Trends and basic figures of pedestrian traffic fatalities in urban areas in the OECD countries

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Abstract

The objective of this paper is the creation of an overall picture on the basic figures and trends of pedestrian fatalities in urban areas in the OECD countries. Existing pedestrian traffic fatality data are presented and interpreted in terms of key factors of pedestrian safety. Moreover, the analysis aims to identify the main questions of pedestrian safety data needs, availability and quality in the OECD countries. In particular, pedestrian fatality data from 26 OECD countries was collected and analysed. The variables considered include person age and gender, month, area type (inside / outside urban area), road lighting conditions (daytime / night), year and month etc. The results show that, although pedestrian fatalities in the OECD countries present a constantly decreasing trend during the last years, the number and proportion of pedestrian fatalities in urban road accidents in several OECD countries and as a whole is still unacceptable, and illustrates the need for even greater efforts with respect to pedestrian safety. They also suggest that most pedestrian fatalities occur inside urban areas, during the winter and during nighttime, and they confirm that the children and the elderly are still at increased fatality risk as pedestrians. Such results can be useful at macroscopic level for monitoring overall trends and figures, as well as for setting priorities for policy making. Within this framework, a number of issues are discussed, which need to be kept in mind when analyzing international pedestrian safety data of OECD countries, namely the lack of common international definitions of pedestrians' accident and injuries, the pedestrians' injuries under-reporting and the lack of pedestrians' mobility / exposure data. These issues concern the safety data of all road users, but are even more critical for pedestrians. Finally, while international analyses allow each country to learn from others, the differences in culture, traffic laws, urban form and walking conditions mean that each country also needs to analyze its own situation in more detail.

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Introduction

Despite the fact that pedestrian road traffic casualties in the OECD countries presented a constantly decreasing trend during the last years, the number of pedestrians involved in road accidents in several countries and as a whole is still unacceptable and illustrates the need for even greater efforts with respect to pedestrian safety. Most importantly, it is observed that the peak or abnormal situations remain practically unchanged over this period, suggesting a persistence of the basic pedestrian risk factors (OECD, 2001; ERSO, 2008). In particular, in 2006 there were more than 78,000 fatalities in road traffic accidents in 23 OECD countries, out of which more than 11,000 were pedestrian fatalities, and out of which more than 7,500 occurred in urban areas.

The objective of this paper is the analysis of existing data issues on pedestrians' safety in urban areas, at national and international level. In particular, the analysis aims to identify the main questions of pedestrian safety data needs, availability and quality and to present pedestrian safety data for the creation an overall picture on the current potential for pedestrians' road safety analysis in urban areas in OECD countries. These issues are discussed in terms of data needs and potential for analyses for policy making. In particular, this paper focuses on macroscopic data, which are typically available in international databases. The distinction between macroscopic and microscopic (or in-depth) data implies not only different scales and objectives of analysis but also significantly different data availability and quality issues. Macroscopic data are useful and comparable data sources that may provide an overall picture of basic trends and figures related to pedestrian safety. However, the need for detailed analysis, allowing to identify specific factors and patterns of pedestrian accidents, can only be addressed through the exploitation of much more detailed information, which may only be available at national level.

The questions related to macroscopic pedestrian safety data are analyzed in the following sections. Existing pedestrian safety data are presented and interpreted in terms of key factors of pedestrian safety. In particular, data from the CARE database of the European Commission are initially used, together with related data from other OECD countries, collected by means of a questionnaire. The potential, advantages and limitations for exploiting existing data for decision making are discussed. Finally, particular emphasis is put on data quality issues during the analysis, so as to limit the consequences of incompatible data definitions and collection methods.

