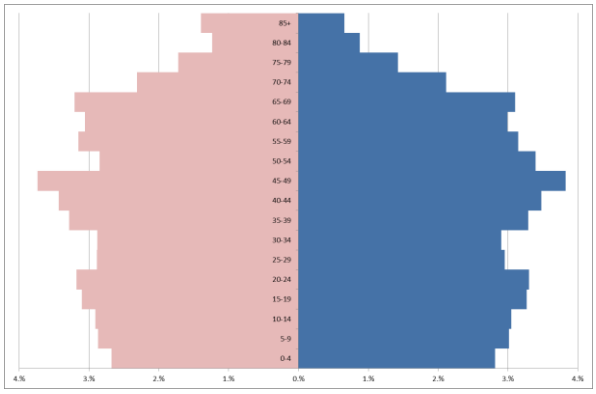


(a) UK

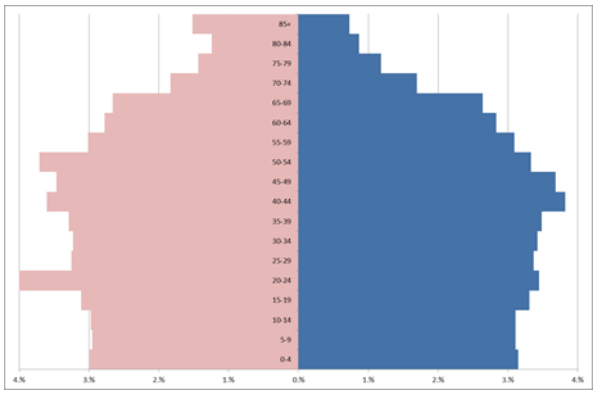


(b) Sweden

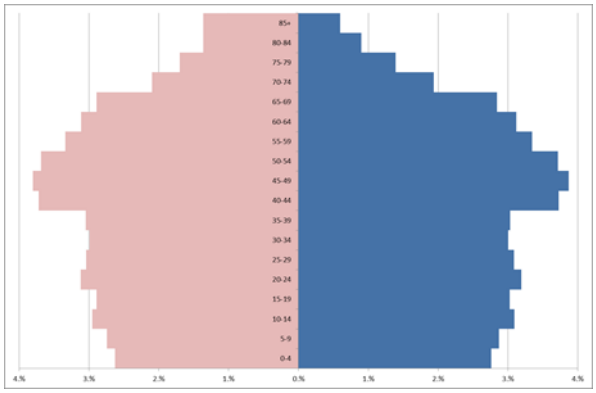
[3] The original version of this report incorrectly suggested that the Netherlands was one such country.



(c) Denmark



(d) Norway



(e) The Netherlands

Figure 29: Proportion of the population split by age group and sex in the UK, Sweden, Denmark, Norway and the Netherlands

(IRTAD, 2016)

Females slightly outnumber males in all of these countries apart from Norway, and this difference is more pronounced in Britain than in Sweden, Denmark and the Netherlands. Differences in the proportions of people of each sex in different countries may affect road casualty rates given that the average male and average female driver differ both in terms of exposure and risk, for example.

The UK's population is slightly younger, on average, than those of the other countries presented here, again with the exception of Norway. For example, the proportion of the

population who are over 64 in Britain is smaller than in Sweden, Denmark and the Netherlands, so Britain might be expected to have relatively fewer elderly road deaths. However, this is not reflected in the pedestrian death statistics, as seen in Figure 17. Similarly, a larger proportion of the population is under 25 in Britain than in these three other countries.

3.6.2 Young drivers

The relatively higher number of under 25 year olds in Britain may point to a higher number of casualties per head, given that young male drivers are a particularly high risk group. The inset box overleaf considers the specific example of the risk to which young people (18-24 year olds) are exposed. More work is required to understand exactly how differences in the distribution of the population in terms of age and sex affects relative road casualty rates.

3.6.3 Population density

The population density of the Netherlands is one of the highest in Europe, with 503 people per square-kilometre in 2015. (Monaco, Gibraltar, Vatican City, Malta, Jersey, Guernsey, San Marino and various French and Dutch islands are the only sovereign states in Europe with greater population densities.) The UK's population density in 2015 was 269 people per square-kilometre, Switzerland's was 210, Denmark's was 134 and Sweden's and Norway's a mere 24 and 14 people per square-kilometre respectively (The World Bank, 2016). The population within any country is not evenly spread, of course, for example England's population density in 2012 was much higher than that of the UK as a whole, at 410 people per square-kilometre, though still lower than that of the Netherlands (Migration Watch UK, 2015). Figure 30 shows the EU's population density in 2012 with the areas of greatest density in red.

