Methods and examples of road accident data analysis

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1. Aim of data analysis

One of the basic aims of data analysis is to identify the main problems in the field of road safety. The efficiency of accident prevention depends significantly on the reliability of the collected and estimated data and the appropriateness of the used methods.

2. Definition of risk

Different risk categories are used in the field of road safety analysis, for example: accident risk, injury risk, fatality risk, etc.

2.1. Theoretical definition of risk

The risk (or probability) of an accident can be calculated in the following way:

$$\text{accident risk} = \frac{\text{number of accidents}}{\text{unit of exposure}}$$

Exposure denotes the number of trials in which one of the possible outcomes is an accident.

2. Definition of risk /2

The number of trials cannot be easily counted in a meaningful way, the same way we can count the number of times a dice is thrown, the number of tosses of a coin etc.

Therefore, we have to find an estimation (approach) of the number of trials.

These variables are called "exposure".

2. Definition of risk /3

The best theoretical estimate and the commonly used unit of exposure is the number of vehicle-kilometres. But this number is rarely based on reliably systematic traffic counts. In most cases this number is only estimated, even if by traffic experts. The method of estimation is different by countries, which can cause serious problems during the comparison of results.

2.2. Practical definition of risk

In the professional road safety practice, different rates are estimated in order to approximate the probability (risk) of accidents.

3. The most important rates in road accident analysis

The different rates are appropriate for specific reasons. For the international comparison of road safety, for example, the fatality rate and the mortality rate are used. According to Elvik, more commonly used terms in the international literature are traffic risk instead of fatality risk, and health risk or personal risk instead of mortality rate. In these cases, the nominator is always the number of people killed, because the definition (30-day-definition) is the same in almost every country. If not, correction factors can be used in order to calculate the data according to the common definition. The denominator is the number of vehicle kilometres, or the number of vehicles for the fatality rate, and the number of inhabitants for the mortality rate.

3. The most important rates in road accident analysis /2

International comparisons are most suitable if they are based on several rates at the same time [1].

It can be misleading, even in EU analyses, if only the mortality rate is used. This rate in itself is not suitable for this aim, because its value can be low not only in the case of high-level road safety, but in the case of low motorization level as well [2].

[1] Trinca, G,. Johnston, I., Campbell, B., Haight, F., Knight, P., Mackay, M., McLean, J. & Petrucelli, E. (1988). Reducing traffic injury - a global challenge. Royal Australasian College of Surgeons, Sydney.

[2] Holló, P.: Relationship between motorisation and fatality rates based on IRTAD data. International Seminar on Road Traffic and Accident Data Needs for the New Century, Vienna, September 2000. Proceedings. (CD-ROM)
Kuratorium für Verkehrssicherheit, Wien, 2000.

3. The most important rates in road accident analysis /3

The accident rate (number of personal injury accidents related to the number of vehicle-kilometres) and the accident density (number of personal injury accidents related to the length of a road section) are used mainly in the field of black spot identification and analysis, and for the comparison of accident risk on different road categories.

4. Why do we need risk figures?

The absolute numbers of accidents or casualties themselves do not give any information about the changes in risk. For example, it is not always true that the increasing accident numbers express the deterioration and the decreasing ones the improvement of the road safety situation.

4. Why do we need risk figures? /2

The relationship between traffic volume and accidents can be expressed as follows [3].