Macroscopic pedestrian safety data analysis in the OECD countries

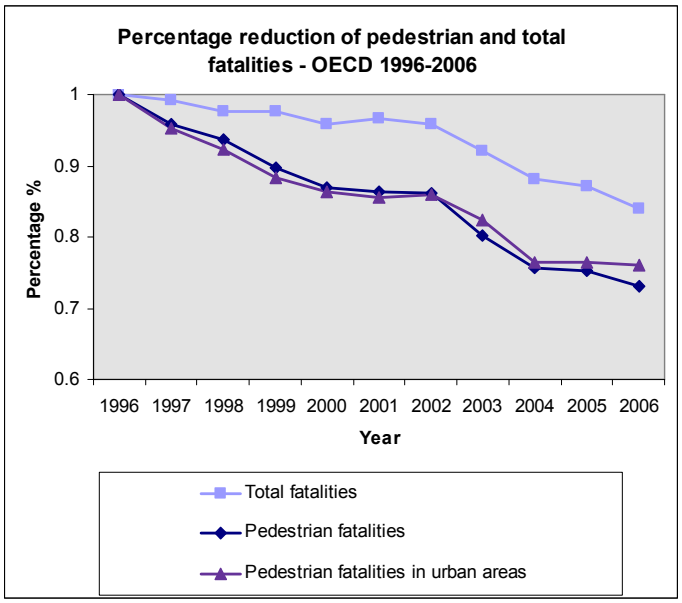
This section presents the basic road safety facts for pedestrians in OECD countries. The road safety data were extracted from the CARE database for year 2006 or for the last available year, for 20 EU countries, namely AT, BE, CZ, DK, EE, ES, FI, FR, GR, HU, IE (2003), IT, LU, LV, MT, NL, PL (2005), PT, SE, UK. Moreover, data for 6 more OECD countries, namely AU, CA, IL, JP, MX and USA, were collected by means of a questionnaire. The variables considered include person age and

gender, month, inside / outside urban area, road lighting conditions etc. Moreover, time series data for the period 1991-2006 were extracted for these countries countries. The respective population data were extracted from the Eurostat and OECD databases for the period 1991-2006 and the variables considered are person age and gender.

The analysis is limited to pedestrian fatalities inside urban areas. It is noted that, in all European countries urban areas are defined as "area inside urban area boundary signs (except GB, IE, NI), includes dual carriageways and national roads, can include motorways (except DK, DK, GR, IT)" (European Commission, 2006). Only in a couple of countries (DK, SE) it is defined upon the opinion of the police. In the Australian data, urban areas were defined on the basis of speed limits (i.e. roads zoned 80 km/h or lower).

Trends of pedestrian safety data

Figure 1 shows that pedestrian fatalities in the OECD countries present a more significant decrease than total fatalities during the last decade. However, during the last five years, the reduction of pedestrian fatalities inside urban areas is somewhat lower than the reduction of total pedestrian fatalities. It is noted that the peak shown in 2002 is due to an important increase of pedestrian fatalities in Italy on that specific year.



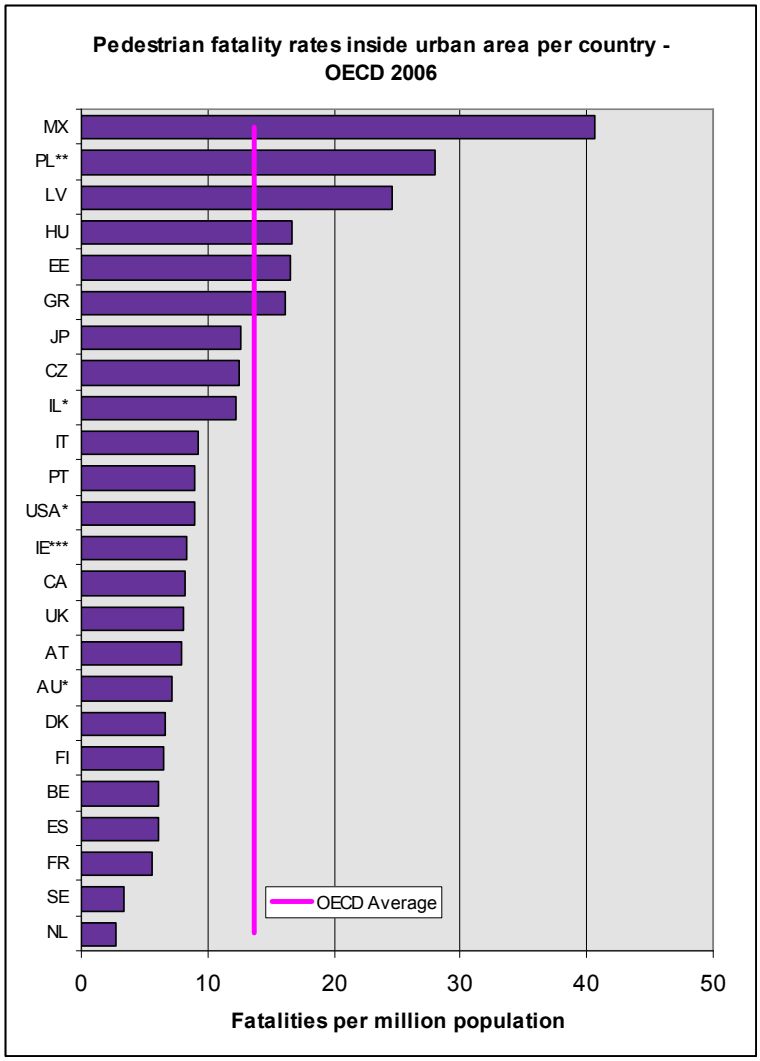
Source: CARE database (date of query: September 2009), OECD questionnaire
Countries: AT, AU, BE, CA, DK, ES, FI, FR, GR, IE (up to 2003), IL, IT, JP, NL, PT, SE, UK, USA.