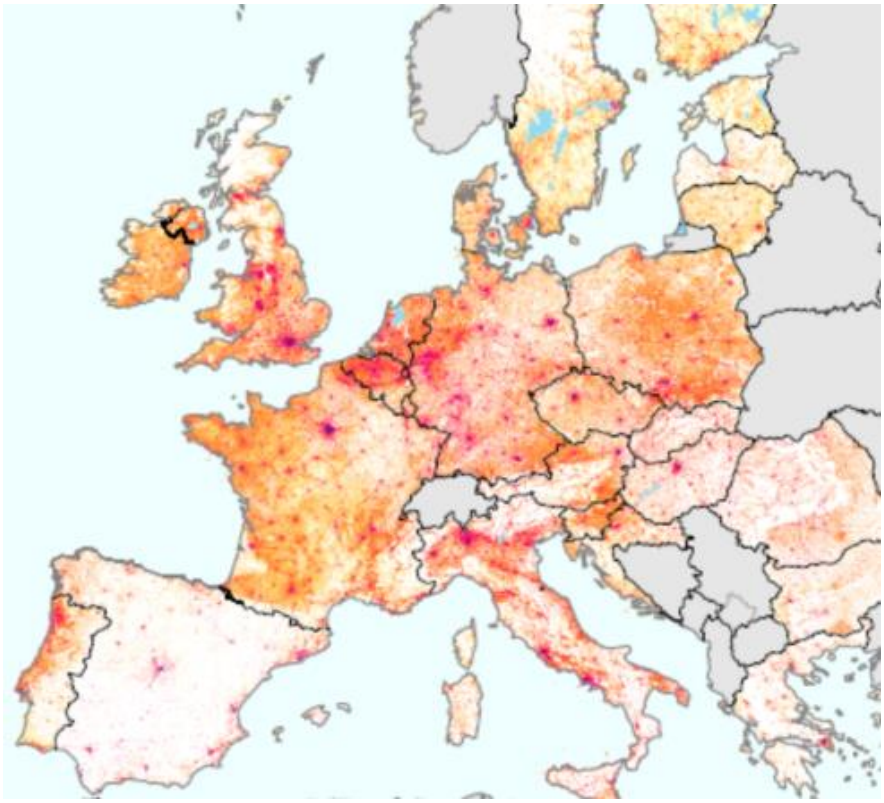


Figure 30: Population density in the EU

Eurostat data republished by Migration Watch UK (2015)

Population density may affect the mix and amount of road travel and hence road casualty rates in a variety of ways. For example, where the population is densely packed, walking and cycling may be more common due to the increased feasibility of being able to visit friends and to access jobs and services by travelling shorter distances. On the other hand, where there are substantial distances between big centres of population, longer distance motor vehicle travel may inevitably be more common. To be able to explore this further, comparable data on modal shares and distances driven per head would be required but these data do not appear to be available at the current time.

How young people's road risk differs to that of the general population

The risk of a collision is substantially higher for young, inexperienced drivers than for the population as a whole, with both age and inexperience playing a part in this risk. Figure 31 therefore presents the ratio of the number of fatalities among 18-24 year olds per person of that age to the number of fatalities of all ages per head of all of the population.

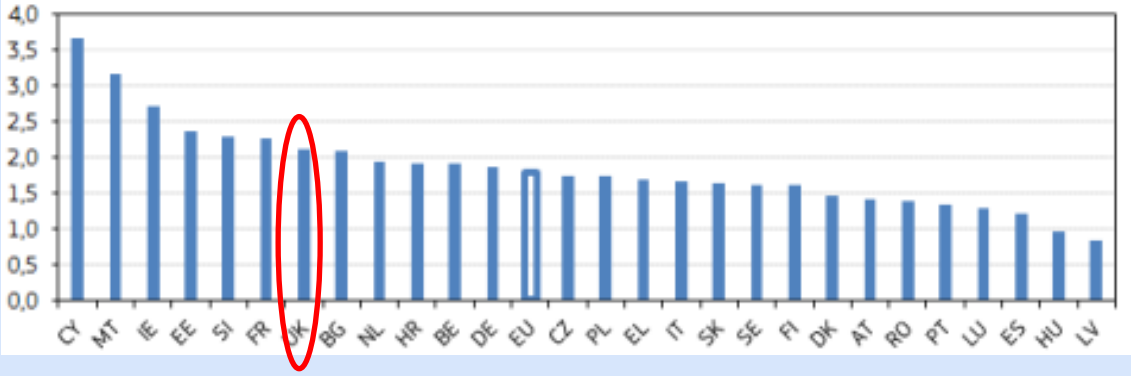


Figure 31: Ratio of the number of fatalities among 18-24 year olds per person of that age to the number of fatalities of all ages per head of all of the population

Reprinted from the European Commission (2015g)

Across the EU as a whole, 18-24 year olds are at almost twice the risk per head of being killed in a road collision compared with the population as a whole. This ratio varies by country but, in the UK, this ratio is more than two whereas it is less than two in the Netherlands, Sweden and Denmark, amongst others. The risk associated with young drivers in Britain therefore appears to be particularly high, which is concerning given that a larger proportion of Britain's population is under 25 year olds in Britain than in these three other countries – see section 3.6.1.

It may be that this is related to the minimum driving age: unlike in Britain, most people are not allowed to drive motor vehicles unsupervised until they are 18 in the Netherlands and Sweden, for example.

4 Vehicles

4.1 Introduction

Section 3 considered how road casualty risk varies by road user type, and highlighted differences between that of vehicle occupants and that of vulnerable road users. A key finding appeared to be that vehicle occupants in Britain are at relatively less risk but that vulnerable road users in Britain appear to be at relatively more risk than in other countries. In this section, the relative safety of the car fleet is considered in more detail to understand more about some of the reasons for this difference.

4.2 Basic vehicle standards

Vehicle standards are consistent across the EU, EFTA plus Turkey and the Russian Federation. Britain's cars meet the seven minimum UN safety standards (which cover seat belts, seat belt anchorages, front and side impact, electronic stability control, pedestrian protection and child seats) – see Figure 32.