$$\text{Number of accidents} = a \cdot Q^{b}$$

Where: Q = measure of traffic volume

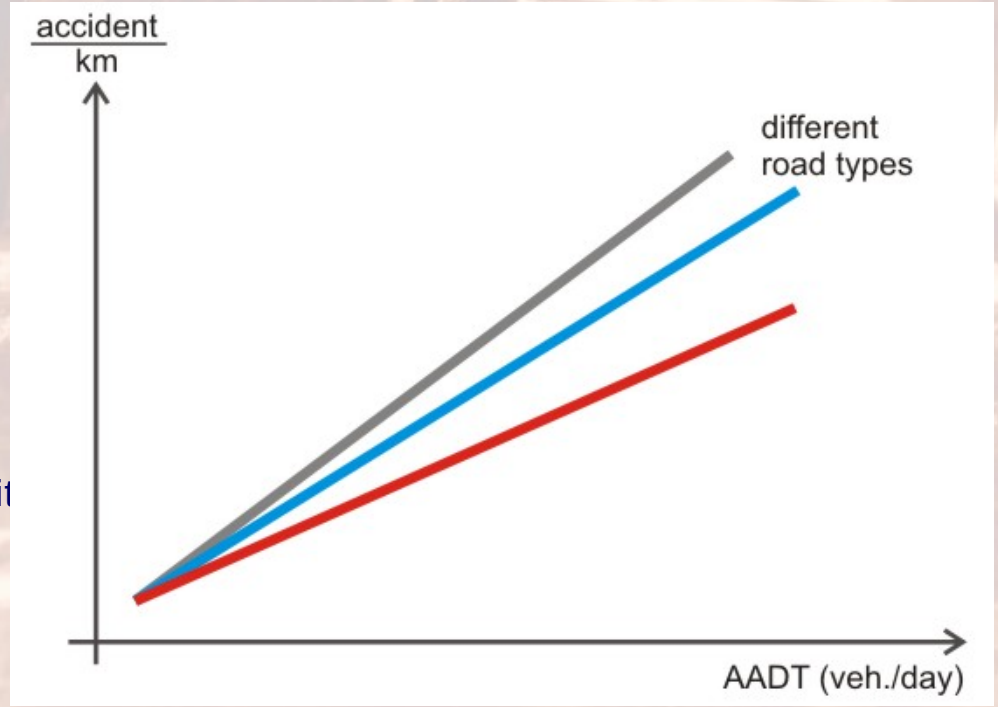
a, b = constants

If b=1, 1% increase in traffic volume is associated with an 1% increase in the number of accidents.

[3] Elvik and Vaa, 2004, Handbook of Road Safety Measures

4. Why do we need risk figures? /3

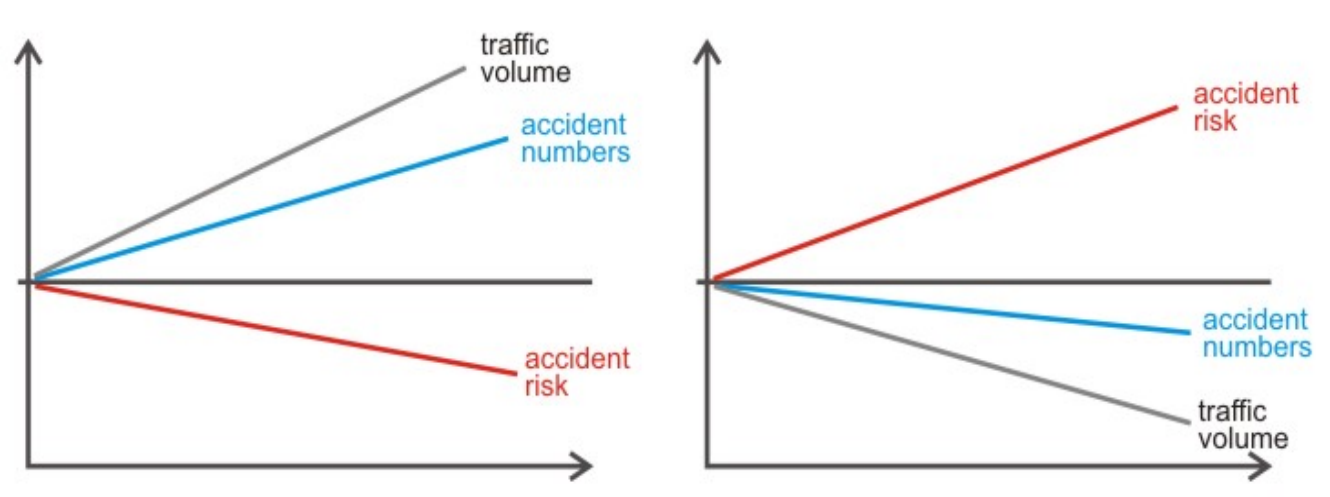
For injury accidents b=0,911 (Fridstrøm 1999), which means that there is a nearly linear relationship between the frequency of accidents and the traffic volume [4], at least within the category of the usual traffic volumes. Based on this relationship it can be said that increasing traffic volumes are basically connected with increasing accident numbers and vice versa.