Figure 1. Percentage reduction of pedestrian fatalities and total fatalities in the OECD countries, 1996-2006.

Country comparisons

The fatality rate (persons killed per million population) of pedestrians also presented a constantly decreasing trend in the last fifteen years in Europe, where the related risk was almost halved. The average pedestrian fatality risk in urban areas (Figure 2) in the examined OECD countries is equal to 13.7 pedestrians per million inhabitants. It is noted that population figures concern the total country population. The fatality rates range from 2 to 10 in northern and western European countries, USA, Canada and Australia, from 10 to 15 in southern European countries and Japan, and from around 12 to 30 in the EU New Member States. This unbalance within the EU countries as regards pedestrian safety may be explained as follows: as regards southern European countries, it may be attributed to increased exposure of pedestrians, as a result of favorable climate, whereas as regards the new Member States, it is more likely associated with increased exposure of

pedestrians due to low motorization levels (ETSC, 2006). The related pedestrian fatality risk in Mexico is by far the highest and reaches 40 pedestrian fatalities in urban areas per population.

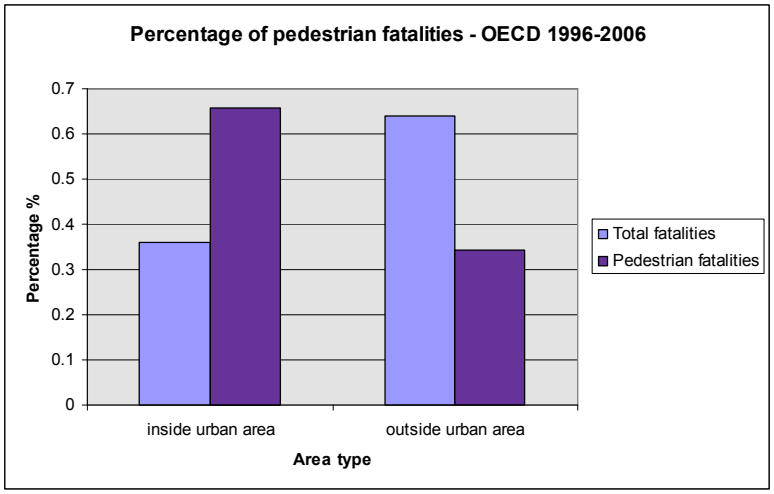


Source: CARE database / OECD database / Eurostat (date of queries: September 2009)
* Data for year 2008
** Data for year 2005
*** Data for year 2003

Figure 2. Pedestrian fatality rates (fatalities per million population) inside urban area per country, OECD - 2006

Effect of area type

It can be seen that (Figure 3), although most of all fatalities occur outside urban areas, the majority (around 70-80%) of reported pedestrian fatalities happened in urban areas. This is due to the fact that most of the population live in urban areas and also that those who live in urban areas, walk more than people living in rural areas.

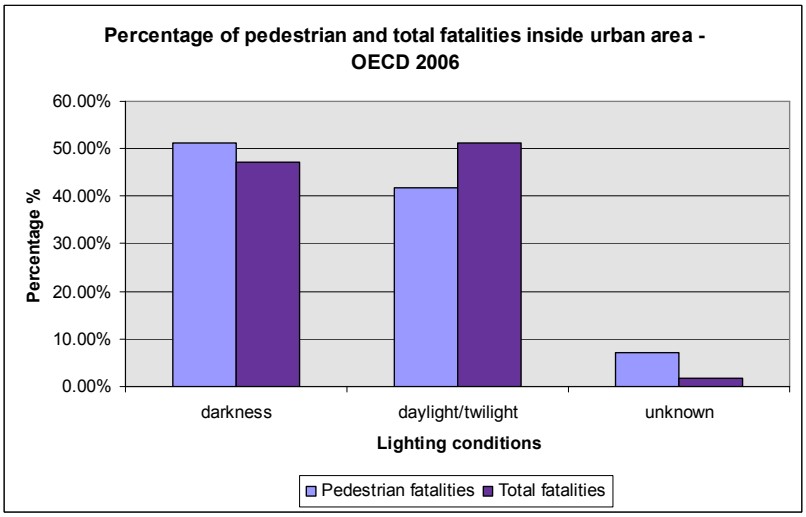


Source: CARE database (date of query: September 2009), OECD questionnaire
Countries: AT, AU, BE, CA, DK, ES, FI, FR, GR, IE (up to 2003), IL, IT, JP, NL, PT, SE, UK, USA.