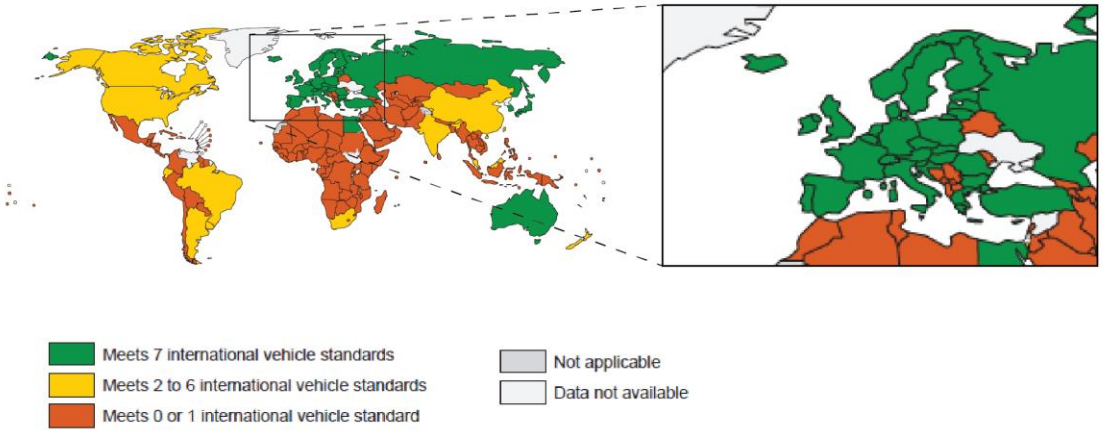


Figure 32: Countries applying priority UN vehicle safety standards

Reprinted from the World Health Organisation (2015)

The European Union has stringent vehicle safety regulatory provisions mandated by the General Safety Regulation (GSR) EC 661/2009 and the Pedestrian Safety Regulation (PSR) EC 78/2009. The type-approval requirements which cover the general safety (GSR) of motor vehicles include the implementation of these UN Regulations.

In addition, cars are typically designed and manufactured to exceed the minimum regulatory thresholds, partly driven by the more demanding European New Car Assessment Programme (Euro NCAP) consumer testing criteria and also by the manufacturers' own in-house design standards.

4.3 Age of car fleet

New cars represented 4.8% of the total car fleet in the EU in 2013, but 7.5% of the total car fleet in the UK (The European Transport Safety Council, 2016b). Only Belgium and Denmark had car fleets with a larger proportion of new cars than the UK had. This might appear to suggest that the UK has a relatively modern fleet. Given that more modern cars are, on average, safer than older cars, this would be good news for Britain. However, as Figure 33 shows, the new car percentages may be misleading: Austria, Ireland and Sweden, along with Belgium and Denmark, appear to have more modern overall fleets than the UK, and the proportion of cars which are more than ten years old is bigger in the UK than in Germany, France and all of the countries identified above with the exception of Sweden. This suggests there is potential for more to be done in Britain to improve safety by modernising the vehicle fleet, particularly in terms of replacing the oldest cars with new ones.

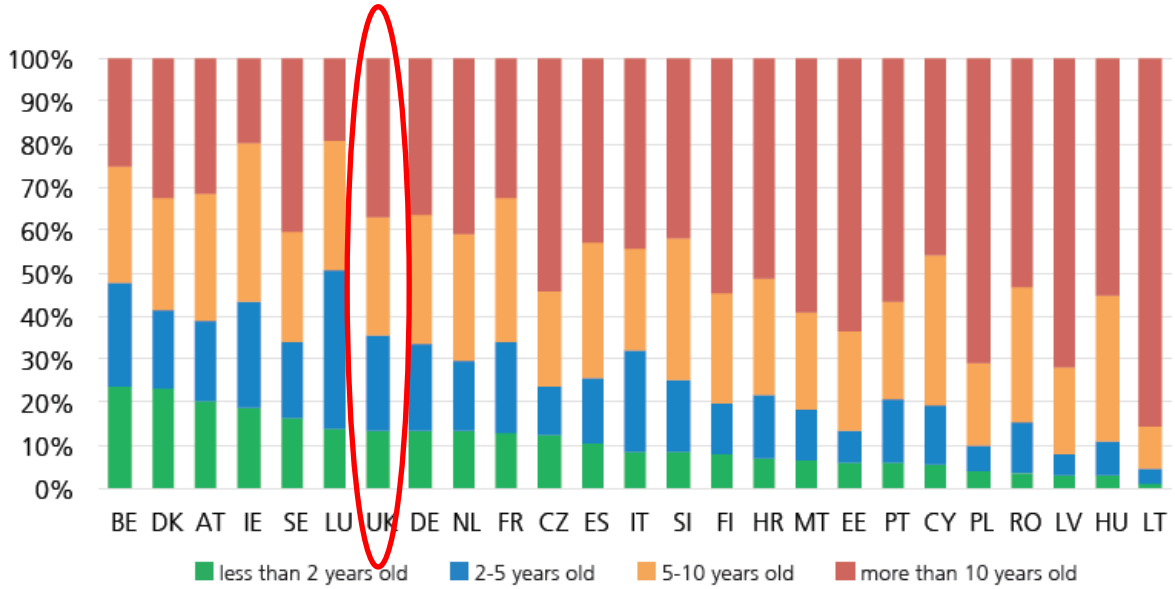


Figure 33: Proportion of cars by age, 2012

Reprinted from the European Transport Safety Council (2016b)

4.4 Star ratings of new cars

Although the proportions of new cars are small, Figure 34 presents the proportions of new cars sold in each EU country in 2013 split by their star ratings, where the cars concerned were Euro NCAP tested between 2010 and 2013.

