# TEN YEARS ROAD SAFETY IN THE NETHERLANDS

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# ten years road safety in The Netherlands

*A description of the extent and trends of road traffic and road safety in The Netherlands since 1964.*

SWOV

INSTITUTE FOR ROAD SAFETY RESEARCH SWOV

P.O. BOX 71 2270 AB VOORBURG THE NETHERLANDS

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More information is to be found in the brochure Aims and Activities, available at request from the Information Department SWOV.

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# Foreword

Further to the material contained in the Contributions for the Road Safety Memorandum of the Minister of Transport (1965) a study was made of the implications for road safety in The Netherlands of the post-1964 trends. Especially the welcome decrease in the number of traffic fatalities in the years 1974 and 1975 should be carefully analysed, because it might disclose the fundamental reasons for it. Knowledge of these can be very valuable to those responsible for policy formulation.

In order to find a full explanation for the differences which such an analysis discloses, for instance in terms of the effects of measures which are adopted, not only theories and prediction models are needed, but also more reliable and adequately specified basic data. More detailed proposals are made with a view to having this information available in the future.

This publication was compiled by an editorial committee from contributions by the following SWOV workers: J.van Minnen, A.Blokpoel and F.C.Flury.

E.Asmussen
Director Institute for Road Safety Research SWOV

# 1. Introduction

The importance to society of research preparatory to policy formulation makes this type of research one of the principal terms of reference of the Institute for Road Safety Research SWOV. Such research leads to recommendations to the authorities and the results must therefore be presented in a form which the policymaker can use.
One type of research of importance for road-safety policy is described in the Road Safety-Policy Plan (November 1975) as follows:
*'Research into the nature and extent of road safety in order to develop adequate counter-measures and monitor the trend of road safety'.*
For policy formulation, it is essential that situations regarding road traffic and road safety should be measurable as precisely as possible at any time. This indicates to the policymaker whether the policy is correct, in both substance and form. (...) Research should cover description and cataloguing the present situation, collection and amplification of data, their analysis, the problems and theories and, based on these, the formulation of possible measures as elements for a policy.'

In order to formulate a road-safety policy and especially in order to decide priorities, it will be clear that a fairly detailed description and analysis of the trend in road safety must be possible and that this requires an adequate supply of basic data.

Opinions on and research into road safety are based mainly on road accident and casualty data. In the past, measures were sometimes taken, either administrative or with respect to road safety, and it was afterwards impossible to ascribe movements in road-accident statistics purely to the measure or measures in question. This was mostly due to the lack of data for determining the impact of such measures. Owing to this, the effectiveness of the particular measure may be only partly detectable, if at all, and hence there is no guarantee whatsoever that the measure has had the contemplated result and it cannot be effectively corrected.
An adequate policy therefore requires that all components of the road-traffic process are monitored so that the influence of every measure and/or disturbance can be noted. The knowledge thereby gained will ultimately help to improve road safety.
In order to examine what description is already possible with existing data, the present publication firstly reviews the extent and trends of *road traffic* in The Netherlands since 1964. This is further to the Contributions for the Road Safety Memorandum (SWOV, 1965), which included such information up to 1964. This description has necessarily been limited, on the one hand because a detailed analysis was not aimed at and on the other because of the lack of many traffic para-

meters: vehicle and traveller-kilometres, and so on, specified for road and vehicle categories, age groups, inside and outside built-up areas, time of day, day of week, month of year, road situation, and so on.
For the same reasons, the description of the extent and trend of *road safety* is likewise limited. Another reason for this is that nothing like a reliable picture can be given of the numbers of accidents (those involving material damage only, and those involving injury) or of the numbers of persons injured.
An attempt has, however, been made, based on the relevant information now available, theories and prediction models, to *explain* the welcome *decrease* in the number of road deaths in the years 1974 and 1975 in terms of effects of measures adopted or prepared in those years. Where this was not possible, other potential contributory causes have been considered.

In order to examine what else might be achieved with more and better information, this is followed by a brief consideration of the value and need for *quantifying the consequences of road accidents* and a short discussion of a number of research methods aimed at determining the economic consequences of road *accidents*. Next, the problems of the completeness and reliability of the *basic data* needed for road safety policy and research are examined. Several examples are given of the implications of the lack of systematically and continiously collected data for policy-preparing research based on appropriate data which, moreover, usually has to be carried out at short notice.

Some final remarks go into the problems of basic data used for various purposes including scientific research. It will also be examined what problems arise in seeking to *improve* the quality and/or quantity of basic data. As SWOV obviously needs many (specific) data to perform its duties and as these involve special requirements, the *marginal conditions* for these are also indicated. Lasly, the *initiatives* taken by SWOV to fill the gaps in the relevant data and the steps required to improve the situation.

