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Burden of injury of serious road injuries in six EU countries

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Highlights:

- The burden of injury is assessed and compared for serious (MAIS 3+) road injuries in six EU countries.
- Head injuries, spinal cord injuries and injuries to the lower extremities have a high share in the total burden of injury.
- The average burden per casualty, the percentage of casualties that experience lifelong consequences and results per transport mode differ between the countries
- Differences between countries are mainly due to differences in distribution of casualties over age and over different types of injuries.

ABSTRACT

Background: Information about the burden of (non-fatal) road traffic injury is very useful to further improve road safety policy. Previous studies calculated the burden of injury in individual countries. This paper estimates and compares the burden of non-fatal serious road traffic injuries in six EU countries/regions: Austria, Belgium, England, The Netherlands, the Rhône region in France and Spain.

Methods: It is a cross-sectional study based on hospital discharge databases. Population of study are patients hospitalized with MAIS3+ due to road traffic injuries. The burden of injury (expressed in years lived with disability (YLD)) is calculated applying a method that is developed within the INTEGRIS study. The method assigns estimated disability information to the casualties using the EUROCOST injury classification.

Results: The average burden per MAIS3+ casualty varies between 2.4 YLD and 3.2 YLD per casualty. About 90% of the total burden of injury of MAIS3+ casualties is due to lifelong consequences that are experienced by 19% to 33% of the MAIS3+ casualties. Head injuries, spinal cord injuries and injuries to the lower extremities are responsible for more than 90% of the total burden of MAIS3+ road traffic injuries. Results per transport mode differ between the countries. Differences between countries are mainly due to differences in age distribution and in the distribution over EUROCOST injury groups of the casualties.

Conclusion: The analyses presented in this paper can support further improvement of road safety policy. Countermeasures could for example be focused at reducing skull and brain injuries, spinal cord injuries and injuries to the lower extremities, as these injuries are responsible for more than 90% of the total burden of injury of MAIS3+ casualties.

Keywords: burden of injury, YLD, road traffic injury, MAIS3+, road safety policy, serious injuries

1. Introduction

Traditionally, road safety policy has been primarily aimed at reducing the number of fatalities. However, road traffic crashes also cause a large number of non-fatal (serious) road traffic injuries, resulting in considerable economic and human costs (Weijermars, Bos, & Stipdonk, 2016b). Moreover, the number of serious road traffic injuries has not been decreasing as fast as the number of fatalities in some countries, and has even been increasing in other countries (Berecki-Gisolf et al., 2013; OECD/ITF, 2011). Therefore, serious road traffic injuries are increasingly being adopted as an additional indicator for road safety (e.g. EC, 2010).

Non-fatal injuries can have a major impact on the quality of life of a crash survivor and their relatives. On a more aggregated level, they also pose a burden to society. The health burden of injuries can be expressed in Disability Adjusted Life Years (DALYs) (Murray & Acharya, 1997). This measure integrates premature mortality –expressed in Years of Life Lost (YLL) - and loss of quality of life due to disability. The latter is expressed in Years Lived with Disability (YLD) and is estimated by multiplying the prevalence of a disorder by the loss of health associated with the disability (disability weight). Information on the burden of non-fatal injury enables policy makers to compare 1) the burden of non-fatal injuries with the burden of fatal injuries (expressed in YLL), and 2) the burden of road traffic injuries with the burden of other types of injuries and the burden of diseases (Bhalla et al., 2014; Haagsma et al., 2016; Murray et al., 2013). Furthermore, information about the burden of (non-fatal) injury for different groups of road traffic casualties is very useful to further improve road safety policy. In cases where a group of casualties (e.g. a certain transport mode or type of injury) experience relatively large health impacts from their injuries, it might be advisable to develop measures targeting them specifically. Additionally, measures might also aim at reducing health impacts.

Previous studies calculated the burden of road injury in individual countries like Belgium (Dhondt, Macharis, Terryn, Van Malderen, & Putman, 2013), France (Lapostolle et al., 2009), The Netherlands (Weijermars, Bos, & Stipdonk, 2016a) or Sweden (Tainio, Olkowicz, Teresiński, De Nazelle, & Nieuwenhuijsen, 2014). As previous studies have applied different methods and different definitions of (serious) road injuries, between country results cannot easily be compared on the basis of these individual studies. In the present paper, the burden of non-fatal, serious road injuries is estimated for a number of EU countries and regions - Austria, Belgium, England, The Netherlands, the Rhône region in France and Spain - based on one and the same method. The country results can therefore be compared

2. Method

2.1. Study design and population

This is a cross-sectional study based on Hospital Discharge Databases. The population of study is patients hospitalized due to road traffic injuries. For this study, only patients with serious road traffic injuries were considered. A patient with a serious road injury is thereby defined as a hospitalized non-fatal road traffic casualty with an injury score of MAIS3+ (MAIS=Maximum Abbreviated Injury Scale, see Gennarelli & Wodzin, 2005). This definition was proposed as a result of the EU funded SafetyNet project (Thomas et al., 2009) and the IRTAD working group on serious injuries (OECD/ITF, 2011) and accepted by the High Level Group on Road Safety representing all EU Member States (EC, 2013).