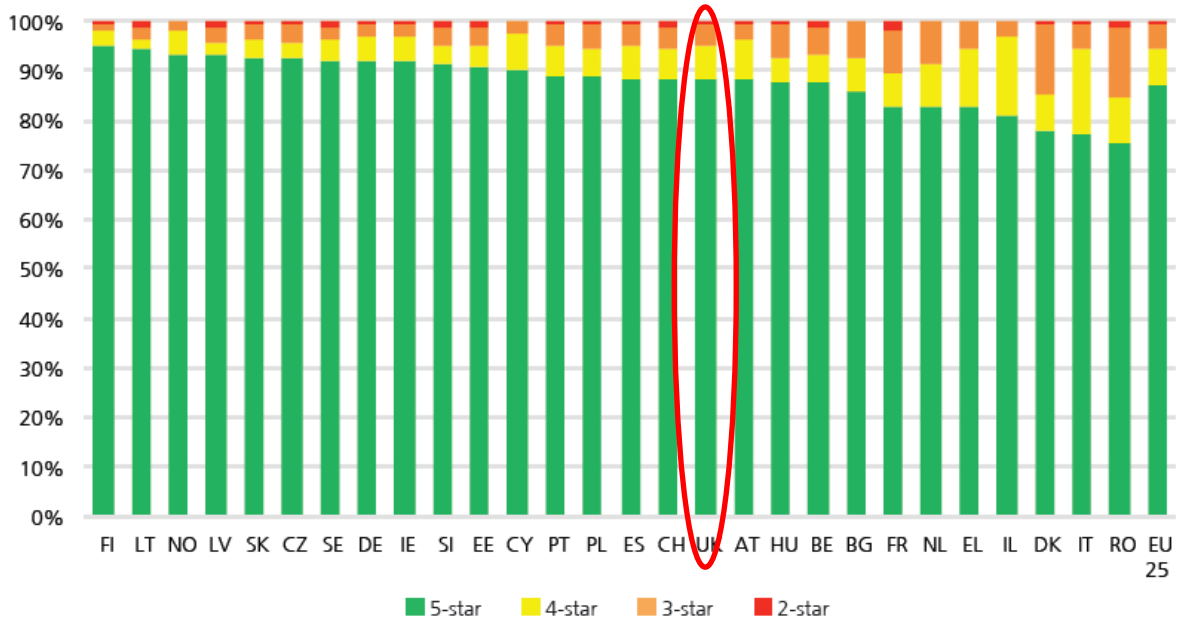


Figure 34: Proportion of cars by Euro NCAP star rating among all cars tested over the period 2010-2013 and sold in 2013

Reprinted from the European Transport Safety Council (2016b)

The proportion of new cars which were 5-star is lower in the UK than in the majority of EU countries including Norway and Sweden, though more than in the Netherlands and Denmark. In the UK, 0.5% of new cars sold in 2013 were 2-star rated, compared with just 0.1% of cars sold in Norway and the Netherlands. This suggests that, although relatively modern, the UK's new cars are not as safe as those in other countries.

The UK's position in terms of the star ratings of new cars is reflected in both its adult protection and child protection scores, the UK's positions being below those of Norway, Switzerland and Sweden, though above those of the Netherlands and Denmark in both cases. On Safety Assist[4], the UK scores more highly than all but a handful of countries, the latter including the Netherlands, Sweden and Norway (The European Transport Safety Council, 2016b). Figure 35 presents a different picture, however, for the pedestrian protection scores for new cars sold in 2013.

[4] "The Safety Assist score is determined from tests to the most important driver assist technologies that support safe driving to avoid accidents and mitigate injuries. In these tests, Euro NCAP tests system functionality and/or performance during normal driving and in typical accident scenarios." The technologies tested are Electronic Stability Control, Seatbelt Reminders, Speed Assistance, AEB Interurban and Lane Support. (EuroNCAP, 2016)

