SWOV Fact sheet

Risk in traffic

Summary
The most common means of measuring road safety is the number of road crashes and/or the number of casualties resulting from such crashes. This is not, however, the measure that most accurately reflects the level of road safety. The fatality rate is more accurate in this regard. With respect to a specific group or otherwise, the fatality rate not only looks at the number of fatalities in a specific group of road users, it also takes the exposure into account. The exposure is often expressed in terms of distance travelled. The fatality rate of car occupants has been decreasing in the Netherlands since the 1970s. Moped and light moped riders and motorcyclists have relatively high fatality and injury rates. In addition, both the elderly and young people are at above-average risk, the elderly due to their greater vulnerability and young people because of their as yet brief experience in motorized traffic.

Background
Everyone in the Netherlands participates in traffic virtually on a daily basis. This is one of the reasons that the issue of lack of road safety concerns all individuals. The most common measure used to define the lack of road safety is the number of road crashes and/or the number of casualties resulting from such crashes. However, mobility is a major factor in the number of road casualties: the longer or more frequently people travel, the more road crashes may occur. It is therefore necessary to consider the 'underlying' lack of road safety or, in other words, risk in traffic. This fact sheet first defines exactly what we mean by 'risk', before proceeding to a discussion about how the fatality rate and injury rate in traffic have developed in the Netherlands, both as the levels as a whole and the levels for different subgroups (mode of transport, age groups) in traffic. Finally, the fact sheet will briefly discuss some other road safety measures.

Why use fatality and injury rate as a measure of road safety?
The number of road crashes or the number of road crash casualties are the most commonly used measures of lack of road safety. They are not, however, the measures that most accurately reflect the level of road safety. Imagine, for instance, that every year 500 road crash casualties occur each of two different countries. If the distance travelled in one of the countries is twice that in the other country, the countries' respective levels of traffic safety are not considered to be the same. The degree to which people are exposed to traffic is an important contributing factor. In short, it is therefore necessary to consider not only the number of road crashes or casualties, but also the 'risk' of a road crash or casualty occurring. The concepts fatality and injury rate filter, as it were, the differences in mobility or, in other words, the distance travelled out of the casualty numbers. This fact sheet addresses the objective – that is, measured – lack of road safety. In addition, the subjective factor, the way in which lack of road safety is perceptually experienced, is considered to be of increasing importance in the Netherlands. The SWOV Fact sheet *Subjective feelings of road safety in traffic* (to be published) gives more information about this subject.

How can risk in traffic be defined?
To be able to discuss 'risk' in traffic, it is necessary to define exactly what is meant by the term. A distinction can be made in this regard between, for instance, the risk of a crash, the risk of a fatality or the risk of an in-patient. In this fact sheet, we will focus on the 'risk' of casualties in traffic and therefore not on the risk of a crash. One of the reasons for this choice is that more data is available on casualties (fatalities and in-patients). Information about the development of the number of road crash casualties and the precise definitions of fatality and in-patient can be found in the SWOV Fact sheet *Road crash casualties in the Netherlands*. Furthermore, we must also decide which level of exposure must be used to determine this risk. In other words, which standard does best measure the exposure to potentially dangerous traffic? In general, mobility is considered the best possibility for expressing the level of exposure (see for example Hakkert & Braimaister, 2002; Yannis et al., 2005).

We therefore define the casualty rate, as the quotient of the number of fatalities or in-patients and the distance travelled; in other words, the casualty rate is the number of casualties per distance travelled. This fact sheet is makes use of the registered numbers of casualties. Although these are somewhat below real numbers, they accurately reflect developments in casualty rate. Since it relates best to casualty numbers, traveller mobility was used as much as possible to determine the distance travelled. Where data for traveller mobility was unavailable, data on motor vehicle mobility was used instead. Although this measure of exposure actually relates better to the number of crashes, we limit ourselves to the casualty rate. Other measures for evaluating lack of road safety are discussed at the end of this fact sheet.

At a national level, lack of road safety can therefore be expressed as the casualty rate which is calculated by dividing the number of road casualties in a given period by the total mobility on Dutch roads in the same period. However, considerable differences in casualty rate can exist between various subgroups in traffic. Different casualty rates may apply to different age groups or modes of transport, for example. To enable consideration of these differences, we look at the casualty rate per subgroup, for instance at the number of moped casualties divided by their mobility value, in this example the mobility of moped riders.

What is the casualty rate in traffic in the Netherlands?