For all countries, MAIS3+ casualties were selected using hospital discharge data, applying the guidelines that were developed within the SafetyCube project (Pérez et al., 2016). This means that all patients with an injury diagnosis (ICD9CM:800-999; ICD10: S00-T88), with external causes for road traffic injuries (ICD9CM: E810-E819, E826, E827, E829, E988.5; ICD10: V01-89) and an injury severity of MAIS3+ are selected. Moreover, fatalities within 30 days and readmissions are excluded as far as possible.

As a consequence of differences in available data, there are some differences in selection of MAIS3+ road injuries between the countries. Table 1 provides an overview of these differences. Differences in methodology mainly affect the total estimated number of serious road injuries and therefore the total burden of injury (see Weijermars et al., 2016 for more detailed information). Effects on the estimated average burden of injury per casualty are assumed to be relatively small.

Table 1: Selection of MAIS3+ casualties in study countries

	Austria	Belgium	England[1]	Netherlands[2]	Rhône (Fr)[3]	Spain
Year	2014	2011	2010	2014	2004-2013	2014
Number of casualties	1,410	4,005	7,807	7,691	5,140	7,610
AIS rating	AAAM10	ICDpic	ECIP-Navarra	ICDmap90	Direct coding	ICDpic
AIS-version	2008	2005	1998	1990	1990	2005
ICD-version	ICD10	ICD9	ICD10	ICD9	-	ICD9
Number of diagnoses	1	20	9	12	8+	14
Full ICD-codes available	No	Yes	Yes	Yes	-	Yes

[1] Hospital Episode Statistics (HES) inpatient database. Copyright© 2016, Re-used with the permission of The Health and Social Care Information Centre and Department for Transport. All rights reserved.
[2]LBZ-DHD LBZ (Landelijke Basisregistratie Ziekenhuiszorg) is a national database that includes all patients that are admitted to a Dutch Hospital. The database is administered by DHD (Dutch Hospital Data).
[3]Rhône register

2.2 Calculation and analysis of the burden of injury

The burden of injury, expressed in YLD, is calculated using a method that was developed within the European INTEGRIS study (Haagsma et al., 2012). The method combines data on the incidence of injuries with disability information for these injuries using the EUROCOST injury classification. The EUROCOST injury classification distinguishes 39 injury groups defined in such a way, that they are more or less homogeneous in terms of healthcare use (Polinder et al., 2004).

The INTEGRIS study provides disability weights (DWs) and proportions of casualties with lifelong consequences (Pls) for each of the 39 EUROCOST injury groups (see Appendix A). A disability weight reflects the impact of a health condition and has a value between 0 (full health), and 1 (entirely disabled or dead). A patient was assumed to encountered lifelong consequences if, at the two year follow up, he or she still claimed to be experiencing injury-related health problems and reported symptoms compatible with the injury suffered. The DWs and Pls are mainly based on a study of functional outcomes in injury patients in the Netherlands (Polinder et al., 2007), supplemented for some injuries with disability weights from a different study (Haagsma et al., 2008). Separate DWs and Pls are available for casualties that were admitted to the hospital and for casualties that were only treated at the Emergency Department. Since our study focuses on serious road injuries, we applied the DWs and Pls for hospital admitted casualties. Moreover, the INTEGRIS study provides separate DWs for the first year after the crash (acute) and for the remainder of a casualty's life (lifelong).

The application of the INTEGRIS method consists of the following steps:

<u>Step 1: Assign each road traffic casualty to one of the 39 EUROCOST groups</u>

For all selected MAIS3+ casualties, ICD or AIS (Rhône region of France) injury codes are translated into EUROCOST injury groups. In case of multiple injuries, the hierarchical scheme proposed by Polinder et al. (2008) is applied.

Step 2: Calculate the burden of injury for each road traffic casualty by applying equation 1

For each MAIS3+ casualty, the burden of injury is estimated by means of equation 1.

$$B_i = DWa_{j(i)} + Pl_{j(i)} * DWl_{j(i)} * (LE_i - 1) \qquad \text{(Equation 1)}$$

With:

B_i = Burden of injury [YLD] of MAIS3+ casualty *i=1…N*, with *N*=number of MAIS3+ casualties

j(i) = EUROCOST injury group, *j=1...39* of casualty i

$DWa_{j(i)}$ = Disability Weight for disability during first year, provided by Haagsma et al (2012)

$DWl_{j(i)}$ = Disability Weight for lifelong disability, provided by Haagsma et al (2012)

$Plj_{(i)}$ = Proportion [%] of cases with lifelong consequences, provided by Haagsma et al (2012)

LE_i = remaining Life Expectancy [years] of casualty *i* given its age and gender.

Information about the remaining Life Expectancy is taken from the Global Burden of Disease study 2013. The mean life expectancy of the region R10 Western Europe is used, as it appeared to best suit the countries analysed here[1].