Figure 3. Percentage of pedestrian fatalities and total fatalities per area type in the OECD countries, 1996-2006.

Effect of lighting conditions

As regards the effect of road lighting (Figure 4), although the majority of all fatalities inside urban area occur at daylight, the majority of pedestrian fatalities inside urban area occur at darkness, despite the reduced exposure of pedestrians during the night. The non-negligible proportion of unknown values for lighting conditions does not allow for conclusions to be drawn in this case, however, darkness appears to be a risk factor associated with pedestrian fatalities inside urban areas.

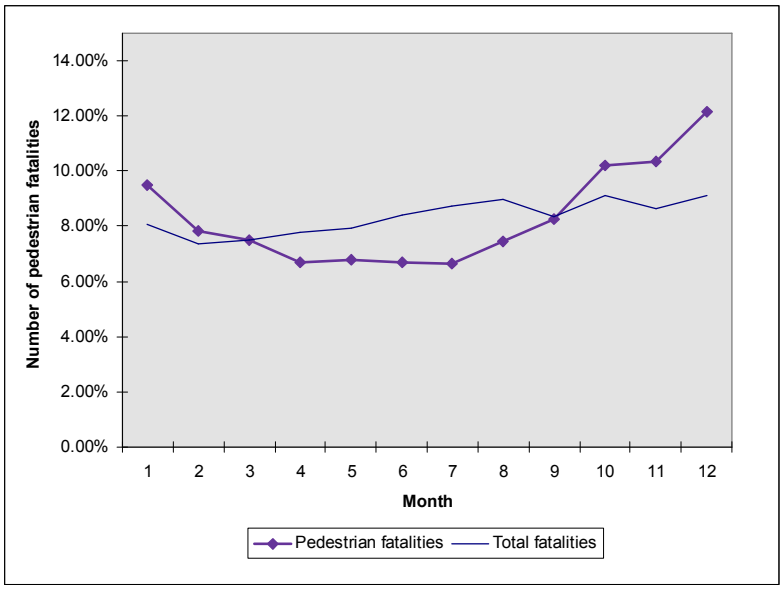


Source: CARE database (date of query: September 2009), OECD questionnaire
Countries: AT, BE,CA, CZ, DK, EE, ES, FI, FR, GR, HU, IE (2003), IL (2008), IT, LU (2005), LV, MT, NL, PT, PL (2005), SE, JP, AU (2008), USA (2008), UK.

Figure 4. Percentage of pedestrian and total fatalities inside urban area per lighting conditions, OECD - 2006

Seasonality

Another interesting pattern rises from the examination of the monthly variation of pedestrian fatalities in the OECD countries, shown in Figure 5. More specifically, while the total number of road accident fatalities inside urban areas peaks during the spring / summer period (April to August), the number of pedestrian fatalities inside urban areas peaks during the fall / winter period (October to January), despite the fact that pedestrians exposure is expected to decrease during that period. It is likely that poor lighting conditions and adverse weather conditions result in increased occurrence of pedestrian accidents inside urban areas during the winter.



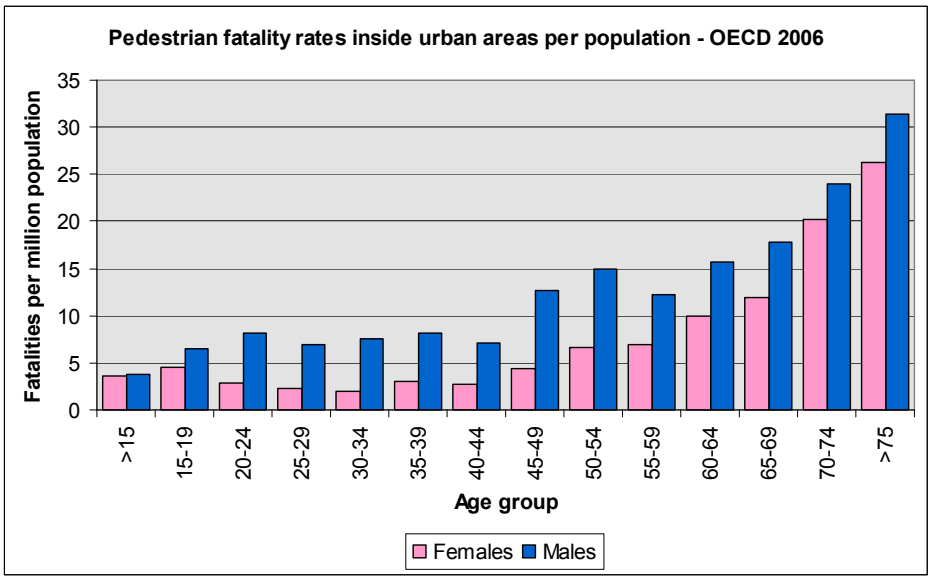
Source: CARE database (date of query: September 2009), OECD questionnaire
Countries: AT, BE,CA, CZ, DK, EE, ES, FI, FR, GR, HU, IE (2003), IL (2008), IT, LU (2005), LV, MT, NL, PT, PL (2005), SE, JP, AU (2008), USA (2008), UK.