According to the definition provided in the previous section, the casualty rate is determined by the number of road casualties and their mobility value in the Netherlands. For more information about the number of casualties and mobility, please see the SWOV Fact sheets *Road crash casualties in the Netherlands* and *Mobility on Dutch roads*.

We will first provide an overall picture of the casualty rate in Dutch traffic from 1950. Only the number of fatalities has been reliably recorded for this extended period. For the years prior to 1985, only data on motor vehicle mobility is available. Data on non-motorized traffic is not available (see also the SWOV Fact sheet *Mobility on Dutch roads*). In addition, it must be remembered that, certainly in the 1950s, traffic was not yet dominated by the car as is the case today. The quotient of the total number of road casualties and total motor vehicle mobility would therefore present an inaccurate picture of the casualty rate. For this reason, only the fatality rate for car occupants is presented with respect to the fatality rate development in traffic since 1950.

Figure 1 shows the fatality rate for car occupants in the Netherlands for the period 1950 - 2004 calculated as the annual number of fatalities among car occupants per distance travelled by cars. Although the number of fatalities increased sharply in the period 1950-1970 (see the SWOV Fact sheet *Road crash casualties in the Netherlands*), *Figure 1* indicates that the fatality rate for car occupants remained more or less constant during this period. It is also apparent that the fatality rate has been decreasing virtually continuously since the 1970s. This decrease is approximately 5.5% a year on average and is the result of, among other things, measures concerning infrastructure, vehicle safety and law enforcement. Increasing driver experience from 1970, following an explosive growth of car traffic until 1970, also contributed to the decrease in the fatality rate (Stipdonk & Berends, 2008). However, this decrease exhibits considerable variation between successive years. This may be the result of both irregular shifts in mobility and changes in risk. Statistical variance in both the number of fatalities and mobility also plays a role in variation between the years.

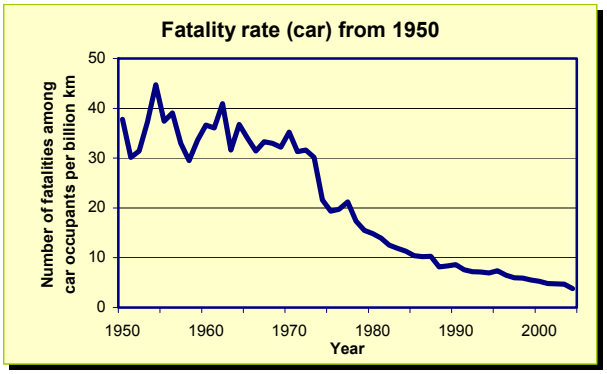


Figure 1. *The fatality rate in traffic (number of fatalities among car occupants per billion car kilometres) in the Netherlands for the period 1950-2004. Source: Statistics Netherlands (CBS)/Ministry of Transport.*

What are the differences in fatality and injury rate for the different modes of transport?

There are considerable differences in fatality and injury rates between the different modes of transport. *Figure 2* shows the number of fatalities and the number of in-patients per billion kilometres travelled for the different modes of transport. It first must be noted that fluctuations in fatality and injury rate are rather large particularly among moped riders and motorcyclists. This is because annual distances travelled by these modes of transport are limited and the associated absolute number of fatalities is small. However, the fatality and injury rate for riders of motorized two-wheeled vehicles, both motorcycles and mopeds, are high compared with the fatality and injury rate for car occupants. The fatality rate for motorcyclists is more than 20 times higher than that for car occupants, while the fatality rate for moped riders is almost 25 times higher. Indeed, the injury rate for moped riders as a result of a road crash is around 60 times higher than that for car occupants.

In 2007, there were more than two fatalities and 27 in-patients per billion kilometres travelled among car occupants. In comparison with the late 1990s, that meant a halving of the fatality rate and a reduction of approximately 25% of the injury rate among car occupants. In recent years, a decrease in the fatality and injury rates can also be seen for pedestrians and, to a lesser extent, for cyclists. With approximately two in-patients per billion kilometres travelled, public transport (excluding train travel, which has not been included in *Figure 2*) is the safest transport mode.