Step 3: Sum the burden of injury of individual road traffic casualties and analyse results

The burden of injury for a group of road traffic casualties (e.g., cyclists) was estimated by summing up the burden of injury of individual road traffic casualties within that group. Moreover, the average burden per casualty was estimated by dividing the burden of injury for a group of casualties by the number of casualties in that group. A distinction was made between the acute burden of injury and the lifelong burden of injury. The acute burden of injury refers to disabilities during the first year after the crash, whereas the lifelong burden of injury deals with the burden after the first year. The lifelong burden is only determined for casualties that experience lifelong consequences.

[1] http://ghdx.healthdata.org/global-burden-disease-study-2013-gbd-2013-data-downloads.

The proportion of serious road traffic injuries suffering from lifelong consequences was determined by applying equation 2.

$$Pl = \frac{\sum_{j=1}^{39} N_j * Pl_j}{N} \quad \text{equation 2}$$

The average burden of injury per casualty as well as the distribution of the total burden of injury is calculated and analysed for different injury groups, transport modes and for men and women. The analysis concerning transport modes is based on data from four countries and the Rhône region, as the Austrian data does not contain information on the transport mode of the casualty. The distribution of injuries and burden of injuries over the body is visualised by the so-called burden of injury body profiles that were introduced by Weijermars et al. (2016a).

3. Results and interpretation of results

Table 2 shows summary information about the average burden of injury per casualty in the six countries. The average burden per MAIS3+ casualty varies between 2.4 YLD and 3.2 YLD per casualty, with an average of 2.8 YLD per casualty for the six countries together. On average, 25% of the MAIS3+ casualties encounter lifelong disabilities. However, differences between countries are quite large, varying from 19% of all MAIS3+ casualties in Spain and 33% of all MAIS3+ casualties in the Netherlands. Lifelong consequences are responsible for about 90% of the total burden of injury of MAIS3+ casualties.

Table 2: Estimated Numbers of serious injuries (MAIS3+) and Burden of those injuries in study countries.

	Austria	Belgium	England	Netherlands	Rhône (Fr)	Spain
Burden pp [YLD]	3.1	2.7	3.1	3.2	2.5	2.4
Acute burden per person [YLD]	0.3	0.3	0.3	0.3	0.2	0.1
Lifelong burden per person [YLD]*	10.1	10.1	9.9	8.7	11.1	11.5
Lifelong burden [% of total]	91%	91%	91%	91%	91%	90%
Proportion casualties with lifelong disabilities [%]	28%	25%	28%	33%	21%	19%

** for casualties with lifelong consequences*

As the same disability weights have been applied to the incident cases of the different countries, differences in results between countries are mainly due to differences in the types of injuries encountered and the age distribution of the casualties. The age distribution differs considerably between the countries, as is shown in Figure 1. In the Netherlands, for example, road traffic casualties are relatively old, compared to the other countries. This explains the relatively low average lifelong burden per person in the Netherlands. The average lifelong burden of injury per casualty decreases with age, as older people have fewer remaining life years than younger people.

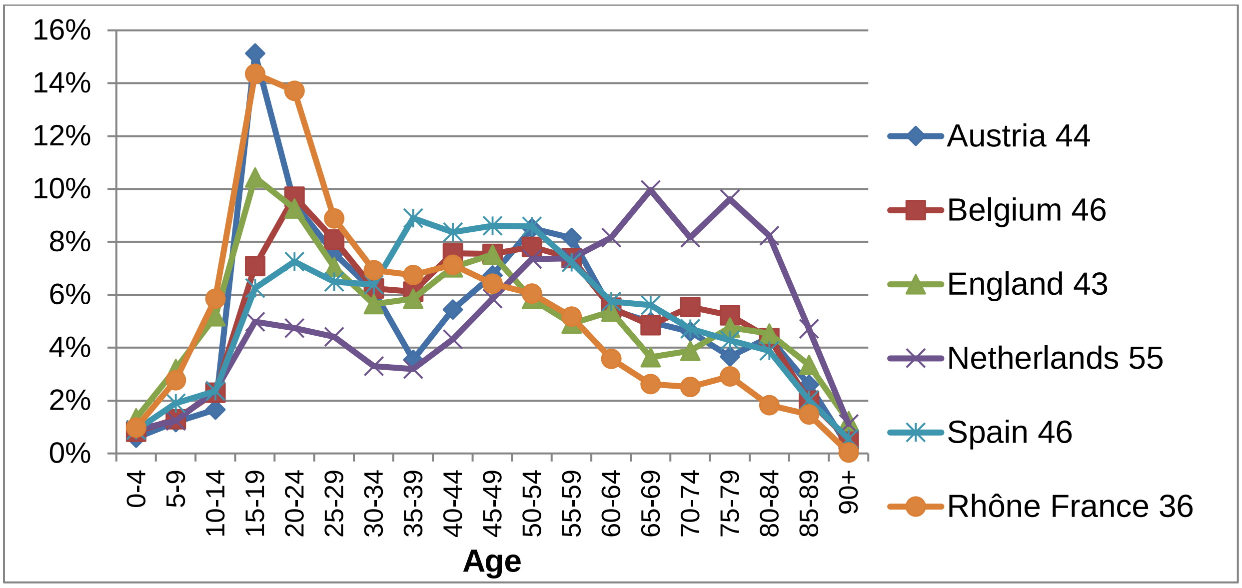

Figure 1: Age distribution of casualties in five countries and the Rhône region. For each country, the average age of serious road injuries is mentioned in the legend.