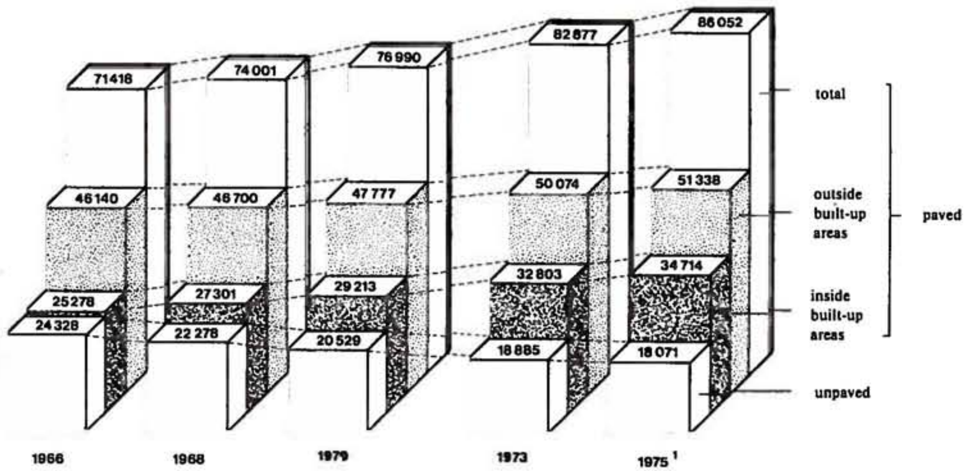
# 2. Extent and trends of road traffic in The Netherlands since 1964

## 2.1. Number of vehicles

The characteristic feature of this period is the great increase in the number of private cars; in ten years they more than trebled: from just over a million in 1964 to nearly 3.2 million in 1974 (Table 1). The number of private cars in 1976 is about 3.8 million. This brings the total to 70 - 80 per cent of the saturation level expected in fifteen to twenty-five years' time (Van Minnen, 1974).
The number of bicycles - 7.6 million in 1974 - is about twice that of private cars. In the past period, there has been an increase of about 100,000 a year: pronounced growth, though less spectacular than that of private cars. Over half the total number of vehicles are still bicycles. Far more than in the case of other means of transport, a large proportion of bicycles are seldom used. For 1972, it was estimated that out of 7.3 million bicycles, some 5 million were used more or less regularly (CBS, 1975).
The number of mopeds reached a peak about 1970, of about 1.9 million, after which it declined again to about 1.75 million in 1974 and about 1.65 million in 1975. This decrease is due largely to competition by private cars, which are coming within the reach of more and more people. At first, this decrease was offset by an increase in moped ownership by the youth (16 to 20 years), but since saturation level has been reached in this age group, the total number has declined (SWOV, 1976).
The number of motor cycles and scooters, about 60,000 in 1974, dropped considerably from 1974 to 1972; there has recently been a slight increase again. This is accounted for by motor cycles, because scooters are hardly bought any more.
The number of motor trucks, including delivery vans, is increasing steadily, but their absolute and relative growth is less than for private cars.
Buses, which have fluctuated between 9,000 and 10,000 for many years, are not included under motor trucks.

## 2.2. The road-system

The extension of the road-system has not kept pace with the growth in the number of motor vehicles. Comparison of the position at 1st January 1975 with that at 1st January 1966 (Figure 1, Table 2), shows that the total length of paved roads increased by about 20 per cent. The increase was greater inside built-up areas, about 37 per cent, compared with about 11 per cent outside.
This disparity is not so remarkable, because there is a fundamental difference between the increase in road mileage outside built-up areas on the one hand,




1) provisional figures

Figure 1: Length of paved and unpaved roads in kilometres in 1966, 1968, 1970, 1973 and 1975

where it is almost entirely a question of greater density in the road-system, and inside built-up areas on the other, where the increase is largely in the new suburbs.

The fact that the road-system inside built-up areas is hardly becoming denser can be inferred, for instance, from the following comparison: between 1st January 1968 and 1st January 1975 the total length of roads inside built-up areas increased by about 27 per cent, while built-up areas increased by about 25 per cent.

Roads outside built-up areas can be subdivided into:
- (major) national highways, partly motorways.
- secondary and tertiary roads (predominantly provincial roads).
- other roads (predominantly municipal roads).

The importance to traffic of the various categories is illustrated in Figure 2 (See also Table 3).

The motorway system, in which there was the greatest relative increase from 1966 to 1973, covered about 1.3 per cent of total road mileage outside built-up areas in 1966 and about 2.5 per cent in 1973. It has become by far the most important category for fast traffic, and was used for about 22 per cent of vehicle-kilometres outside built-up areas in 1966 and about 36 per cent in 1973.

'Other roads' present a totally different picture; they account for about 75 to 78 per cent of total road mileage, but are used for only a small proportion of vehicle-kilometres as far as fast traffic is concerned (in 1966 about 14 per cent).

The proportion of private cars in these vehicle-kilometres increased slightly more: from about 81 per cent in 1966 to over 84 per cent in 1973.

The classification of road mileage inside built-up areas is given in Table 2. Little is known about the number of vehicle-kilometres on these roads. Counts taken in 1966 indicate that about 45 per cent of vehicle-kilometres (fast traffic) was travelled in built-up areas.

## 2.3. Traffic and travel performances

The increasing importance of private cars is already evident from the figures for numbers of vehicles. This becomes clearer still if we compare traffic and travel performance by private cars, motor cycles/scooters and mopeds (Table 4). In 1964 nearly three times as many kilometres were covered by private cars as by mopeds; in 1973 over seven times as many. The differences are greater still in the numbers of traveller-kilometres; in 1964 about four times as many were covered by car as by mopeds, compared with over eleven times in 1973.

*Note:* In judging these data, we should allow their lack of accuracy, especially as regards two-wheeled vehicles. This is indicated, for instance, by the rather varied results of different enquiries. For cyclists and pedestrians no usable travel performance data whatever are known. Therefore these categories could not be included in the comparison.