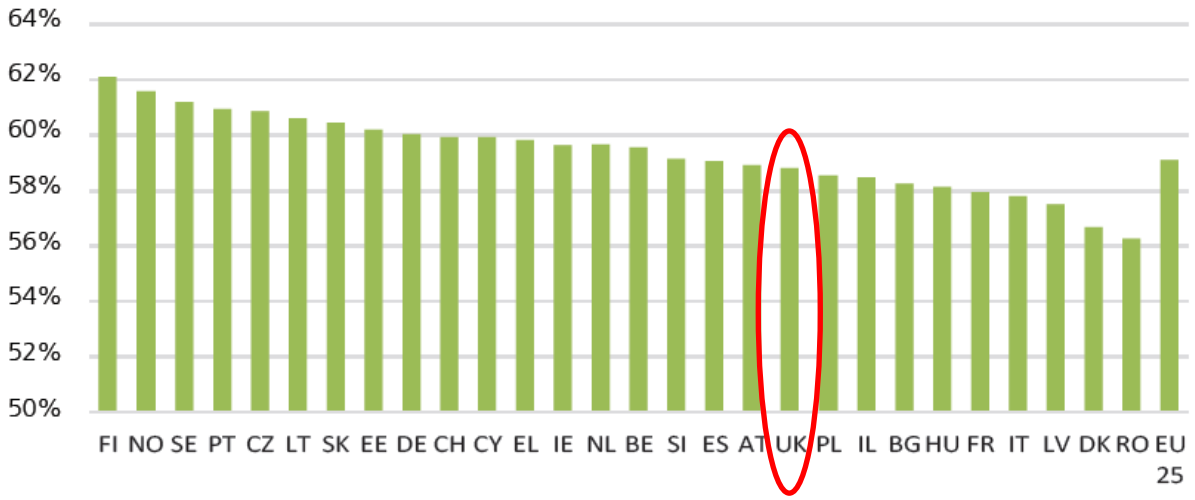


Figure 35: Average score of pedestrian protection for new cars sold in 2013

Reprinted from the European Transport Safety Council (2016b)

The UK's pedestrian protection standards on new cars are again lower than across the EU as a whole, and below those of Norway, Sweden, Switzerland and the Netherlands, though higher than in Denmark.

There is potential to improve the safety of vehicles with respect to vulnerable road users across the EU and in the UK in particular. The European Commission is currently reviewing the General (EC 661/2009) and Pedestrian (EC 78/2009) Safety Regulations to identify opportunities to prevent or mitigate future road injuries. Measures such as pedestrian detection, Automatic Emergency Braking, and improved crashworthiness of head impacts on A-pillars and windscreens are being considered. If adopted into regulation, these measures could contribute to providing a more equitable balance of road user risk for those inside and outside of the vehicle.

4.5 Improvements in car secondary safety

Secondary safety refers to the protection offered by a vehicle in the event of a collision. Logistic regression models have been developed (Wallbank, et al., 2015) to measure the relative year-on-year improvement of car secondary safety by measuring the proportion of casualties who were killed or seriously injured by registration year. Note, the data in this section are restricted to London only; however, modelling the data from all of GB has shown a similar trend (Lloyd, Reeves, Broughton, & Scoons, 2012).

4.5.1 Car users

Figure 36 shows the modelled proportion of male car driver casualties who were killed or seriously injured by registration year. Although the model estimates the coefficients for all of the variables, this graph displays only the results for one set of factors: males aged 25-59 in small family cars in collisions in 2013. By fixing factors at a reference level the general trend in the proportion of casualties who were killed or seriously injured can be examined; the trend for other casualty groups (e.g. females aged 60+ in small family cars in 2013) is the

same (as the main effects are modelled), but will be lower or higher on the graph, depending on the groups selected.

The downwards trend shows that improvements to car secondary safety have reduced the proportion of car drivers being killed or seriously injured in London.

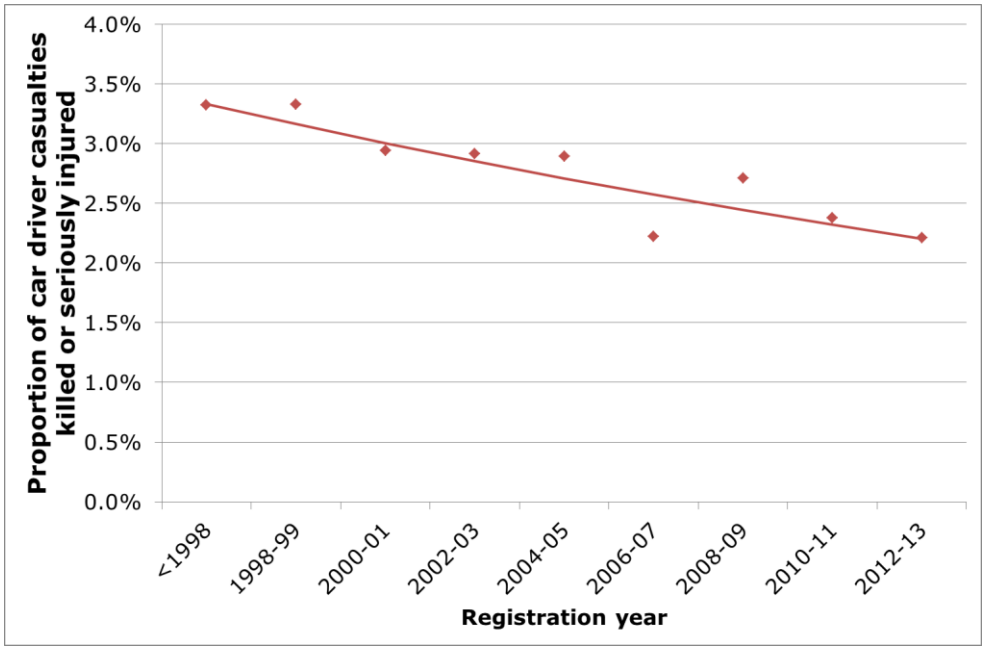


Figure 36: Modelled proportion of car driver casualties who were killed or seriously injured by registration year (Reference levels: males 25-59, small family car, 2013)

4.5.2 Car to pedestrians impacts

The pedestrian model shows the proportion of pedestrian casualties who were killed or seriously injured in collisions where the pedestrian was hit by the front of a car. As with the car driver casualty results presented in Figure 36, Figure 37 shows how secondary safety has changed for a set of fixed reference levels (i.e. male pedestrians aged 16-59, hit by small family cars in 2013).