Appendix B shows the distribution of MAIS 3+ casualties as well as the burden of injury of these casualties over the 39 EUROCOST injury groups. The relatively low proportion of people with lifelong consequences for Spain can be explained by a relatively high proportion of people with rib/sternum fractures; this injury does not lead to lifelong consequences. Looking at the distribution of the total burden of injury over the EUROCOST injury groups, five injury groups represent more than 90% of the total burden of injury in the six countries together. These are skull-brain injury other than concussion, open head wounds and facial injuries, spinal cord injuries and fractures in hips, femur shafts and knees/lower legs (Table 3). From the table can also be seen that skull-brain injuries other than concussions, open head wounds and facial injuries (EUROCOST group 2) have a high share in the total burden of injury in all countries, whereas for example hip fractures and fractures in knees/lower legs have a high share in some countries and a lower share in other countries. The average burden per casualty is by far the highest for spinal cord injuries. This is due to a very high percentage of casualties experiencing lifelong consequences (100%) and high disability weights.

Table 3: Five injury groups that contribute most to the total burden of MAIS3+ road traffic injuries in the six countries together.

EuroCOST injury group	Average burden pp [YLD]	% of total burden of injury (MAIS3+)		
		Min	Max	Average
2 other skull-brain injury	3.3	27% (Rhône)	36% (Austria)	32%
9 spinal cord injury	27.7	13% (Rhône)	35% (Netherlands)	22%
22 fracture hip	2.6	6% (Rhône)	20% (Netherlands)	13%
23 fracture femur shaft	3.2	4% (Netherlands)	23% (Austria)	11%
24 fracture knee/lower leg	4.3	3% (Netherlands)	31% (Rhône)	13%

Figure 2 shows the burden of injury body profiles for the six countries. Head injuries, hip/upper leg injuries and back/chest injuries appear to have a high share in the burden of injury compared to other body regions. Moreover, for back/chest injuries, the share in the burden of injury is clearly higher than the share in the number of MAIS3+ casualties. This is due to spinal cord injuries which have a relatively high burden per casualty (also see Table 3). Injuries to the abdomen on the contrary have a higher share in the number of MAIS3+ casualties than in the burden of injury.