[4] Knoflacher, H.,: Kern, U.:
Zusammenhang zwischen stündlicher Verkehrsbelastung und Unfallhäufigkeit
Kleine Fachbuchreihe, Band 14,
Kuratorium für Verkehrssicherheit,
Wien, 1979.

4. Why do we need risk figures? /4

Therefore, increasing accident numbers can express decreasing accident risk, if the traffic volume has increased to a higher amount than the number of the accidents. Of course, decreasing accident numbers can mean increasing accident risk as well, if the traffic volume has decreased to a higher amount than the accident numbers. In other words: the change in absolute numbers can be misleading.



5. Advantages and disadvantages of the different rates and exposure data

The reliability and availability of the different exposure data (rates) show a great variety.

The three most widely used rates in the professional practice are as follows:

Fatality rate or traffic risk (killed/10^8 vehicle-kilometres)

Advantages:

- The best indicator from the theoretical point of view [5]

Disadvantages:

- In most countries only the estimated number of vehicle-kilometres is available, if any
- The methods of estimation are different in the individual countries

[5] Koornstra, M.I.: FERSI mission paper on road safety research, first draft version (Chapter 1: Road Safety in Europe), Leidschendam, 15 April 1996.

5. Advantages and disadvantages of the different rates and exposure data /2

Fatality rate or traffic risk (killed/10^4 vehicles)

Advantages:

- The "second best" indicator of the fatality risk [5] [2]

Disadvantages:

- Differences and problems in the registration of the vehicles
- Different composition of the vehicle fleet can cause distortion in the estimation and comparison of the fatality rate. (For example, in the South-European countries the rate of motorised two-wheeled vehicles is significantly higher than in the Central- or Western-European ones. It can be misleading, because the fatality risk implied by motorcycle or moped riding is much higher than the one implied by driving a car [6]).

[6] Transport Safety Performance in the EU, a statistical overview, ETSC, 2003, ISBN: 90-76024-154 (www.etsc.be)

5. Advantages and disadvantages of the different rates and exposure data /3

Mortality rate or health/personal risk
(killed/10^6 population)

Advantages:

- Both the nominator and the denominator are reliable and in most cases available

Disadvantages:

- This indicator can be used mainly for the comparison of the consequences of road accidents and other causes of deaths (illnesses, epidemics, etc.)
- It does not depend significantly on the level of motorization, therefore can have a low value not only in countries with good road safety records, but with low motorization level, as well.

6. International comparison of road safety

Since reliable vehicle-kilometre data are available in some countries only, the usage of the following two indicators is proposed:

fatality rate or traffic risk (killed/10^4 vehicles)

mortality rate or health/personal risk (killed/10^6 population)

If only one of these indicators is used, the ranking orders of the individual countries are entirely different [2].

6. International comparison of road safety /2

When mortality figures are applied, the countries with low levels of motorization achieve a more favourable position, while it is disadvantageous to those with high levels of motorization. Nevertheless, these drawbacks are eliminated by fatality rates, but neither can be considered as perfect from all aspects.

The best compromise is the application of both indicators at the same time according to the model elaborated by Trinca et al [1]. (Figure 1).