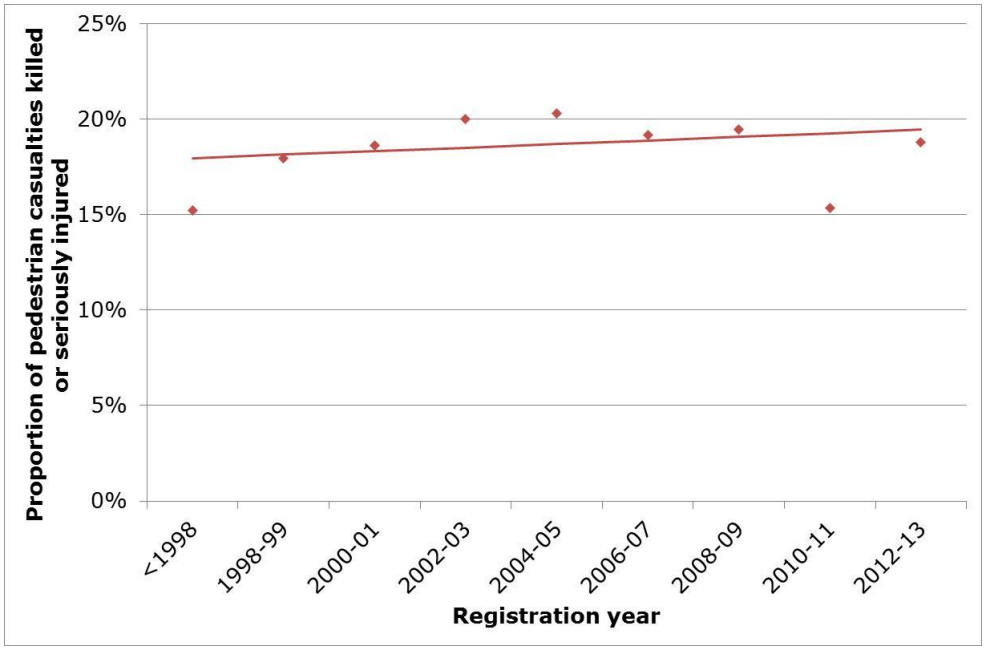


Figure 37: Modelled proportion of pedestrian casualties who were killed or seriously injured by registration year in frontal collisions only (Reference level: males 16-59, small family car, 2013)

Although the trend in this line is slightly upwards, the main effect of registration year is not significant for this model, which indicates that the gradient of the line is not significantly different from zero. This suggests that the secondary safety changes to cars have had no discernible effect with respect to reported police injury severity (positive or negative) for pedestrian casualties hit by the front of a vehicle.

One possibility is that softer bonnets, with enhanced bumper profiles and stiffness characteristics have improved the outcome for struck pedestrians, but only within the serious injury category. A serious injury is defined in STATS19 as:

> *"An injury for which a person is detained in hospital as an "in-patient", or any of the following injuries whether or not they are detained in hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident."*

This covers a broad range of injuries and severities: a person who just avoided a fatal injury and/or who sustained a life-changing disability is categorised at the same level of severity as someone who sustained only a simple closed fracture, a concussion or a severe cut. Clearly this scale of change would have a major influence on society, but it would not be evident from the results presented in Figure 37. As such, it is possible that Figure 37 does a disservice to pedestrian secondary safety improvements to vehicles in recent years, because the injury severity measure is too broad to differentiate and quantify changes to injury patterns. Nonetheless, given secondary safety benefits can be measured for car users with the same limitations with respect to the injury outcome measure, it is reasonable to conclude that vehicle design improvements have resulted in greater benefits for car users compared to pedestrians in the last decade.

Another possible explanation for the model not identifying any secondary safety benefit for pedestrians hit by the front of cars could be that cars with a newer registration year have different exposure to potentially fatal or serious injury collisions with a pedestrian, in a way that is not included within the statistical model (e.g. if they were driven more aggressively around peak pedestrian movement times). However, differences in exposure would also be observed for car user casualties and therefore this is an unlikely explanation.

5 Conclusions

5.1 Overall fatality rates

There are fewer road deaths per head of the population in Britain than in almost any other country in the world. With minor variations in international rankings, this has been the case consistently for many years. The most recent data (2015) show that Norway and Sweden both have fewer road deaths per head than Britain, while Switzerland, Denmark and the Netherlands have more. The work reported here has attempted to disaggregate this important, but high-level statistic and to explore the relative safety of Britain's roads, road users and vehicles in order to see if there are areas where renewed focus might deliver significant safety benefits. In areas where Britain's road safety record is even better than those of other countries, it may be possible to improve Britain's roads further still through measures which have been found to be effective elsewhere, though these areas were not the focus of the study reported here.

Britain's relative position is broadly consistent when the road fatality rate is expressed in terms of road deaths per head as above, road deaths per person-kilometre, or road deaths as a proportion of all deaths. Britain's relative performance may partly be due to higher levels of compliance, for example with mobile phone and drink-drive legislation.

The comparisons used to assess the relative safety of different countries' roads described above necessarily involve using figures which are averaged across each country as a whole. These can disguise the variation within each country and differences in different aspects of the road safety system. Nonetheless, some indicative differences between Britain and other countries with similar numbers of road deaths per head emerge in relation to the safety of each of the three aspects of roads, road users and vehicles.