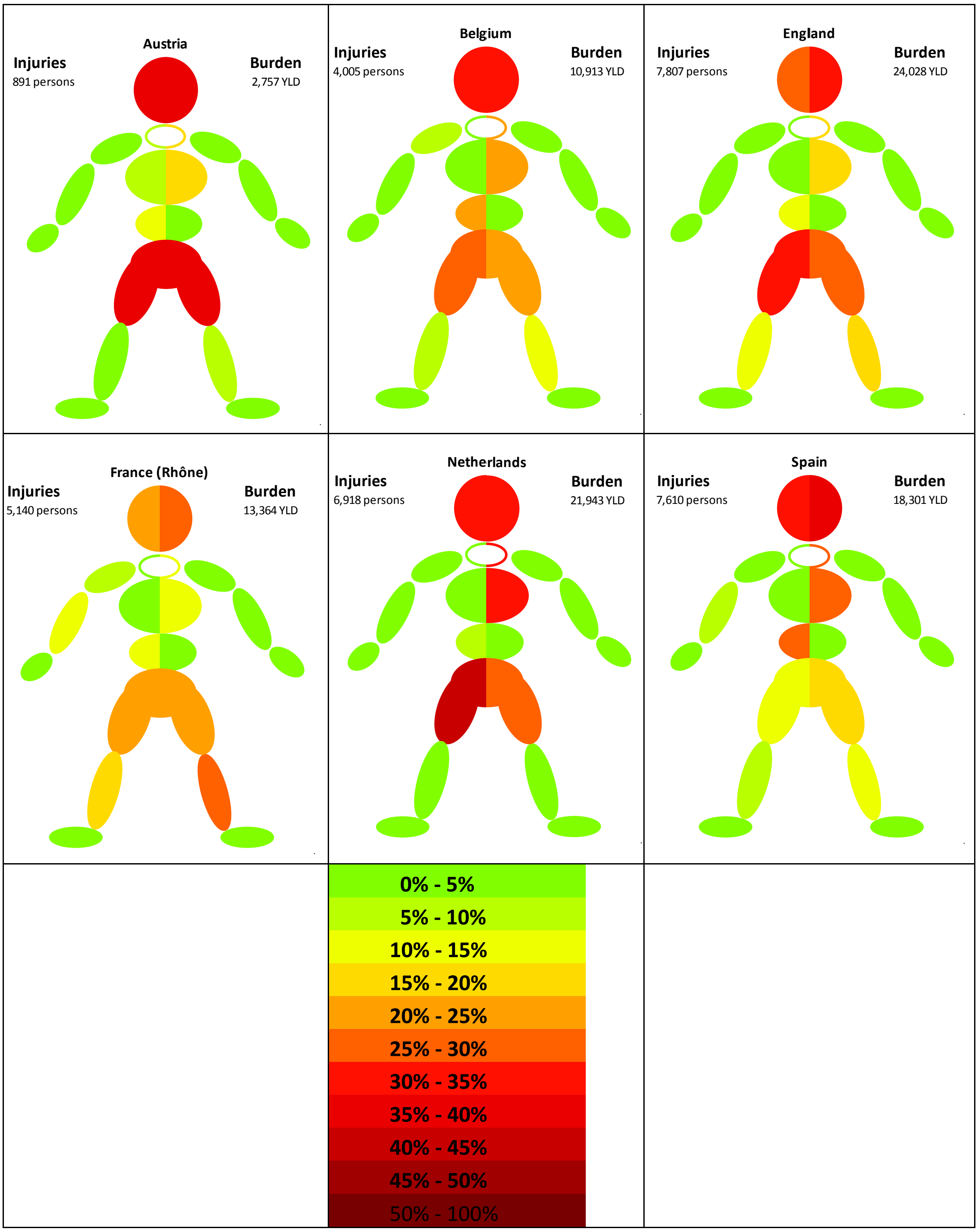

Figure 2: Burden of injury body profiles of the six countries. The left side of the body profiles shows the distribution of the casualties (prioritized EUROCOST injury group) over the body regions, the right side shows the distribution of the burden of injury.

Differences in the burden of injury body profiles between the countries are partly due to differences in the distribution of casualties over transport modes. Table 4 shows that the distribution of casualties over transport modes differs between the countries, and Aarts et al. (2016) show that the injury profiles differ between transport modes. The relatively high share of hip/upper leg injuries in the total number of injuries and in the total burden of injury in the Netherlands for example is due to a relatively high number of bicycle (only) crashes (Weijermars et al., 2016b).

Table 4: Distribution of MAIS3+ casualties over transport modes.

	Be	Eng	NL	Rhône	Spain
Pedestrians	8%	21%	5%	18%	13%
Cyclists	35%	19%	62%	15%	15%
Motorized two-wheelers	19%	20%	16%	37%	22%
Car/van	33%	26%	10%	23%	12%
Other/missing	4%	14%	7%	7%	38%

* Austria is not included in this table as for Austria no information is available concerning transport mode.

Table 5 shows the average burden per MAIS3+ casualty for the different transport modes. The average burden per casualty is highest for car occupants and lowest for cyclists (in crashes without motorized vehicles). Moreover, on average, the percentage of casualties that suffer from lifelong consequences is slightly higher for pedestrians and cyclists compared to motorized transport modes. The results however differ between the countries. In Spain and the Netherlands, the average burden per casualty was highest for car/van occupants, whereas in the Rhône region and Belgium, the average burden per casualty was highest for motorized two-wheelers and in England the average burden per casualty was highest for pedestrians. The percentage of MAIS3+ casualties that experience lifelong consequences is highest for pedestrians in Belgium, Spain and the Rhône region, for cyclists in crashes without motorized vehicles in the Netherlands and for motorized two-wheelers in England.

Table 5: Average burden of injury for different transport modes for Belgium, England, The Netherlands, Spain and the Rhône region.

Transport mode	**Burden per person [YLD] average (max, min)**			**% casualties lifelong**
	Acute burden	**Lifelong burden**	**Average burden**	
Pedestrian	0.26 (0.28-0.25)	9.5 (10.8-8.4)	2.8 (3.4-2.4)	27% (30%-23%)
Cyclist (Be, Sp, Fr)	0.26 (0.29-0.24)	8.8 (10.2-6.8)	2.3 (2.3-2.3)	25% (30%-20%)
Cyclist in crash without motorized vehicle (Eng, Nl)*	0.31 (0.33-0.29)	6.9 (8.3-5.4)	2.6 (2.9-2.4)	35% (37%-32%)
Cyclist in crash with motorized vehicle (Eng, Nl)*	0.28 (0.29-0.26)	10.4 (10.7-10.1)	3.3 (3.4-3.1)	29% (31%-27%)
Motorized two-wheelers	0.24 (0.27-0.23)	12.0 (13.0-11.1)	3.0 (3.5-2.4)	24% (29%-17%)
Car/van	0.25 (0.29-0.22)	13.6 (16.4-10.5)	3.4 (5.8-2.3)	23% (33%-17%)

* For England and the Netherlands, a further distinction was made for cyclists injured in a crash with a motorized vehicle and cyclists injured in a crash without a motorized vehicle. For other countries, this distinction was not possible.

Table 6 shows the burden of injury information for men and women. For all six countries, the average burden per person is very similar for both genders. However the number of MAIS3+ casualties is higher for men than for women. As a consequence, men have a higher share in the total burden of injury in all six countries.