Figure 5. Percentage of pedestrian and total fatalities inside urban area per month, OECD - 2006

Effect of age and gender

The effect of pedestrian age and gender on fatality rates of pedestrians inside urban areas present an interesting pattern (Figure 6). In general, male pedestrians have higher fatality rates than females. It is likely that this is a result of differences in behaviours of males compared to females (Yagil 2000). However, fatality rates become more balanced between males and females for elderly pedestrians (>70 years old), and are significantly increased compared to the other age groups.

A reason for the increased risk of elderly pedestrians could be the even more increased physical vulnerability, together with a lower level of motorization in this age group, the latter reflecting an exposure pattern (OECD, 2004).



Source: CARE database / Eurostat (date of queries: September 2009), OECD questionnaire
Countries: AT, BE, CZ, DK, EE, ES, FI, FR, GR, HU, IE (2003), IT, LV, NL, PT, PL (2005), SE, UK.

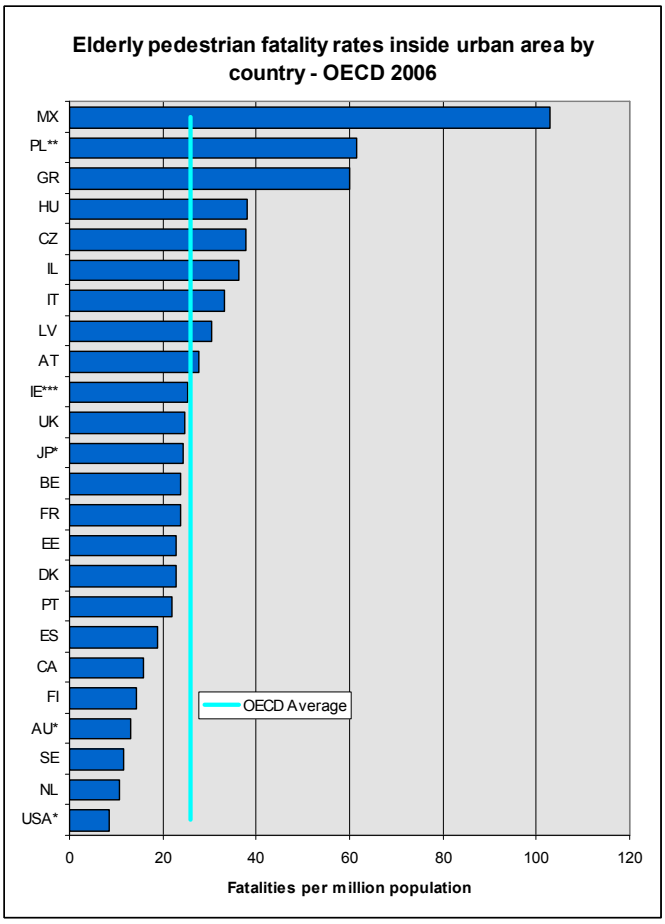
Figure 6. Pedestrian fatality rates (fatalities per million population) inside urban area per age and gender, OECD - 2006

Elderly pedestrians

Additional interesting information is obtained when examining the related fatality risks for vulnerable age groups, namely children and the elderly (Figure 7). The overall classification of countries does not change substantially as regards fatality rates of elderly pedestrians inside urban area (Figure 7, left panel). However, Greece, Austria and the UK present increased fatality rates for elderly pedestrians inside urban areas in relation to other countries, compared to their respective total rates. On average, 25 elderly pedestrian fatalities per population are observed in urban areas in the OECD countries.