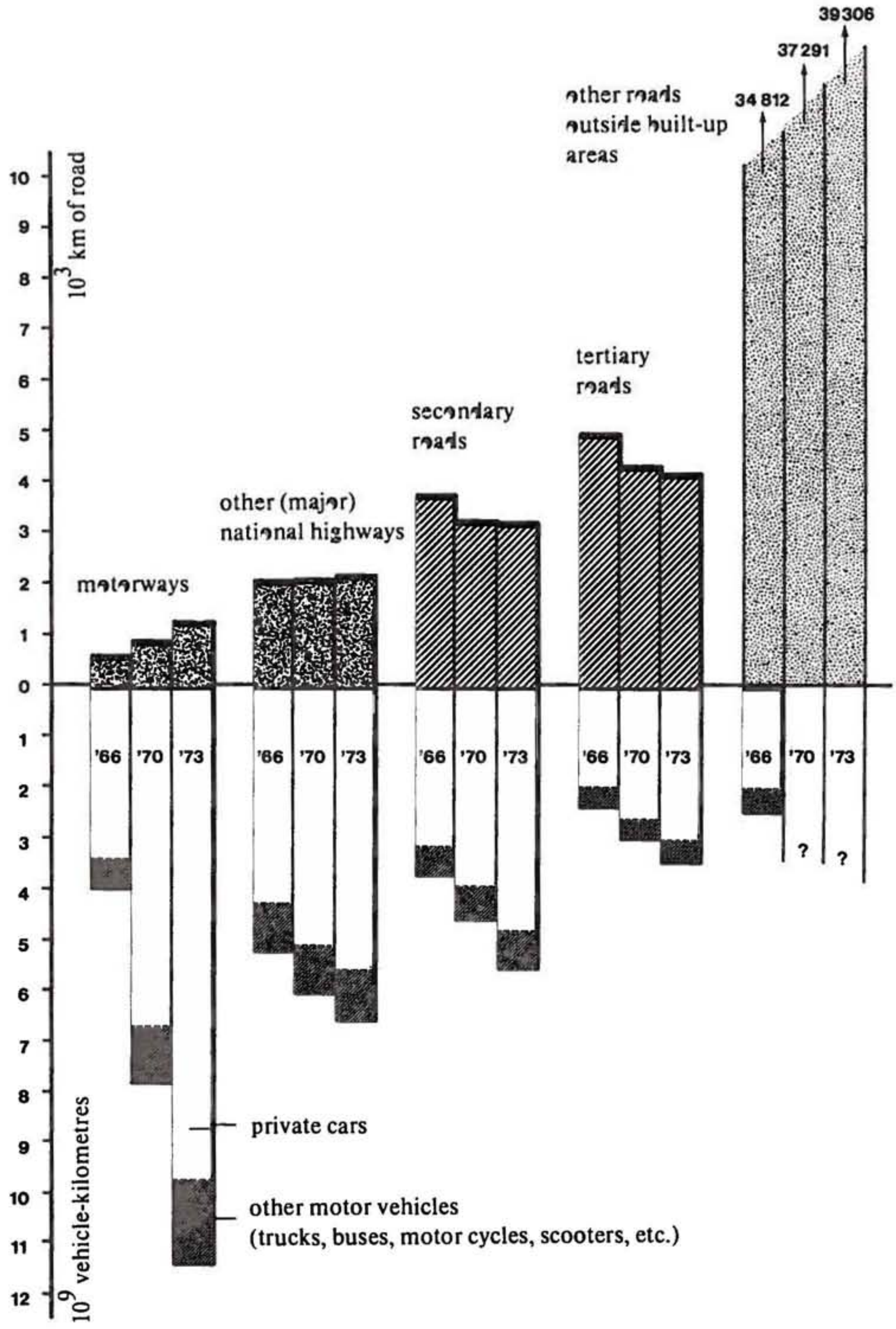



Figure 2: Lengths of road and numbers of (motor) vehicle-kilometres on various categories of roads outside built-up areas in 1966, 1970 and 1973.