5.2 Roads

Differences in road type classifications in different countries make comparisons on this basis more challenging than many other comparisons. Nonetheless, some differences emerge. For example, comparisons with other countries with similar numbers of road deaths per head indicate that:

- A greater proportion of British road deaths are on roads with speed limits of 60 mph or more (90 km/h or more). (Proportionally fewer British road deaths are on roads with speed limits of 50 mph (80 km/h) or less.)
- Britain has more deaths per unit length of motorway, though not necessarily per vehicle-kilometre, than the average motorway in the EU.
- Deaths on roads in urban areas are more likely to be male in Britain, and in rural areas more likely to be female, than in other countries.
- Road deaths are more likely to be recorded as occurring at junctions in Britain.
- In rural areas in Britain, pedestrians constitute a larger proportion of road deaths, and car/taxi occupants a smaller proportion.

5.3 Road users

Although there appear to be fewer vehicle occupant deaths per head in Britain than in other countries which have similar numbers of road deaths per head in total, there appear to be more vulnerable road user deaths per head in Britain than in these other countries: pedestrians, pedal cyclists and motorcyclists constitute almost half of Britain's road deaths, but fewer than two-fifths in Sweden. This does not appear to be because there are proportionally more vulnerable road users in Britain than in other countries; there are limited amounts of comparable data on this, but the indications are that, if anything, there are proportionally fewer vulnerable road users in Britain than in other countries.

The likelihood of a pedal cyclist being killed per distance travelled in the UK is approximately twice that in the Netherlands, Denmark or Norway. When pedestrians are killed in Britain, the collision is more likely to involve a car or taxi than is the case in other countries which have similar numbers of road deaths per head, despite marginally lower car ownership levels in Britain. Pedestrian and pedal cyclist deaths are more likely to be male in the UK than in other countries; again, this may reflect differences in the amount of cycling and walking; for example, differences in the amount of walking and cycling undertaken by women and by men may be greater in the UK than in other countries. While motorcyclists account for just 1% of UK traffic, almost one in five UK road deaths are motorcyclists; the motorcyclist fatality rate per person-kilometre in the UK is 35% higher than that in the Netherlands.

18-24 year olds are at more risk of being killed on the road in most countries than the average person. However, this difference in risk per head is proportionally larger on British roads than on the roads of most other EU countries, including those in the Netherlands, Sweden and Denmark.

5.4 Vehicles

The proportion of new cars which have a 5-star European New Car Assessment Programme (Euro NCAP) rating is smaller in the UK than in Sweden, and the proportion of new cars which have a 2-star Euro NCAP rating is larger in the UK than in the Netherlands. In addition, the average pedestrian protection score on new cars is lower in the UK than across the EU as a whole, and lower than in Norway, Sweden, Switzerland and the Netherlands, though higher than in Denmark. These points suggest that the number of road deaths per head in the UK could be reduced further if Britain's new vehicles were as safe as those of other countries with similar numbers of road deaths per head; however, all of these differences are small.

The number of killed or seriously injured car occupants has been falling in Britain; some of this trend can be attributed to secondary safety design improvements in the last two decades, encouraged by Euro NCAP and mandated by EU type-approval. However, these benefits appear not to have been shared by pedestrians and other vulnerable road users: the proportion of injured pedestrians who are killed or seriously injured in impacts with the front of cars has not experienced the same reduction as is the case for car occupants. Nonetheless, the design changes made to the front of cars to protect pedestrians may be having positive effects; for example, there may have been a reduction in the absolute severity of injuries to vulnerable road users, but within the 'serious' category in police STATS19 collision records. Further evaluation is needed to understand the injury types

amongst vulnerable road users to ensure future collision and injury mitigation strategies are effective.

5.5 Background factors

Based on the findings within this study, Britain's relatively low fatality rate could be partly explained by various background factors including differences in national demographics and travel patterns. For example, Britain may have less travel by pedestrians and cyclists than some other comparator countries, though it was not possible to obtain comparable data on these metrics.

Britain's population density is lower than that of the Netherlands but higher than those of Switzerland and Denmark, and substantially higher than those of Sweden and Norway. Britain's population is slightly younger, and a higher proportion of its population is female, than those of Sweden, Denmark and the Netherlands. For example, a larger proportion of Britain's population is under 25 than is the case in all three of these countries. The effect of these differences on road safety outcomes is currently unclear, and more work is required to identify, quantify and analyse these differences if Britain's road safety record is to be understood and improved still further.

5.6 Reliability of comparisons

Although countries within the EU use a common definition for road deaths, there are many differences in the way in which other measures related to road safety are measured. These differences include not only the classifications of non-fatal road injuries, but also the ways in which exposure data are collected and classified. Comparable data for various measures for Norway and Switzerland are harder to obtain than those of other countries on account of these two countries not being EU member states.

Subsequently, it is very challenging to compare the road safety records of different countries meaningfully and to understand the reasons for differences and similarities reliably. For example, the number of road casualties is sensitive to the distances travelled by pedestrians and pedal cyclists yet the standard way in which these distances are measured appears to vary by country; this means that apparent differences in vulnerable road user casualty rates may not reflect genuine differences in safety. More harmonised approaches to data collection and classification in different countries would therefore be beneficial in identifying the effectiveness of different approaches and, ultimately, to improving road safety in all countries including Britain.