Table 6 Summary of information on burden of injury for men and women in six investigated countries.

Gender	% of total burden of injury Average (min, max)	Burden pp [YLD] Average (min, max)	Plifelong Average (min, max)
Men	72% (62% - 76%)	2.9 (2.4 – 3.3)	26% (18% - 33%)
Women	28% (24% - 38%)	2.8 (2.4 – 3.1)	31% (21% - 36%)

4. Discussion

To our knowledge, this is the first paper in which the burden of serious (MAIS3+) road traffic injuries is compared for several countries. This has been achieved by applying the same definition of serious road injuries and using the same method for calculating the burden of injury. The common methodology enables us to compare the results for different countries. The countries show some similarities as well as some differences that will be discussed in more detail below, together with differences between our results and results of previous research.

The average burden per casualty varies between 2.4 and 3.2 YLD for the five countries and one region included in our study. The YLD values reported in the current work are much lower than the 12 YLD reported by Holtslag et al (2008) in a study that was limited to patients from one Dutch hospital with severe trauma (ISS>15), and slightly higher than the 2 YLD reported by Weijermars et al (2016b) in a study including MAIS2+ road traffic injuries in the Netherlands. The difference probably mainly is due to a different study population.

The average lifelong burden per casualty experiencing lifelong consequences varies between 8.7 and 11.5 YLD. This is slightly higher than the 8.4 YLD per casualty for MAIS2+ casualties reported by Weijermars et al. (2016a), and clearly lower than the 14.7 YLD per casualty reported by Tainio et al (2014) for road traffic injuries in Sweden. Please note that Tainio et al. applied the GBD method, which distinguishes fewer injury categories than the INTEGRIS method. Differences in the average burden per casualty between the countries are mainly due to differences in the types of injuries encountered and the age distribution of the casualties.

A result that is similar for all countries (including the Rhône region) is that about 90% of the burden of injury is due to lifelong consequences. These percentages are also comparable to the percentages found by Weijermars et al (2016a) and Dhondt et al. (2013). Tainio et al. (2014) found an even higher percentage (96%). Moreover, according to the study of Tainio et al. (2014), only 2% of the injuries result in lifelong consequences, whereas percentages in our study vary between 19% and 33%. Dhondt et al. (2013) and Weijermars et al. (2016a) report percentages that are more similar to our results, respectively 15% and 20%. Differences in percentage of casualties that encounter lifelong consequences between countries are mainly due to differences in the types of injuries encountered.

Although the distribution of the injuries and the burden of injuries over the EUROCOST injury groups differ between the countries, EUROCOST injury group 2 – skull-brain injury other than concussion, open head wounds and facial injuries- has a high share in the total burden of injury in all five countries and the Rhône region. Also spinal cord injuries and injuries to the lower extremities have a high share in the total burden of injury in all countries. The types of injuries to the lower extremities however differ between the countries. Also previous studies (Lapostolle et al., 2009; Tainio et al., 2014) concluded that head injuries, spinal cord injuries and injuries to the lower extremities have a high share in the burden of injury.

Regarding the burden of injury for different transport modes, results appear to vary between the countries. Therefore, it is not surprising that other studies report different results; Tainio et al (2014) report a high burden per casualty for motorized two-wheelers and Weijermars et al (2016a) report a high burden per casualty for pedestrians and motorized two-wheelers. Differences between countries are probably mainly due to differences in injuries encountered and differences in age distribution.

Information about the burden of injury of road traffic casualties is very useful for policy makers. It enables policy makers to compare the burden of road traffic injuries with the burden of other types of injuries and diseases, and the burden of non-fatal injuries with the burden of fatal injuries. More detailed information on the burden of injury of MAIS3+ road traffic casualties, as presented in this paper, can support policy makers when selecting the most appropriate countermeasures. This research for example shows that countermeasures aimed at reducing or limiting the consequences of skull and brain injuries, spinal cord injuries and injuries to lower extremities would be very useful. It is out of the scope of this paper to discuss which specific countermeasures could be taken. Information per transport mode and burden of injury body profiles can further assist individual countries in developing road safety policy aimed at reducing health impacts of MAIS3+ casualties. In this respect, one should be aware that this paper focusses on MAIS3+ injuries. As Polinder et al. (2015) have shown, MAIS3+ injuries are responsible for only a part of the total burden of all non-fatal road traffic injuries, i.e. about one third in the Netherlands.

Because of the differences between the countries, one should be careful when applying the results from these countries to calculate the burden of serious road traffic injuries in another country. Differences between the countries are due to differences in age distribution and in distribution of injuries over the 39 EUROCOST injury groups. The distribution of the casualties over the 39 EUROCOST injury groups are in turn related to the distribution of casualties over transport modes and possibly also to differences in accident characteristics. These differences will be further analysed within the SafetyCube project.