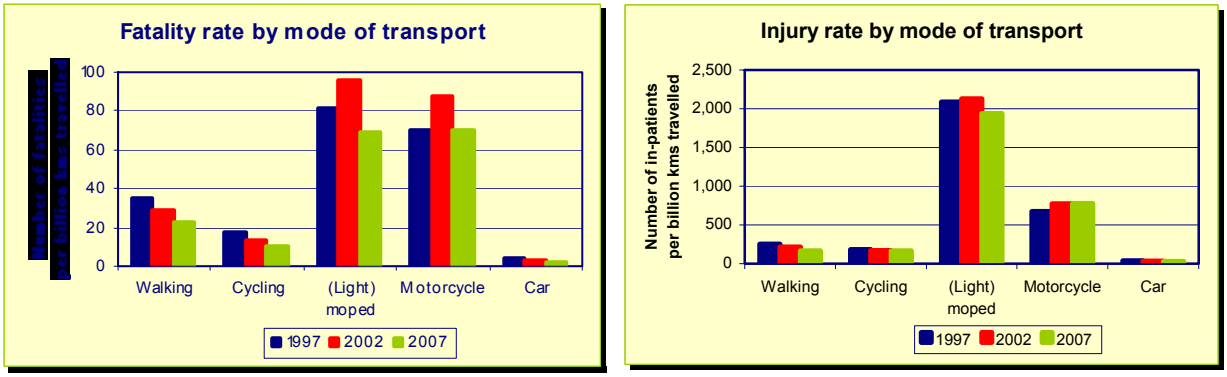


Figure 2. *Number of fatalities and in-patients per billion kilometres travelled in the Netherlands for different modes of transport. Source: Statistics Netherlands (CBS)/Ministry of Transport, Public Works and Water Management.*

For more information about road users with specific modes of transport, please see the SWOV Fact sheets: *Pedestrians*, *Cyclists*, *Moped and light-moped riders* and *Motorcyclists*.

What are the differences in fatality and injury rate for different age groups?

In addition to subdividing according to mode of transport, subdivision according to age group can also give insight into the fatality and injury rate for different groups of road users. *Figure 3* shows the

numbers of fatalities and in-patients per billion kilometres travelled for the different age groups. The first thing to note is that the fatality rate in the event of a road crash is approximately six times higher for those aged 75 and over than the average (all age groups). For young people (aged 12-24), the fatality rate in the event of a road crash is approximately one and a half times higher than the average. The injury rate as a result of a road crash is approximately three times higher for both those aged 75 and over and young people (aged 12-17) compared with that of the average road user.

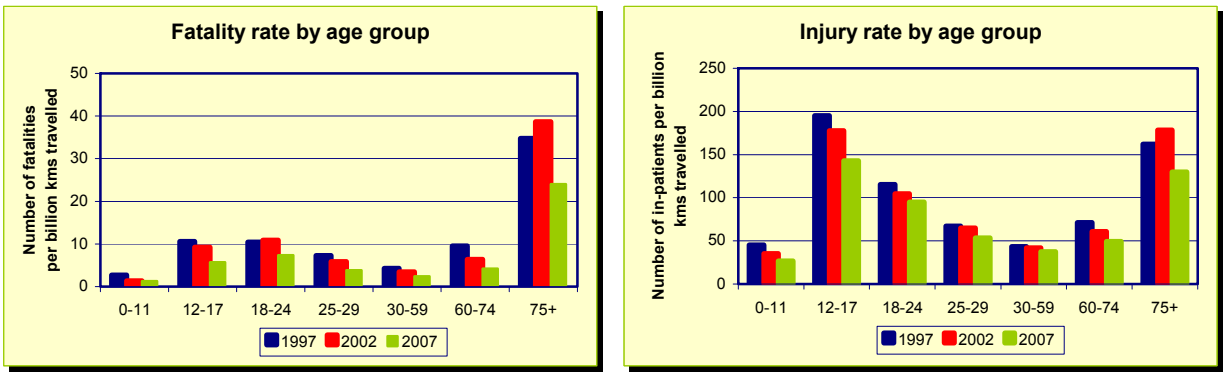


Figure 3. *Number of fatalities and in-patients in the Netherlands per billion kilometres travelled for different age groups. Source: Statistics Netherlands (CBS)/Ministry of Transport, Public Works and Water Management.*

The higher rates for the elderly (aged 75 and over) stem mainly from their greater physical vulnerability and functional disorders. The fatality rate is especially high among older cyclists. The higher rate for younger people is strongly linked to the start of their independent participation in motorized traffic. Relative to other age groups, young people aged 16-19 frequently use mopeds, a high-risk mode of transport in comparison with other modes. The higher rate for those in the 18-24 age group relative to those in the 25-59 age group has to do with the increased rate associated with being young novice drivers.