6 Recommendations

Britain's road safety outcomes do not always appear to be as good as those of some other countries and therefore there is potential to learn from their experience to reduce road casualties further. Recommendations for the UK include:

- Reviewing the safety of roads with speed limits of 60 mph and above, including motorways.
- Further investment in motorway safety.
- Ensuring that junctions are designed as safely as possible, particularly in respect of vulnerable road users.
- Implementing measures to improve the safety of pedestrians, pedal cyclists and motorcyclists.
- Implementing further measures to improve the safety of young drivers.
- Modernising the car fleet in the UK, replacing the oldest cars with today's highest Euro NCAP performing cars.
- Implementing higher standards of protection for vulnerable road users in vehicle safety regulation and Euro NCAP.
- Obtaining and classifying casualty and exposure data in more consistent ways in different countries to enable more robust international comparison and evaluation.

To help address these issues, questions which need further investigation include:

- Why are there proportionally more road deaths on roads with higher speed limits in Britain than in other countries?
- Why do Britain's motorways have more deaths per unit length than motorways in other countries? (If this is simply because traffic volumes are higher, is more effort to improve motorway safety warranted in Britain than is the case in other countries?)
- How do travel patterns vary in different countries by area type? For example:
  - In Britain, do males travel more in urban areas and females travel more in rural areas, proportionally speaking, than in other countries?
  - In rural areas in Britain, are pedestrians and motorcyclists proportionally more common, and cars/taxis proportionally less common, than in other countries?
- How are junctions classified differently in different countries, in terms of where road deaths occur, and what impact do these differences have on the relative proportions of road deaths at junctions?
- Why are there proportionally more vulnerable road user deaths in Britain than in other countries?
- Why are there proportionally more fatalities among 18-24 year olds in Britain than in other countries?
- How many collisions could be prevented and how many casualties mitigated, particularly among vulnerable road users, if cars on Britain's roads have higher Euro NCAP star ratings?

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Appendix A Selected countries ranked by fatalities per head (2006-2014) (The Department for Transport, 2015b)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Malta	1	1	1	9	5	10	1	14	2	1
Great Britain	6	4	4	1	4	1	4	2	4	2
Sweden	3	7	5	2	2	3	7	1	3	3
Netherlands	2	2	3	4	6	7	11	5	8	4
Norway	5	5	8	5	8	4	5	9	5	5
Israel			10	3	12	12	8	7	9	6
Switzerland	4	6	6	7	7	8	10	4	6	7
Iceland	23	3	2	11	1	5	3	15	1	8
Japan	8	8	7	6	10	11	13	10	11	9
Northern Ireland	11	10	11	16	3	2	2	3	15	10
Denmark	7	13	19	13	11	6	6	6	7	11
Germany	9	9	9	8	9	14	14	11	13	12
Irish Republic	15	15	12	12	13	9	9	12	14	13
Finland	10	11	13	10	14	15	15	16	12	14
Spain	19	18	16	14	15	13	12	8	10	15
France	12	12	14	17	18	18	17	17	19	16
Australia	13	14	15	19	17	16	19	19	17	17
Austria	16	16	21	22	21	19	22	20	18	18
Italy	21	19	20	18	23	20	20	23	22	19
Canada	17	17	18	15		24		21		20
Slovakia	25	25	30	20	20	17	16	13	16	21
Luxembourg	14	20	17	30	19	23	24	32	26	22
Portugal	18	21	22	23	29	29	28	26	23	23
New Zealand	20	22	23	27	28	22	29	22	28	24
Belgium	22	23	24	28	27	28	26	29	27	25
Cyprus	26	24	28	29	25	30	18	18	21	26
Hungary	28	27	26	24	24	21	21	24	25	27
Czech Republic	24	26	27	26	26	26	27	28	29	28
Slovenia	30	33	29	25	22	25	23	25	20	29
Estonia	35	34	25	21	16	27	25	27	24	30
Croatia			39	37	31	34	32	33	30	31
Bulgaria	31	30	34	34	34	32	30	31	34	32
Romania	27	29	36	39	36	33	35	37	35	33
Greece	34	32	33	38	37	36	33	30	31	34
Poland	32	35	37	35	33	39	34	35	32	35
Republic of Korea	29	28	31	36	38	38	38	38	36	36
United States of America	33	31	32	32	35	37	37	39	37	37
Latvia	36	36	35	33	32	31	31	36	38	38
Lithuania	37	37	38	31	30	35	36	34	33	39

Appendix B ISO codes of various European countries

ISO Code	Country	ISO Code	Country
AT	Austria	**IT**	Italy
BE	Belgium	**LI**	Liechtenstein
BG	Bulgaria	**LT**	Lithuania
CH	Switzerland	**LU**	Luxembourg
CY	Cyprus	**LV**	Latvia
CZ	Czech Republic	**ME**	Montenegro
DE	Germany	**MK**	Macedonia
DK	Denmark	**MT**	Malta
EE	Estonia	**NL**	The Netherlands
EL	Greece	**NO**	Norway
ES	Spain	**PL**	Poland
FI	Finland	**PT**	Portugal
FR	France	**RO**	Romania
GB	Great Britain	**RS**	Serbia
HR	Croatia	**SE**	Sweden
HU	Hungary	**SI**	Slovenia
IE	Ireland	**SK**	Slovakia
IL	Israel	**TR**	Turkey
IS	Iceland	**UK**	The United Kingdom

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