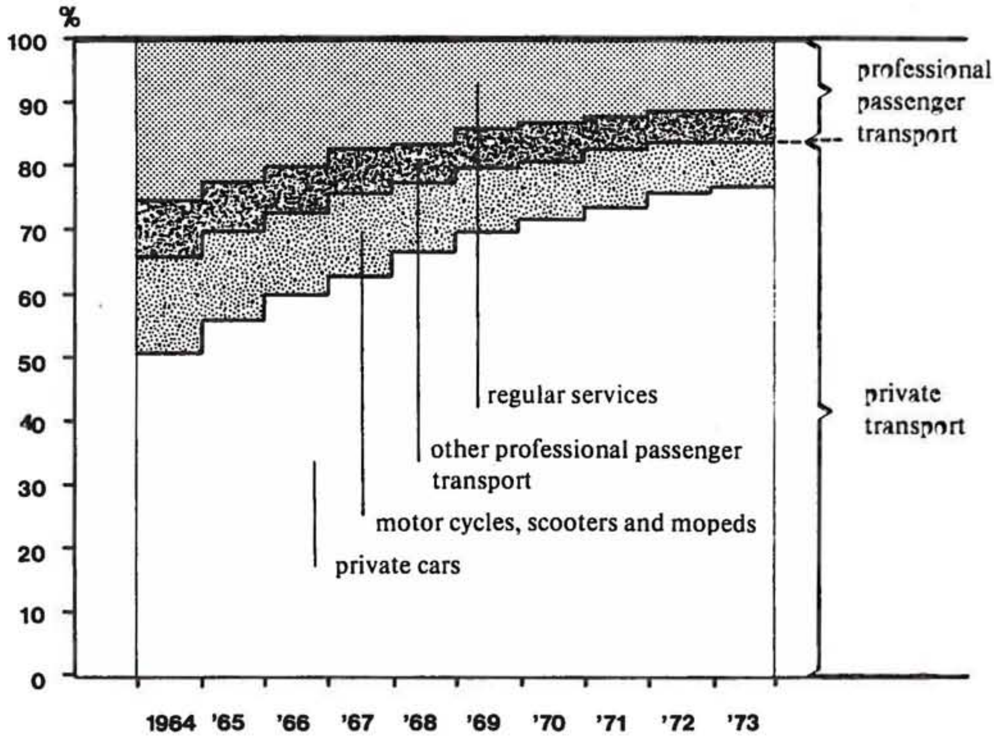



Figure 3: Trend in proportion of total traveller-kilometres of professional and motorised private passenger transport from 1964 to 1973.

Interesting results emerge if we make a distinction for traffic and travel performance by private cars based on reasons for the journey (Table 5 and 6).
In 1973, about 40 per cent of all vehicle-kilometres covered by car and about half of all traveller-kilometres by car related to 'other uses'.
About 8 per cent of car-kilometres but - owing to the high occupancy rate - not less than about 16 per cent of traveller-kilometres were driven during holidays. The latter percentage is even higher than for commuter traffic! We must, however, bear in mind that a good part of holiday mileage is driven in other countries. This 'loss' is partly offset by foreigners driving in The Netherlands. It is not (yet) known how great the net difference is.
In contrast to the various forms of private use, the use of cars for business purposes is no longer increasing. Hence, the proportion fell from 54 per cent in 1964 to 31 per cent in 1973.

In order to make the picture of the trend in personal transport somewhat more complete, transport by rail, tram, metro and bus, which can be grouped together under 'professional passenger transport', are given in Table 7. In rail transport, there was at first a slight decline, followed by a slight increase in the number of traveller-kilometres. Other regular services (bus, tram, metro) tended to fall slightly; other professional passenger transport (group transport, motor coaches, etc.) increased slightly. The total was almost stable from 1964 to 1974; this contrasts with transport by private cars which more than trebled in the same period.

It can be concluded that the increase in mobility since 1964 is accounted for almost entirely by private cars. The proportion of private cars in the total number of traveller-kilometres (excluding pedestrians and cyclists) increased from 51 per cent in 1964 to 77 per cent in 1973 (Figure 3 and Table 8). The proportion of professional passenger transport fell from 33 per cent to 16 per cent.

These changes in traffic and transport are, of course, very important as regards road safety. Not only the greater mobility, but also distribution among the various means of transport with the different risks they involve, are bound to have affected the number of traffic accidents and casualties.
The data presented in this chapter are part of the basic material indispensable for formulating the transport, traffic and road safety policy. They are essential for many measures in this area, such as the stimulation or limitation of certain modes of transport, promotion of uniformity in traffic, segregation of traffic types, and so on. It is therefore necessary for the gaps in this knowledge, which mostly concern slow traffic, to be filled soon.

# 3. Extent and trends of road safety in The Netherlands since 1964

## 3.1. General

The consequences of traffic accidents are many: fatalities, severe and less severe injuries, sometimes temporary, sometimes permanent disablement, damage to vehicles and other material damage, absence from work, and so on.
This enumeration, which is certainly not complete, shows that road safety cannot be expressed in a single figure. The statistics issued by the Central Bureau of Statistics in The Netherlands (CBS) give data relating to:
- numbers of accidents, subdivided into those involving injury and those with fatal consequences;
- numbers of casualties, subdivided into killed and injured.

Since 1967, accidents causing only material damage have no longer been included in the statistics. There is a feeling that the level of recording injuries since 1967 has not been constant (Blokpoel & Carlquist, 1972); this is gone into in greater detail in Chapter 6. Actually, only the numbers of fatalities (and fatal accidents) have been reliably recorded. In presenting the trend in road safety, therefore, only numbers of fatalities or numbers of accidents with fatal consequences will be used, with an odd exception.

## 3.2. Road safety since 1964

The annual number of deaths caused by traffic accidents has greatly increased since 1964 and reached a peak in 1972 (Figure 4 and Table 9). In that year, 3264 deaths were recorded. After this, there was a decline which, in view of the number in 1974: 2546, must definitely be described as exceptional. We have to go back to 1965 to find a still lower figure. This reduction did not occur only in 1974: for 1975, a figure of 2321 deaths is given. Chapter 4 will go somewhat further into this development. (In 1976 an increase of about 100, resulted into 2432 fatalities.)