6. International comparison of road safety /3

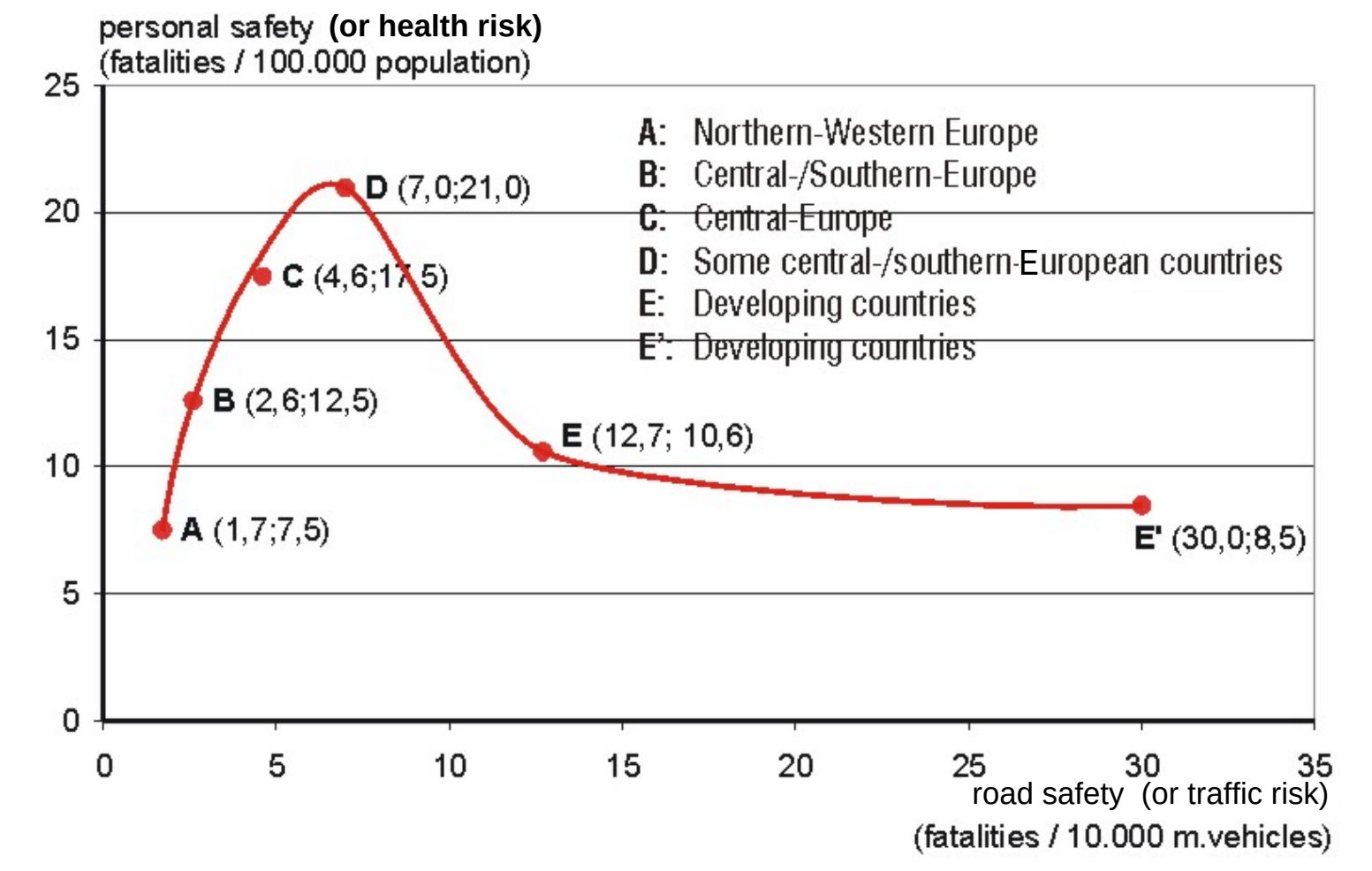


Figure 1. The relationship between personal and road safety.

6. International comparison of road safety /4

This model takes the development of the motorization into account. The individual countries - according to their development in motorization - are "moving" along the theoretical curve (of course, not automatically, the "movement" is the result of consistent road safety activities).

Figure 2 shows one part of this theoretical curve, based on IRTAD data of 2003 [7].