Children

On average, 5 children pedestrians per million inhabitants were killed in road accidents inside urban areas in the examined OECD countries in 2006 (Figure 7, right panel). Finland, Austria and the UK present increased children pedestrian fatality rates, compared to their total fatality rates, whereas Japan and Mexico present reduced children pedestrian fatality rates, compared to their total fatality rates in urban areas. It is underlined that, due to the small sample of children pedestrian fatalities inside urban areas, the average number of fatalities was taken for the EU countries (i.e. for those for which the data was available) for the period 2003-2006. Nevertheless, the children pedestrian fatality rates should be considered with particular caution.



Source: CARE database / OECD database / Eurostat (date of queries: September 2009)
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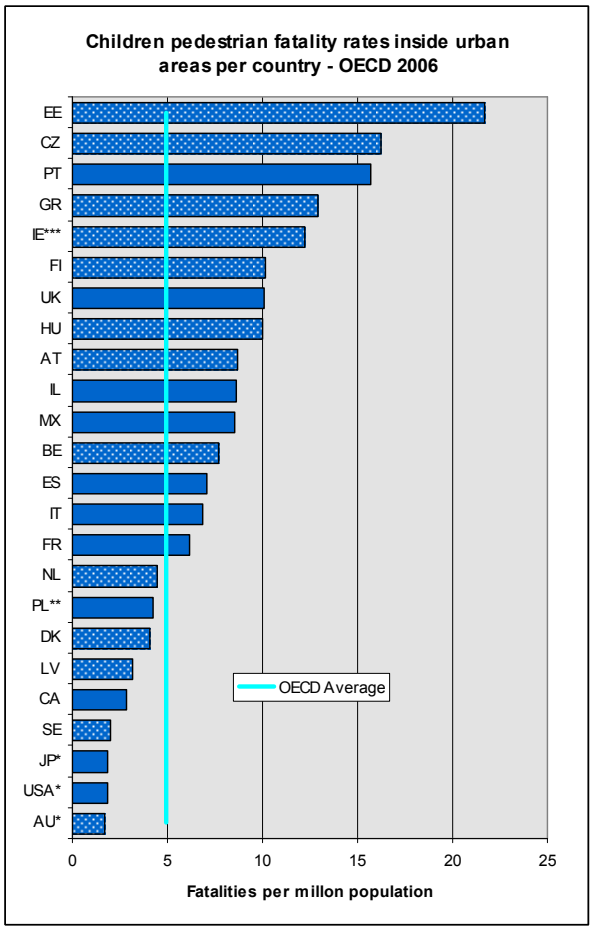

Source: CARE database / OECD database / Eurostat (date of queries: September 2009)
* Data for year 2008
** Data for year 2005
*** Data for year 2003
Notes: EU countries fatality data are 2003-2006 averages. Dotted bars indicate small sample of fatalities.

Figure 7. Elderly (left panel) and children (right panel) pedestrian fatality rates (fatalities per million population) inside urban area per country, OECD - 2006

These differences among counties in children and elderly pedestrians' accident involvement may be attributed to differences in exposure of these particular groups, partly affected by weather conditions, as well as by other factors such as the country's residential and traffic infrastructure and the typical national habits (e.g. adults accompanying children to school etc) (Oxley et al. 1997; Rosenbloom et al. 2008).

Macroscopic pedestrian safety data issues

Road safety data, including pedestrian safety data, are gathered, processed and stored in international data files, such as the IRTAD database of the OECD/ITF (www.irtad.net), the CARE road accident database of the European Commission (http://ec.europa.eu/transport/road_safety/specialist/statistics/care_reports_graphics/index_en.htm), the Eurostat databases, the data files of the European Conference of Ministers of Transport (ECMT) and the UN / ECE. The data included in these databases are based on national road accident statistics, which are mostly based on information collected by the Police. However, only the CARE database includes disaggregate information, whereas the other databases include aggregate data.

These data files are useful and accessible data sources, as a result of several decades of important data collection efforts. However, they may have different objectives; they may collect different data in different forms and structure, and they are maintained by organizations with different scopes and policies (Yannis et al., 2008). Moreover, the availability and quality of the data may vary as well, mainly due to different national definitions of variables and values.

Definitions and data comparability

In some databases (e.g. IRTAD, CARE), appropriate data transformation rules have been developed in order to obtain comparable information for a number of basic variables and values. The CARE database currently includes 17 harmonized variables, concerning person, vehicle, road and accident characteristics (European Commission, 2006).