Nearly 60 per cent of traffic fatalities occur outside built-up areas; there has been little change in this percentage in recent years, including 1974. The big drop in fatalities in that year apparently occurred both inside and outside built-up areas. In 1975 there was a minor change, and the percentage of fatalities outside built-up areas reached a little over 60 per cent.
A slightly different pattern is found in the number of recorded injuries (Figure 5 and Table 9). After the 'break' between 1966 and 1967 owing to the change in the recording method, the number of recorded injuries increased again, but by 1971 it

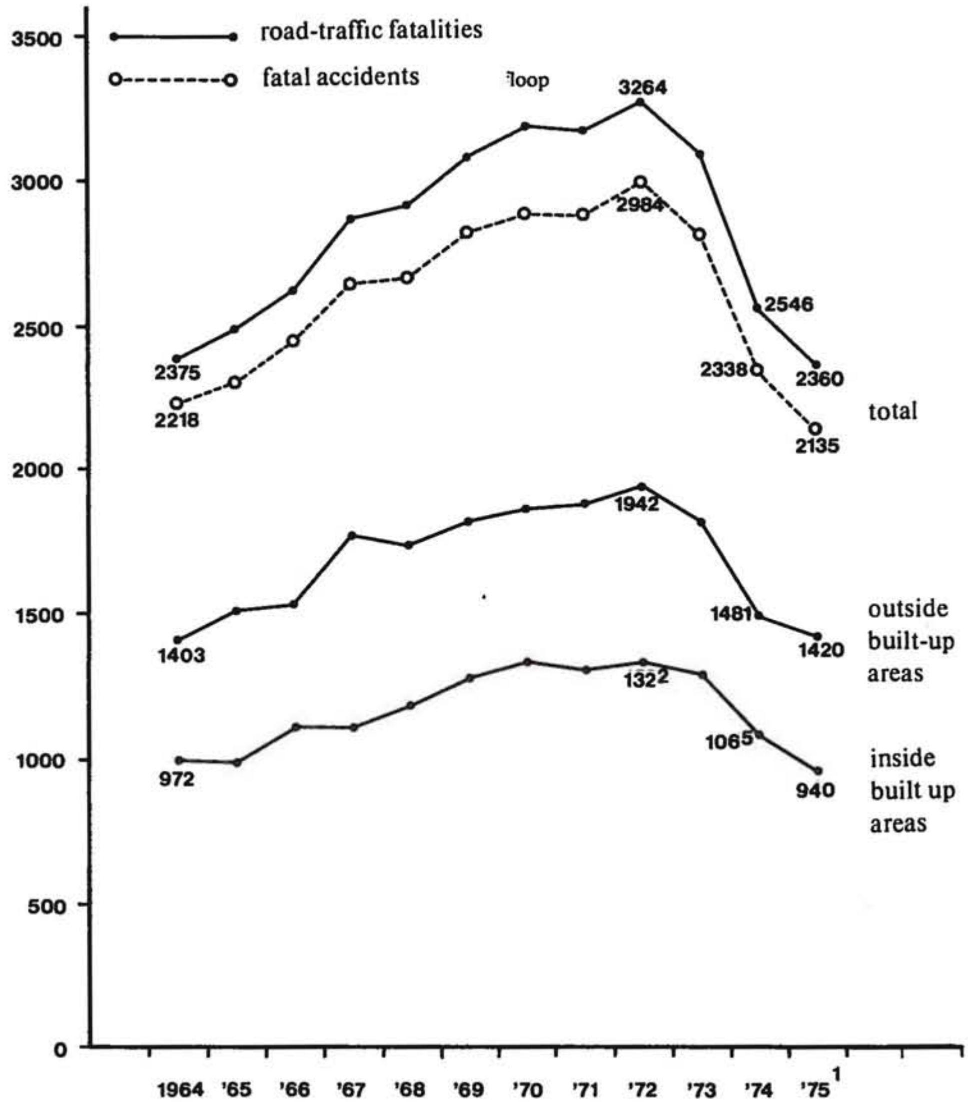



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Figure 4: Trend of total number of road-traffic fatalities and fatal accidents inside and outside built-up areas from 1964 to 1975