The INTEGRIS method is a quite sophisticated method for the calculation of the burden of non-fatal injuries. It has been applied to road traffic crashes before (Dhondt et al., 2013; Polinder et al., 2015; Weijermars et al., 2016a). However, its application to serious road injuries has a number of limitations. The main limitation is that Haagsma et al derived the disability weights on the basis of a sample of hospital admitted injury patients that included casualties with MAIS 1 or 2 injuries as well as non-traffic casualties. It is quite possible that disability weights and proportions of casualties with lifelong disabilities associated with the various EUROCOST injury groups would have been different (higher presumably), should they have been based exclusively on MAIS3+ casualties. Besides, disability weights and proportions of casualties with lifelong disabilities associated with various EUROCOST injury groups might also differ between road traffic casualties and other groups of injuries. Concerning the analysis of differences between countries, we should note that the selection of MAIS3+ casualties slightly differs between the countries, due to differences in available data. These differences could have influenced the results to some extent. The AIS version for example differs between countries and the severity level of some orthopaedic injuries have been lowered from AIS1990 to AIS2005. This could result in differences between the distribution of burden of injury over EUROCOST injury groups and could therefore also (slightly) influence other results like the average burden per casualty.

5. Conclusion

This paper determines and compares the burden of MAIS3+ road traffic injuries for five EU countries and one region. Some of the results differ between countries, mainly due to differences in age distribution and in injuries sustained. The analyses presented in this paper are important for informing and support policy makers to improve road safety policy beyond what is known from considering road fatalities. From this new finding it would be advisable to invoke countermeasures focused at reducing skull and brain injuries, spinal cord injuries and injuries to the lower extremities, as these injuries are responsible for more than 90% of the total burden of injury of MAIS3+ casualties. The importance of countermeasures to mitigate these types of injuries may be overlooked if only road fatality data is considered.

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Appendix A Disability information for 39 EUROCOST injury groups

EUROCOST group	Disability Weights for acute phase	Proportion with lifelong consequences	Disability Weights lifelong consequences
1 concussion	0,100	21%	0,151
2 other skull-brain injury	0,241	23%	0,323
3 open wound head	0,209	-	-
4 eye injury	0,256	0	-
5 fracture facial bones	0,072	-	-
6 open wound face	0,210	-	-
7 fracture/dislocation/strain/sprain vertebrae/spine	0,258	0	-
8 whiplash, neck sprain, distortion cervical spine	ND	ND	ND
9 spinal cord injury	0,676	100%	ND
10 internal organ injury	0,103	-	-
11 fracture rib/sternum	0,225	-	-
12 fracture clavicle/scapula	0,222	9%	0,121
13 fracture upper arm	0,230	10%	0,147
14 fracture elbow/forearm	0,145	8%	0,074
15 fracture wrist	0,143	18%	0,215
16 fracture hand/fingers	0,067	0	0,022
17 dislocation/sprain/strain shoulder/elbow	0,169	18%	0,136
18 dislocation/sprain/strain wrist/hand/fingers	0,029	0	-
19 injury of upper extremity nerves	ND	0	-
20 complex soft tissue injury upper extremities	0,190	15%	0,166
21 fracture pelvis	0,247	29%	0,182
22 fracture hip	0,423	52%	0,172
23 fracture femur shaft	0,280	35%	0,169
24 fracture knee/lower leg	0,289	34%	0,275
25 fracture ankle	0,203	35%	0,248
26 fracture foot/toes	0,174	39%	0,259
27 dislocation/sprain/strain knee	0,159	0	0,103
28 dislocation/sprain/strain ankle/foot	0,151	26%	0,125
29 dislocation/sprain/strain hip	0,309	30%	0,128
30 injury of lower extremity nerves	ND	0	-
31 complex soft tissue injury lower extremities	0,150	13%	0,080
32 superficial injury, including contusions	0,150	-	-
33 open wounds	0,093	-	-
34 burns	0,191	0	-
35 poisoning	0,245	0	-
37 foreign body	0,060	-	-
38 no injury after examination	-	-	-
39 other injury	0,212	-	-