As we discussed earlier in this fact sheet, the differences in fatality and injury rates between the various modes of transport is fairly large. It would therefore be more precise to categorize the rates according to mode of transport when categorizing it on the basis of age group. *Figure 4* shows the fatality and injury rates for car occupants categorized according to age group. It is evident that the 12-17 age group does not have a higher rate than other age groups, whereas this is the case for the 18-24 age group. It can therefore be concluded that the injury rate for those aged 12-17 shown in *Figure 3* does not occur during travel by car, while this is precisely the case for the age group 18-24. Further details about the rates categorized according to mode of transport and age can be found in *The summit conquered* (SWOV, 2007).

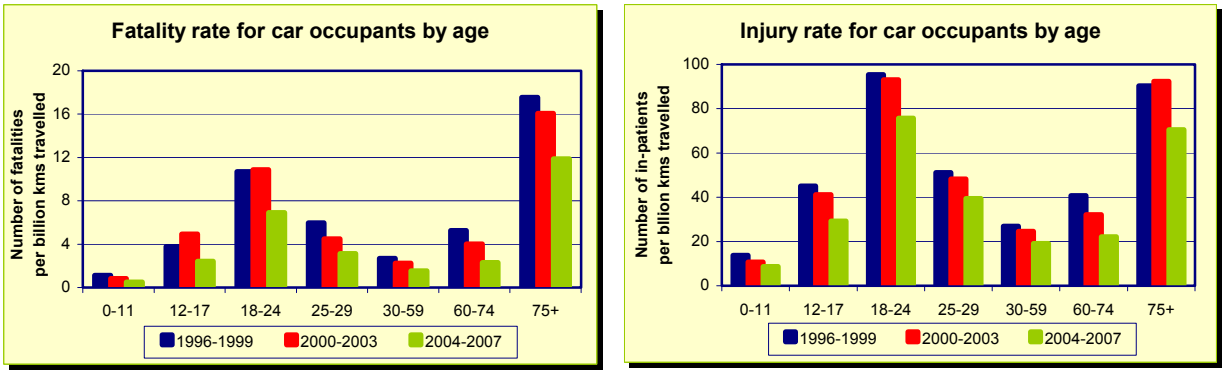


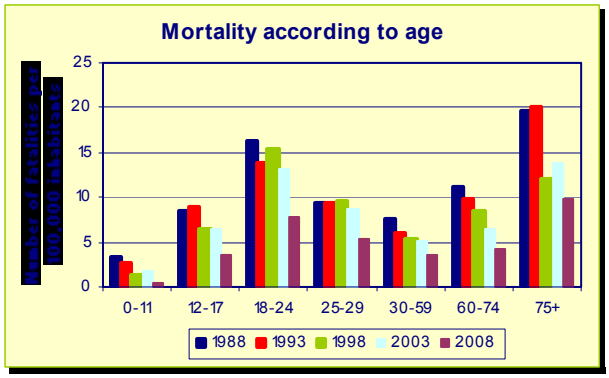
Figure 4. *Number of fatalities and in-patients among car occupants per billion car kilometres in the Netherlands for different age groups. Source: Statistics Netherlands (CBS)/Ministry of Transport, Public Works and Water Management.*

More information about specific groups of road users can be found in the SWOV Fact sheets *Vulnerable road users*, *The elderly in traffic*, *Road safety of children in the Netherlands* and *Young novice drivers*.

What are the differences in fatality and injury rate on different road types?
Unfortunately, due to lack of data on traveller mobility on different road types, it is not possible to determine differences in rates according to road type. No data on the subject is gathered in the Dutch Mobility Survey (*Mobiliteitsonderzoek Nederland*), the source of mobility data. There are estimates, but these are deemed to be insufficiently reliable. Data that is available indicates, among other things, that the number of fatalities per 100 million motor vehicle kilometres in 1986 was four times higher on roads with a speed limit of 80 km/h than it was on motorways and trunk roads, on which the applicable speed limit is 100 or 120 km/h (Koornstra, 1998).

Are there other measures of (lack of) road safety?
Mobility, or the distance travelled, is often seen as the best measure of exposure. For a variety of reasons, however, it can be meaningful to consider alternative measures of exposure (Hakkert & Braimaister, 2002; Yannis et al., 2005). To begin with, there may be a lack of mobility data, thus necessitating the use of an alternative. Fairly sound data on mobility has been available in the Netherlands since the 1980s. However, this is unfortunately not the case in many other countries. Therefore, alternative measures of exposure are generally used for comparisons between different countries (see also the SWOV Fact sheet *International comparability of road safety data*). Furthermore, mobility may not be the best measure to use for specific issues.