The adoption of a common international definition of road accident fatality, as a fatality that occurred within 30 days from the accident, has significantly contributed to the international comparability of fatality data. However, such common definitions have not yet been proposed for injury data, although significant efforts are made. It is therefore strongly recommended that international comparisons are limited to fatality data.

Especially as regards pedestrian safety data, additional questions may rise from the lack of common international definition of pedestrians. In the CARE database, a common definition for pedestrians is available, it is though indicated that this definition is not fully applicable in all countries. More specifically, the Glossary of the CARE database (European Commission, 2006) mentions the following definition, where it is obvious that different definitions of pedestrian are used in different European countries:

"Definition: Person on foot. Person pushing or holding bicycle (except DK). Person pushing a pram or pushchair. Person leading or herding an animal (except AT, DK). Person riding a toy cycle on the footway (except AT). Person on roller skates, skateboard or skis (except AT). Does not include person in the act of boarding or alighting from a vehicle (except DK, ES)".

Furthermore, the definition of a pedestrian road accident is not harmonized at international level. Most databases include pedestrian road accidents in which pedestrians were injured during an interaction with a motorized or non-motorized vehicle. Consequently, injuries resulting from falls (e.g. on the road surface, on metro stairways, inside public transport etc.) are not recorded by the Police and generally not included in the national or international databases. Another inconsistency rises from the fact that some countries do not include in their road accident records uninjured pedestrians (i.e. pedestrians involved in a road accident but not injured).

Injury under-reporting

Although injured pedestrians are included in the data, the lack of a common definition of serious and slight injuries does not allow for conclusions to be drawn. In recent studies (Broughton et al. 2007; Amoros et al.2006), it is proposed that injury severity should be assessed on the basis of medical information, such as the MAIS (Maximum Abbreviated Injury Scale) and the length of stay at the hospital, which can only be obtained through hospital records. However, this data is seldom available or accessible, even at national level.

Within this context, the European Injury Database (IDB), hosted by the European Commission includes accident and injury data from selected emergency departments of Member State hospitals, providing data such as routine causes of death statistics, hospital discharge registers and data sources specific to injury areas, including road accidents and accidents at work. The IDB is the only data source in the EU that contains standardised cross-national medical data; however it

is focused on home and leisure accidents in Europe, most likely not including a considerable percentage of traffic accidents.

Such records are also often used for the estimation of the degree of injury under-reporting, i.e. the estimation of the actual number of casualties of a given level of severity, in relation to the respective number of casualties recorded by the Police. Nevertheless, under-reporting can be fully addressed only once standardized definitions are applied and medical data are exploited. Given the additional particular issues related to pedestrian injury data, the estimation of under-reporting of pedestrian accidents and injuries is expected to be even more complicated.

Mobility and risk exposure data

A final issue that needs to be kept in mind when examining international pedestrian safety data is the lack of respective mobility / exposure data, which would allow for risk estimates. This question concern all types of road users, but it becomes even more critical as far as pedestrians are concerned, given that in this case no other reliable approximation of the amount of risk exposure is available than the population. For instance, vehicle- and passenger-kilometres of travel or vehicle fleet are partly available at international level and may be used as measures of exposure for vehicle occupants. On the contrary, no such data is available for pedestrians. Certainly, several countries perform travel / mobility surveys, in which the number of pedestrian trips performed and the time spent in traffic as pedestrian can be calculated at national level. However, these results are not available in international databases, and important effort would be required in order to achieve comparability of this data, because the features of the surveys (frequency, representativity, sample size, survey design etc.) may vary significantly across countries (Yannis et al. 2008). It is equally important to better align these surveys to road safety analysis needs, given that they mostly have other purposes than to provide exposure data for safety analyses.

Summarizing, an important amount of reliable information on pedestrian safety is available in international databases, as a result of considerable efforts made in the last decades. Particularly the CARE database of the European Commission and the IRTAD database of the OECD/ITF include pedestrian accident and casualty data for several countries and years, which can be analyzed in relation to a number of harmonized variables.

However, several issues need to be addressed as regards pedestrian safety data, namely the standardization of definitions (pedestrian, pedestrian road accident, pedestrian injury, serious or slight etc.), the estimation of pedestrian injury under-reporting through the exploitation of medical data and the collection and harmonization of pedestrian risk exposure data (mobility etc.). These issues concern the safety data of all road users, but are even more critical for pedestrians and thus need to be kept in mind when analyzing international pedestrian safety data.

Synthesis and recommendations

In this paper, pedestrian safety data issues were discussed and existing pedestrian data were analyzed, in order to highlight the priorities in the improvement of existing data, on the one hand, and to demonstrate the current potential for analysis on the other hand.