6. International comparison of road safety /5

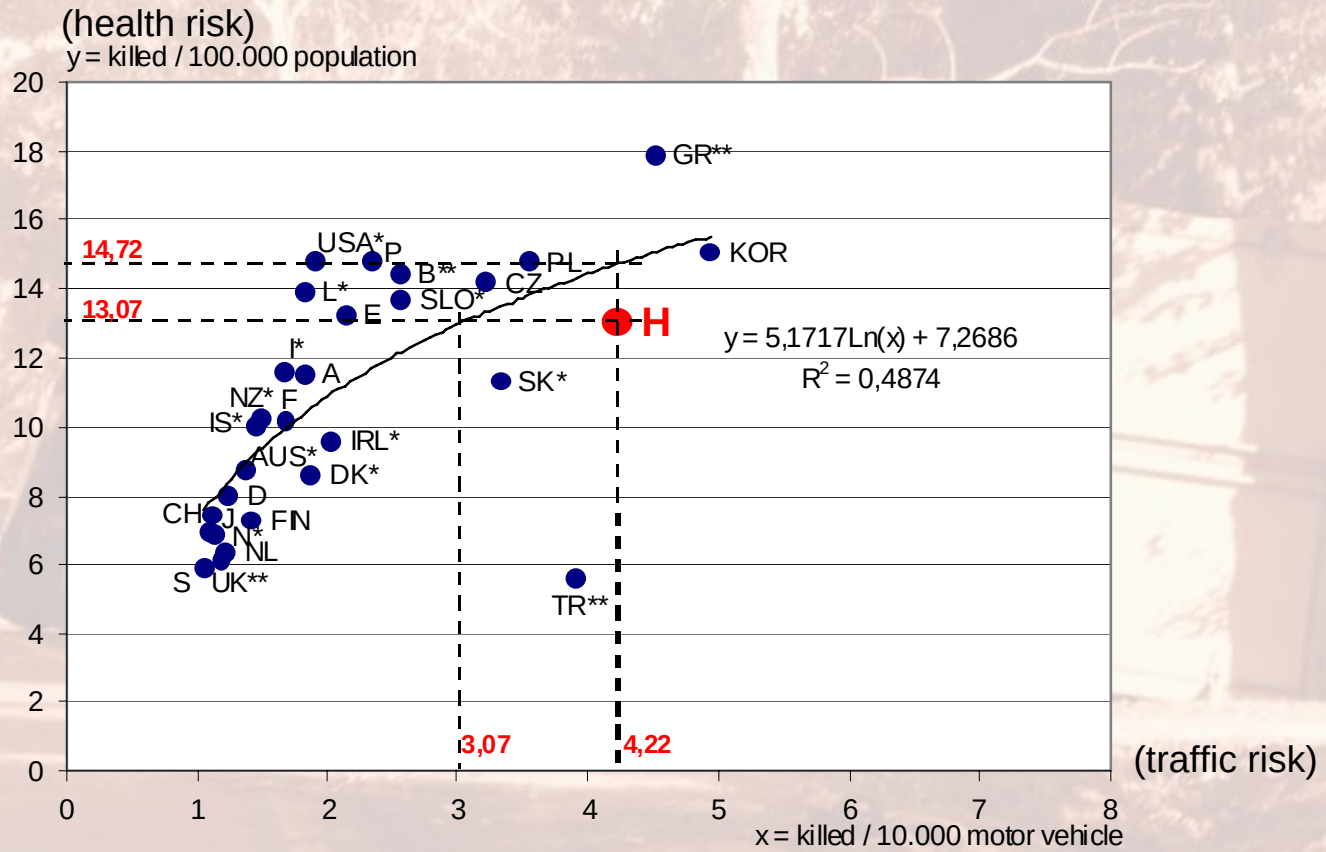


Figure 2. The relationship between the rates of fatality and mortality, based on IRTAD data of 2003 [7].

[7] Holló, P.: Road Safety in Hungary
PIARC Technical Committee 3.1. Road Safety, 2nd meeting, Budapest, 27th-29 th October 2004 (www.piarc.org).