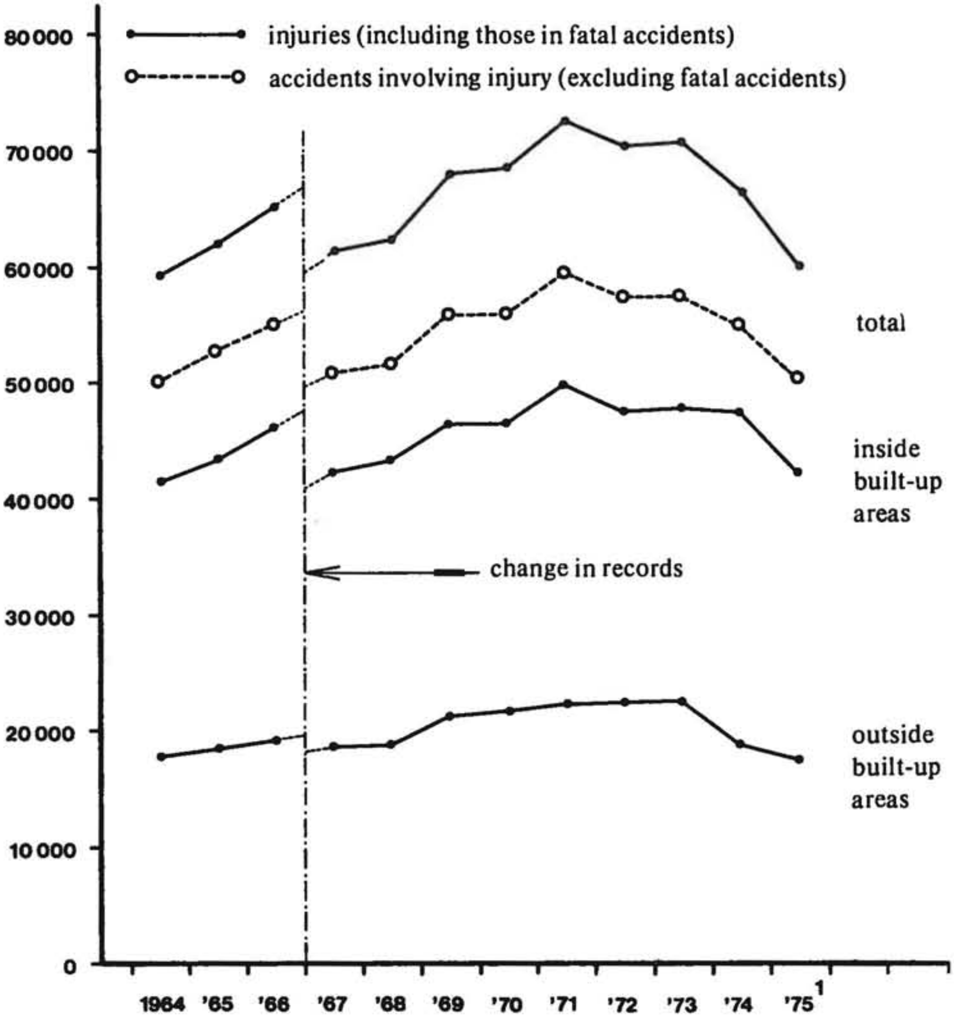


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Figure 5: Trend of total number of recorded road-traffic injuries (and accidents involving injuries) and numbers of recorded traffic injuries inside and outside built-up areas from 1964 to 1975

had already reached a peak (72,167 recorded injuries). In 1973-1974 there was some decrease indeed, but it was much slighter than that in the number of fatalities. Moreover, it seems that it took place almost entirely outside built-up areas. In 1975, the decline in the number of recorded injuries was a little greater than in the number of fatalities.

It cannot be traced to what extent these differences are the consequence of incomplete records. In any event, it is certain that the ratio between inside and outside built-up areas as regards numbers of persons injured (about 30 per cent outside) is completely different from that for the number of fatalities (nearly 60 per cent outside). This can be formulated in a different way: outside built-up areas the ratio between the number of recorded fatalities and injuries is about 1 : 12 and inside about 1 : 60. This suggests that accidents outside built-up areas are less frequent but on average more serious; the latter is largely due to the higher speeds.

### 3.3. Comparison with a number of other European countries

In countries with a bigger population and more traffic (for instance France, the German Federal Republic), there will obviously be more traffic casualties. There is thus little point in making a direct comparison of the numbers of casualties.
Nevertheless, comparison of road safety in various countries is possible if we use the proper standards or indicators. In this case, let us take one of the most important indicators: the number of traffic fatalities per 100,000 inhabitants (Figure 6 and Table 10). It then appears that there are fairly considerable differences between the eight countries covered by the comparison. France and Belgium emerge as relatively unfavourable, and at first also the German Federal Republic, though less so after 1972. Britain and Sweden compare quite favourably; a striking feature is the dip in fatalities in Sweden in 1967, resulting from the special safety precautions taken in that year because of the change from driving on the left to driving on the right. The Netherlands are in the middle, more or less coinciding with Denmark until 1973 and in 1974 about equal to Italy.
It is notable that in 1974 all the countries had varying degrees of reductions in the number of fatalities; in some countries, the decrease already started in 1973. There seems to be no question of a typically Dutch phenomenon.

### 3.4. Detailed information

The risk of being killed in a traffic accident is closely related to age (Figure 7 and Table 11). Up to about 15 years, the fatality rate per 100,000 inhabitants in these age groups is comparatively small. Between 15 and 25 the risk is twice to three times as great; above this, there is a decline again, a minimum level being reached between 35 and 45. Over 45, there is a greater and greater increase, and between 75 and 85 we find the highest figures of all.
In explaining this pattern, the following four elements are very important: the