As regards macroscopic pedestrian safety data, these are gathered and stored by several international organisations; they are processed so that they can be comparable across different countries, by applying common definitions and collection procedures on the national data for a relatively limited number of basic variables. Nevertheless, issues such as pedestrian injury definitions and under-reporting remain to be adequately addressed in the international databases. The use of hospital data may be quite promising towards this objective. Moreover, the general lack

of pedestrian mobility / exposure data at the same level of comparability does not allow for full exploitation of international pedestrian safety data.

The results of the analysis presented in this paper highlight the current potential for pedestrian safety analyses at international level, through the exploitation of existing harmonized data stored in international databases (CARE, Eurostat etc.). Nevertheless, this fact-sheet type of analysis can not (and is not intended to) provide insight on the understanding of factors, mechanisms and interactions within the system, resulting in pedestrian accidents in urban areas. For this reason, more detailed analyses are required, often on a case-specific basis, allowing to assess the role of the urban environment, the drivers and the pedestrians behaviour in the creation of high risk situations for pedestrians (Yannis et al. 2007). The data required for this type of analysis may only be available at national level.

The macroscopic pedestrian safety data are required and useful for monitoring overall trends and figures, as well as for setting priorities for policy making. On the other hand, national road accident databases include a richness of information on pedestrian road traffic accidents, including person, vehicle, roadway and accident characteristics, which are though of limited comparability between countries. Therefore, the analyses carried out at national level may be much more disaggregate and explanatory. The use of exposure data, when available, is also more common in national analyses.

On the basis of the above, several recommendations can be outlined with respect to macroscopic pedestrian safety data. It is important to pursue the harmonization of more variables related to pedestrian accidents in the national databases, according to standard definitions, as well as the harmonization of pedestrian accident and injury definitions (what is a pedestrian, a pedestrian road accident etc.). Moreover, the use of medical data for cross-checking pedestrian injury severity in relation to a common definition may contribute towards the estimation of the degree of under-reporting of pedestrian injuries.

While international analyses allow each country to learn from others, the differences in culture, traffic laws, urban form and walking conditions mean that each country needs to analyze its own situation in more detail.

References

Amoros, E., Martin, J.L., Laumon, B., 2006. Under-reporting of road crash casualties in France. Accident Analysis and Prevention 38, 627-635.

Broughton J.; Amoros E.; Bos N.; Evgenikos P.; Holló P.; Pérez C.; Tecl J., 2007. Estimating the real number of road accident casualties. Deliverable 1.15 - Final Report on Task 1.5 of the SafetyNet Integrated Project. TRL, Crowthorne. Available on-line at: http://www.erso.eu/safetynet/fixed/WP1/D1.15_Estimation_real_number_of_road_accident_casualties_final%20report_3.pdf

ERSO - The European Road Safety Observatory (2008). Traffic Safety Basic Facts - Pedestrians. Available on-line at: http://www.erso.eu/safetynet/fixed/WP1/2008/BFS2008_SN-KfV-1-3-Pedestrians.pdf

ETSC (2006). Road accident data in the enlarged European Union: Learning from each other. ETSC, Brussels.

European Commission (2006). CARE database Glosary. Brussels, August 2006. Available on-line at: http://ec.europa.eu/transport/roadsafety_library/care/doc/care_glossary.pdf

OECD (2001). Safety of vulnerable road users. OECD, Paris, France.

OECD (2004). Keeping children safe in traffic. OECD, Paris, France.

Oxley, J., Fildes, B., Ihsen, E., Charlton, J., and Days, R. (1997). Differences in traffic judgements between young and old adult pedestrians. Accident Analysis and Prevention 29 (6), pp. 839-847.

Rosenbloom T., Ben-Eliyahu A., Nemrodov D. (2008). Children's crossing behavior with an accompanying adult. Safety Science 46, pp. 1248-1254.

Yagil D. (2000). Beliefs, motives and situational factors related to pedestrians self-reported behavior at signal-controlled crossings. Transportation Research Part F 3, pp. 1-13.

Yannis G., Golias J., Papadimitriou E. (2007), Modelling crossing behaviour and accident risk of pedestrians. Journal of Transportation Engineering 133 (11), 634 - 644.

Yannis G., Papadimitriou E., Lejeune P., Bijleveld F., Cardoso J.L (2008). Risk exposure data availability, collection methodologies and use in the EU. 2nd European Road Transport Research Arena - TRA 2008, Ljubljana, Slovenia, 21-25 April 2008.