Source: Haagsma et al., 2012

Appendix B Distribution of MAIS3+ casualties and YLD over EUROCOST injury groups

Distribution of MAIS3+ casualties

	Au	Be	Eng	NL	Rhône	Spain
1 concussion	0%	0%	0%	0%	0%	2%
2 other skull-brain injury	34%	30%	27%	34%	19%	27%
3 open wound head	0%	0%	0%	0%	0%	0%
4 eye injury	0%	0%	0%	0%	0%	0%
5 fracture facial bones	0%	0%	0%	0%	0%	1%
6 open wound face	0%	0%	0%	0%	0%	0%
7 fracture/dislocation/strain/sprain vertebrae/spine	5%	0%	1%	0%	2%	2%
8 whiplash, neck sprain, distortion cervical spine	0%	0%	0%	0%	0%	0%
9 spinal cord injury	2%	2%	2%	5%	1%	2%
10 internal organ injury	10%	18%	12%	9%	16%	6%
11 fracture rib/sternum	0%	3%	0%	0%	1%	21%
12 fracture clavicle/scapula	0%	7%	4%	3%	0%	1%
13 fracture upper arm	0%	0%	0%	0%	5%	1%
14 fracture elbow/forearm	0%	2%	2%	1%	16%	5%
15 fracture wrist	0%	1%	1%	0%	0%	2%
16 fracture hand/fingers	0%	0%	0%	0%	0%	0%
17 dislocation/sprain/strain shoulder/elbow	0%	0%	0%	0%	0%	0%
18 dislocation/sprain/strain wrist/hand/fingers	0%	0%	0%	0%	0%	0%
19 injury of upper extremity nerves	0%	0%	0%	0%	0%	0%
20 complex soft tissue injury upper extremities	0%	0%	0%	0%	0%	1%
21 fracture pelvis	0%	5%	4%	9%	5%	1%
22 fracture hip	18%	14%	0%	31%	5%	8%
23 fracture femur shaft	21%	6%	11%	5%	10%	4%
24 fracture knee/lower leg	5%	9%	11%	3%	17%	6%
25 fracture ankle	0%	1%	2%	0%	0%	1%
26 fracture foot/toes	0%	0%	0%	0%	0%	1%
27 dislocation/sprain/strain knee	0%	0%	0%	0%	0%	0%
28 dislocation/sprain/strain ankle/foot	0%	0%	0%	0%	0%	0%
29 dislocation/sprain/strain hip	0%	0%	0%	0%	0%	0%
30 injury of lower extremity nerves	0%	0%	0%	0%	0%	0%
31 complex soft tissue injury lower extremities	1%	1%	2%	0%	2%	0%
32 superficial injury, including contusions	0%	0%	0%	0%	0%	3%
33 open wounds	0%	0%	0%	0%	0%	2%
34 burns	0%	0%	0%	0%	0%	0%
35 poisoning	0%	0%	0%	0%	0%	0%
37 foreign body	0%	0%	0%	0%	0%	0%
38 no injury after examination	0%	0%	0%	0%	0%	0%
39 other injury	4%	0%	0%	0%	0%	0%
	100%	100%	100%	100%	100%	100%

Distribution of YLD

	Au	Be	Eng	NL	Rhône	Spain
1 concussion	0%	0%	0%	0%	0%	1%
2 other skull-brain injury	**36%**	**32%**	**31%**	**31%**	**27%**	**35%**
3 open wound head	0%	0%	0%	0%	0%	0%
4 eye injury	0%	0%	0%	0%	0%	0%
5 fracture facial bones	0%	0%	0%	0%	0%	0%
6 open wound face	0%	0%	0%	0%	0%	0%
7 fracture/dislocation/strain/sprain vertebrae/spine	0%	0%	0%	0%	0%	0%
8 whiplash, neck sprain, distortion cervical spine	0%	0%	0%	0%	0%	0%
9 spinal cord injury	**16%**	**23%**	**17%**	**35%**	**13%**	**28%**
10 internal organ injury	0%	1%	0%	0%	1%	0%
11 fracture rib/sternum	0%	0%	0%	0%	0%	2%
12 fracture clavicle/scapula	0%	2%	1%	1%	0%	0%
13 fracture upper arm	0%	0%	0%	0%	2%	0%
14 fracture elbow/forearm	0%	0%	0%	0%	3%	1%
15 fracture wrist	0%	0%	1%	0%	0%	2%
16 fracture hand/fingers	0%	0%	0%	0%	0%	0%
17 dislocation/sprain/strain shoulder/elbow	0%	0%	0%	0%	0%	0%
18 dislocation/sprain/strain wrist/hand/fingers	0%	0%	0%	0%	0%	0%
19 injury of upper extremity nerves	0%	0%	0%	0%	0%	0%
20 complex soft tissue injury upper extremities	0%	0%	0%	0%	0%	0%
21 fracture pelvis	0%	4%	3%	5%	5%	1%
22 fracture hip	**17%**	**12%**	**15%**	**20%**	**6%**	**9%**
23 fracture femur shaft	**23%**	**7%**	**12%**	**4%**	**12%**	**5%**
24 fracture knee/lower leg	**7%**	**13%**	**16%**	**3%**	**31%**	**11%**
25 fracture ankle	0%	7%	3%	0%	0%	1%
26 fracture foot/toes	0%	0%	0%	0%	0%	2%
27 dislocation/sprain/strain knee	0%	0%	0%	0%	0%	0%
28 dislocation/sprain/strain ankle/foot	0%	0%	0%	0%	0%	0%
29 dislocation/sprain/strain hip	0%	0%	0%	0%	0%	0%
30 injury of lower extremity nerves	0%	0%	0%	0%	0%	0%
31 complex soft tissue injury lower extremities	0%	0%	0%	0%	0%	0%
32 superficial injury, including contusions	0%	0%	0%	0%	0%	0%
33 open wounds	0%	0%	0%	0%	0%	0%
34 burns	0%	0%	0%	0%	0%	0%
35 poisoning	0%	0%	0%	0%	0%	0%
37 foreign body	0%	0%	0%	0%	0%	0%
38 no injury after examination	0%	0%	0%	0%	0%	0%
39 other injury	0%	0%	0%	0%	0%	0%
	100%	100%	100%	100%	100%	100%