A frequently used alternative measure of exposure is based on the number of inhabitants. The number of fatalities per 100,000 inhabitants is also referred to as the (traffic) mortality rate. In addition to international comparisons, this measure is also used to make comparisons between developments in the rates of various causes of death. Developments in the mortality rate of different age groups in the Netherlands are shown in *Figure* 5. The traffic mortality rate decreased for all age groups in the last 20 years. This rate was lowest throughout that period for children aged 0-11 and decreased for that age group from approximately 3.5 fatalities per 100,000 inhabitants in 1988 to around 0.5 fatalities per 100,000 inhabitants in 2008. Like the fatality and injury rates in traffic, the mortality rate is highest in the 75 and over and 18-24 age groups. In specific cases it is also possible to consider the segment of the population with driving licences rather than the total population.



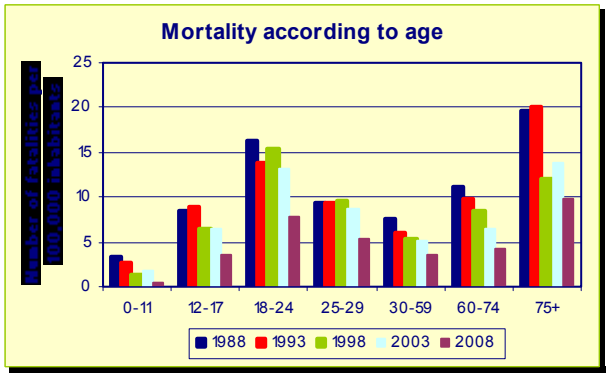


Figure 5. *Traffic mortality rate (number of fatalities per 100,000 inhabitants) in the Netherlands for different age groups. Source: Statistics Netherlands (CBS)/Ministry of Transport, Public Works and Water Management.*

In the case of insufficiently reliable figures on mobility, the number of vehicles and sales figures for fuel can be used as alternative measures of mobility (see also the SWOV Fact sheet *Mobility on Dutch roads*). These alternatives can therefore also be used as measures of the level of exposure in the definitions of fatality and injury rate in traffic. A disadvantage of these alternatives is that they cannot account for slow traffic such as pedestrians and cyclists.

Furthermore, the number of casualties per road length is used as a road safety measure. This is also referred to as the casualty density. This measure is mainly used on a local level; that is, for a certain road or road section. For more information on this subject, please see the SWOV Fact sheet *Measuring (un)safety of roads*. Finally, the total time spent in traffic rather than distance travelled can be used to measure the level of exposure. Comparisons using number of casualties per unit of time can be especially relevant when comparing with activities other than traffic participation (see also ETSC, 1999).

Do fatality and injury rate also depend on the type of crash opponent?
So far, the casualty rate has been considered from the perspective of the casualty and his or her degree of mobility. For a cyclist, for example, the casualty rate was defined as the number of bicycle casualties divided by the distance travelled per bicycle. This method does not, however, take the mobility of a potential crash opponent into account, although this is important to the casualty rate in question. After all, if the number of passenger car mobility increases, cyclists will encounter more cars and there will be an increase cyclist casualties in bicycle-car crashes. In addition, there may be considerable differences in casualty rate between different conflict categories, such as differences in the risk of being a cyclist in a bicycle-car crash or a bicycle-bicycle crash. A car occupant, for example, has a greater risk of dying in a single-vehicle crash than in a collision with another car (SWOV, 2007). Taking the characteristics of a (potential) opponent into account in addition to those of casualties can therefore be worthwhile in road safety studies. Moreover, from the perspective of a crash opponent it is also possible to study the risk of being involved in a crash as a crash opponent rather than as a casualty.

Conclusion
Road safety can be expressed in terms of number of crashes or casualties as well as in terms of rates like of fatality and injury rate. In addition to the number of casualties, a rate also takes the exposure to traffic into account. Although different measures of exposure can be used, mobility in terms of distance travelled is frequently used. Risk is then defined as the casualty rate: the number of road casualties (fatalities or in-patients) per billion kilometres travelled. For car occupants, the fatality rate in traffic has been decreasing in the Netherlands since the 1970s. The fatality rate and injury rate according to mode of transport is relatively high for moped/light moped riders and motorcyclists in particular. In addition, both the elderly, due to their greater vulnerability, and young people, as novice participants in motorized traffic, have above-average rates.

Publications and sources

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Yannis, G. et al. (2005). *State of the art report on risk and exposure data*. Deliverable 2.1 of the SafetyNet project. http://www.erso.eu. European Commission, Brussels.