7. Some examples of the use of different rates

Among others, the accident rate can be used for the comparison of accident or fatality risk of different road categories. In most countries, relatively reliable vehicle-kilometres are available for the main road network (roads outside built-up areas). Figure 3 shows some international comparison of the fatality rates on motorways based on IRTAD data [8].

[8] Holló, P.: Accident risk on the Hungarian road network, manuscript in Hungarian, Budapest, 2004.

7. Some examples of the use of different rates /2

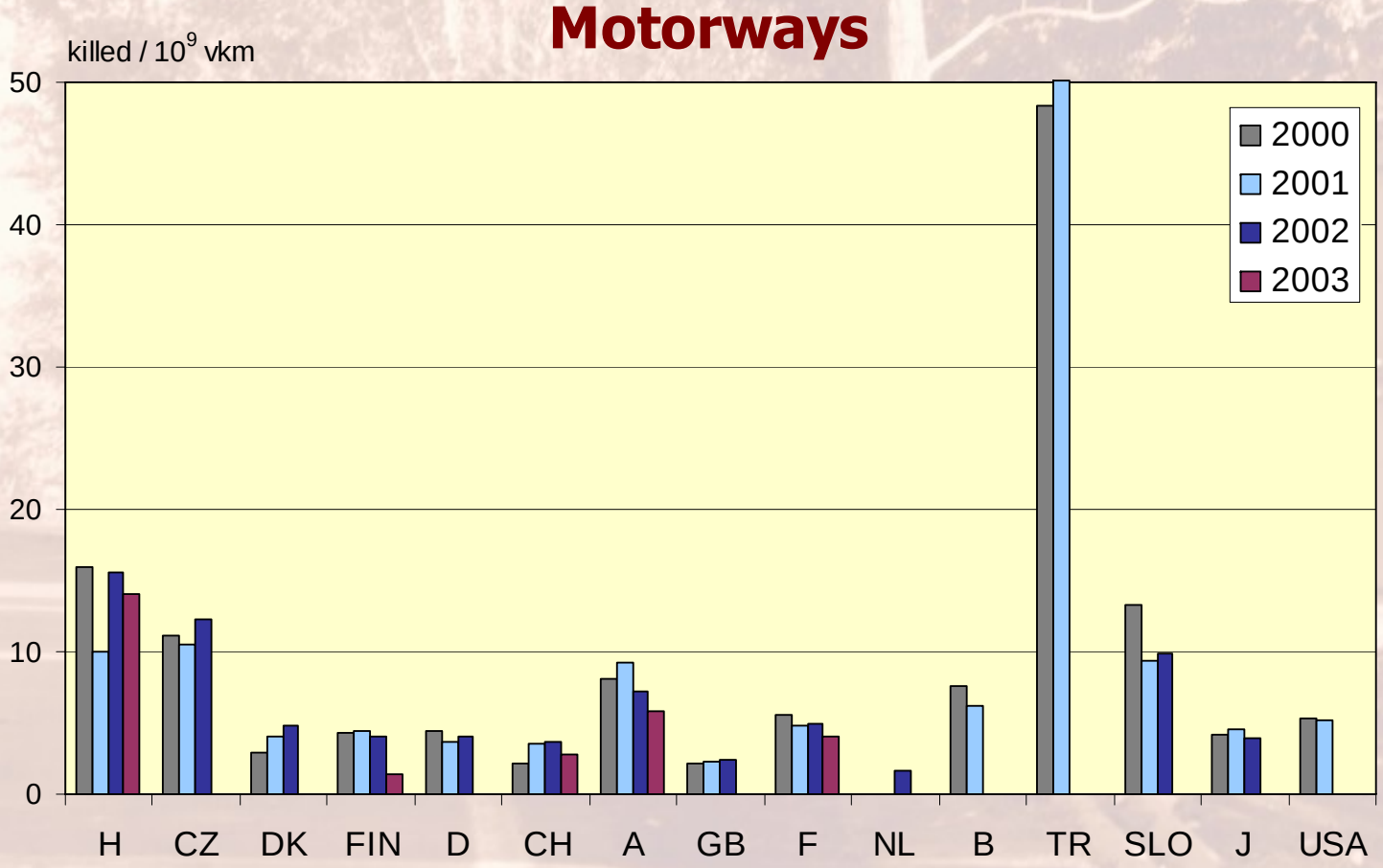
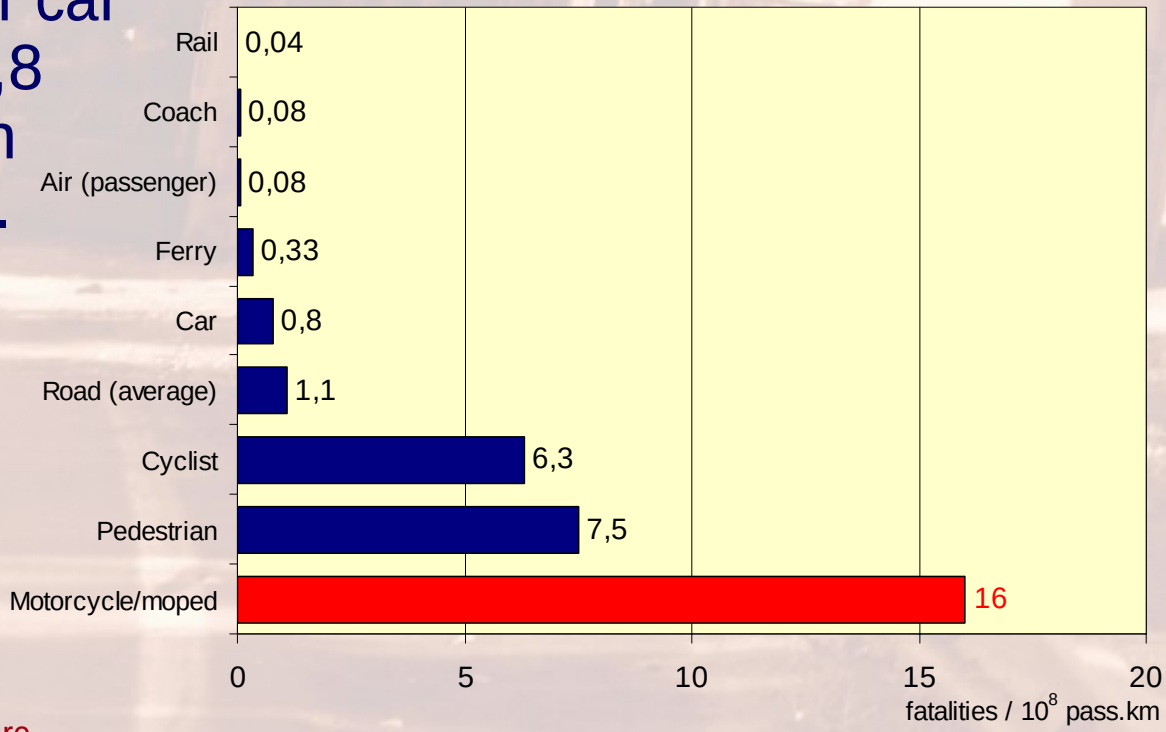


Figure 3. Fatality rates on motorways between 2000 and 2003 (Source: IRTAD).

7. Some examples of the use of different rates /3

Another important example is the comparison of the fatality risk of different modes of participation in the road traffic [5]. The average fatality risk of motorcycle riders in the EU 15 was 16,0 killed/100 million person-kms, while the fatality risk of car occupants was 0,8 killed/100 million person-kms [9].



[9] Transport Safety Performance in the EU, a statistical overview, ETSC, 2003, ISBN: 90-76024-154 (www.etsc.be)

8. The minimum scope of the data

A. Minimum standard containing total number of:

- injury accidents
- persons killed (30 day - definition)
- population
- vehicle fleet

Mikulik J.: Global Collision Database Standards

Benchmarking Road Safety Standards, Apeldoorn-Amsterdam, 24-28 May 2004

Thank you for your attention