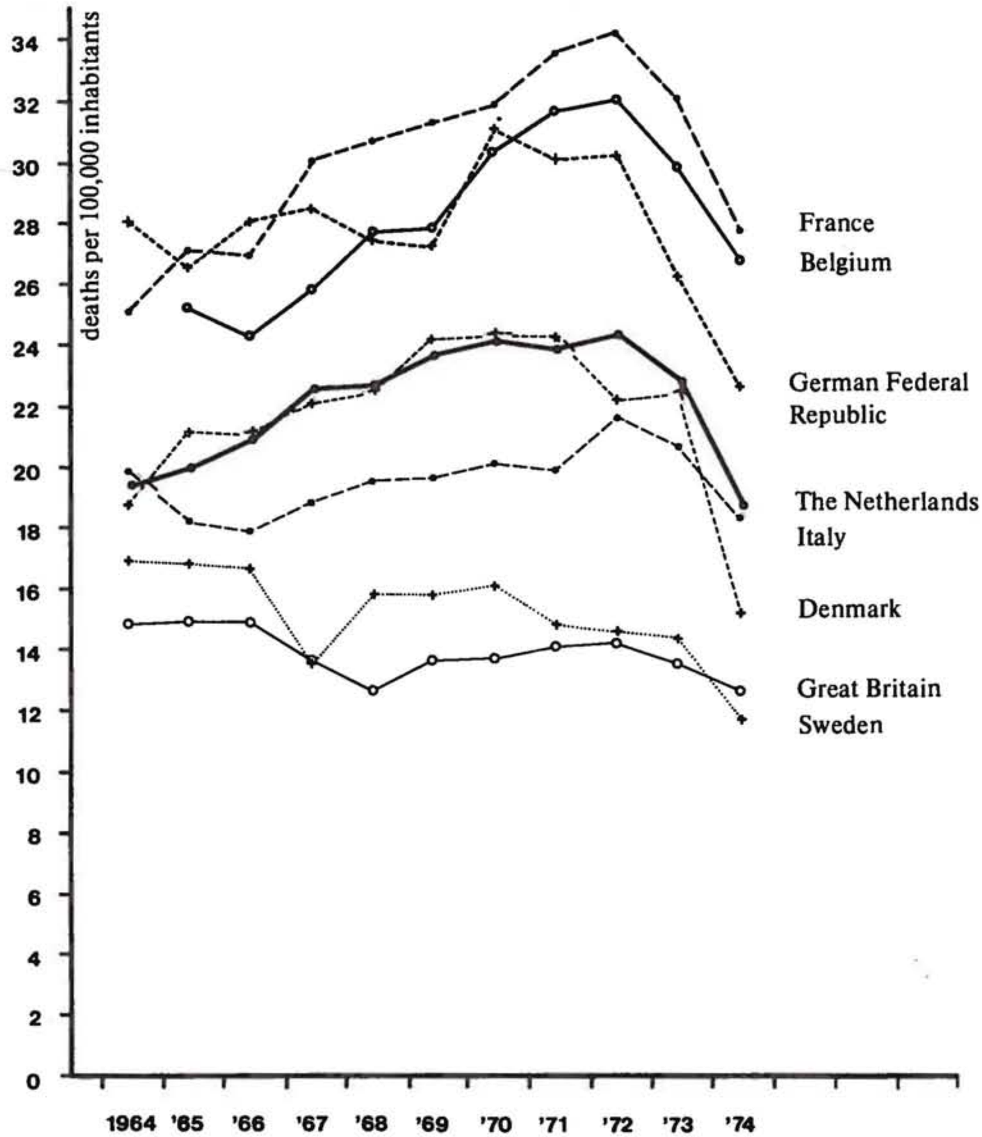


Figure 6: Trend of numbers of road-traffic fatalities per 100,000 inhabitants in eight European countries from 1964 to 1974

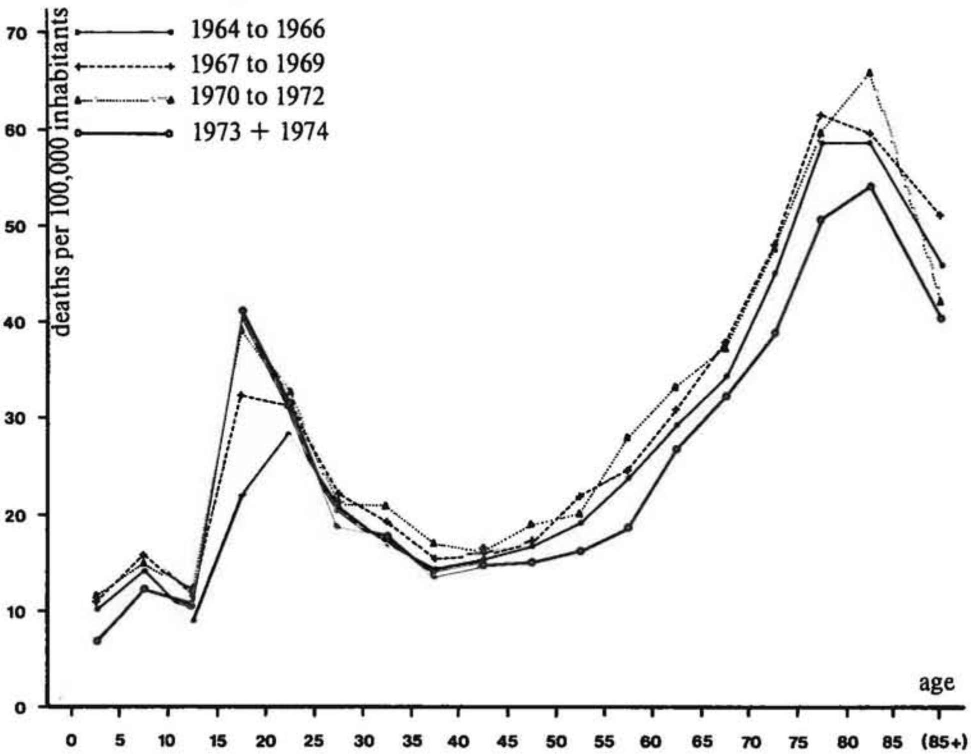


Figure 7: Comparison of average numbers of road-traffic fatalities per 100,000 inhabitants by age groups in a number of periods

extent of road usage, mode of usage (type of vehicle), the number of accidents per $10^9$ kilometres travelled (the accident rate) and the chances of those involved in accidents surviving. All four variables are age-related in different ways. The numbers of kilometres covered by the various modes of transport per age group, however, are not known. (Such information cannot in fact be obtained with counts, but only from interviews. Extensive interviews concerning these and many other exposure data are at present in course of preparation).
Nor are there any data on the numbers of accidents involving only material damage per age group and part of those involving injury. Hence it is impossible to establish the relationship between these variables.

The decrease in deaths per 100,000 inhabitants in 1973 and 1974 took place in nearly all age groups. An exception is the 15 to 25 group. From 1964 to 1974 the risk of being killed in a traffic accident had risen most in the 15 to 25 age group; it had almost doubled.

Classification of the numbers of traffic fatalities according to mode of road usage puts the private car right at the very top (Figure 8 and Table 12). The number of fatalities among cyclists, moped riders and pedestrians does not differ much: in 1974 there were between 400 and 500 deaths in each category. In 1975 the differences have become somewhat greater owing to the big drop in the number of moped-rider casualties. Since 1972, there has been a falling trend in all three categories.
As compared with the others there are few deaths among motor cyclists and scooter riders and occupants of trucks (including delivery vans). In 1969 the first-mentioned category had the lowest figure (76 deaths) and in recent years it has fluctuated around 100 a year. The number of occupants of trucks killed is gradually decreasing slightly, and 1975 was a particularly good year (39 deaths).

It has already been pointed out that distribution of the number of fatalities (per 100,000 inhabitants) depended, among other things, on the mode of road usage. Figure 9 and Table 13 show this clearly; the numbers of fatalities are given by age groups for the various modes of road usage. They are averages for the period 1970 to 1973. Among very young children (0 to 5 years), most casualties are pedestrians; between 5 and 10 they are both pedestrians and cyclists, and between 10 and 15 mainly cyclists. Between 15 and 20, moped riders predominate (the minimum permitted age for riding a moped is 16) although there is already a sizable proportion of car occupants. Over 20, private cars always account for most casualties. This only changes at advanced ages, when the highest toll is taken among pedestrians and cyclists. Motor-cyclist and scooter-rider casualties are mainly in the 15 to 30 age groups.

The percentage of road users killed in accidents *inside built-up areas* is not the same for the various modes of road usage (Table 14). It is highest among pedestrians (in 1973 nearly 70 per cent) and lowest among car occupants (about 23 per cent in 1973). These disparities can be explained by the differences in traffic

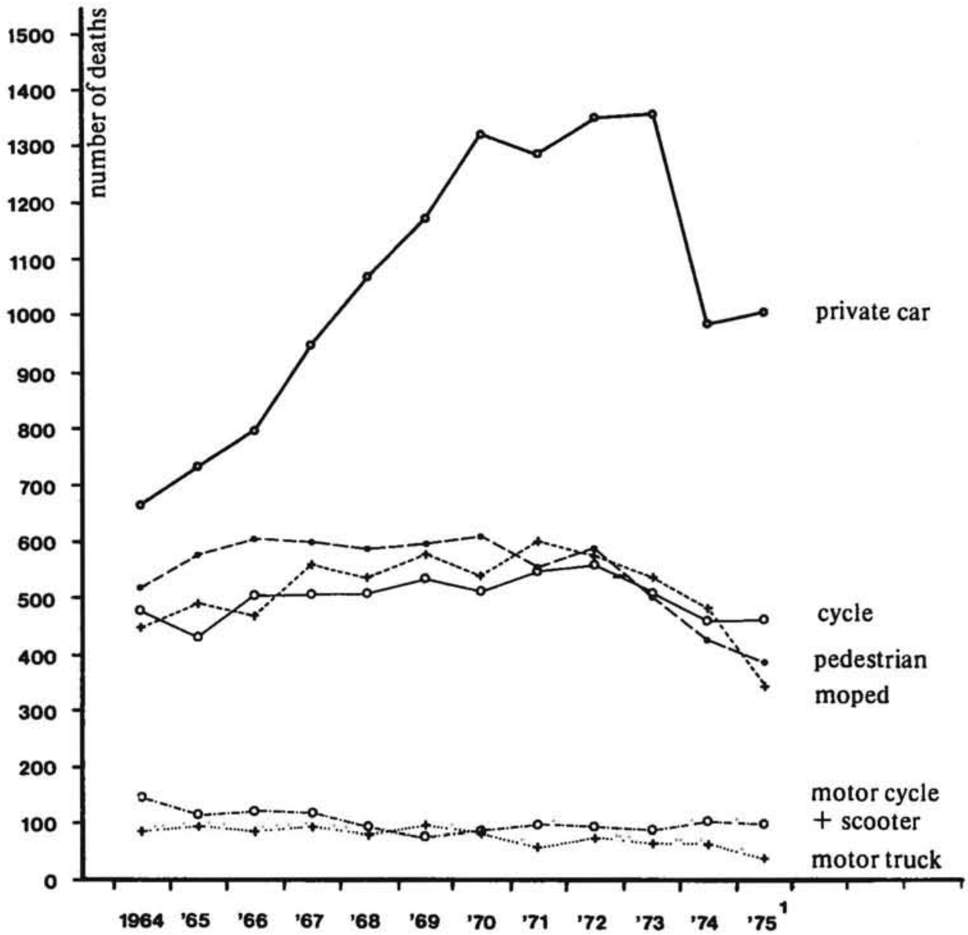


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Figure 8: Trend in numbers of road-traffic fatalities according to mode of road usage from 1964 to 1975.

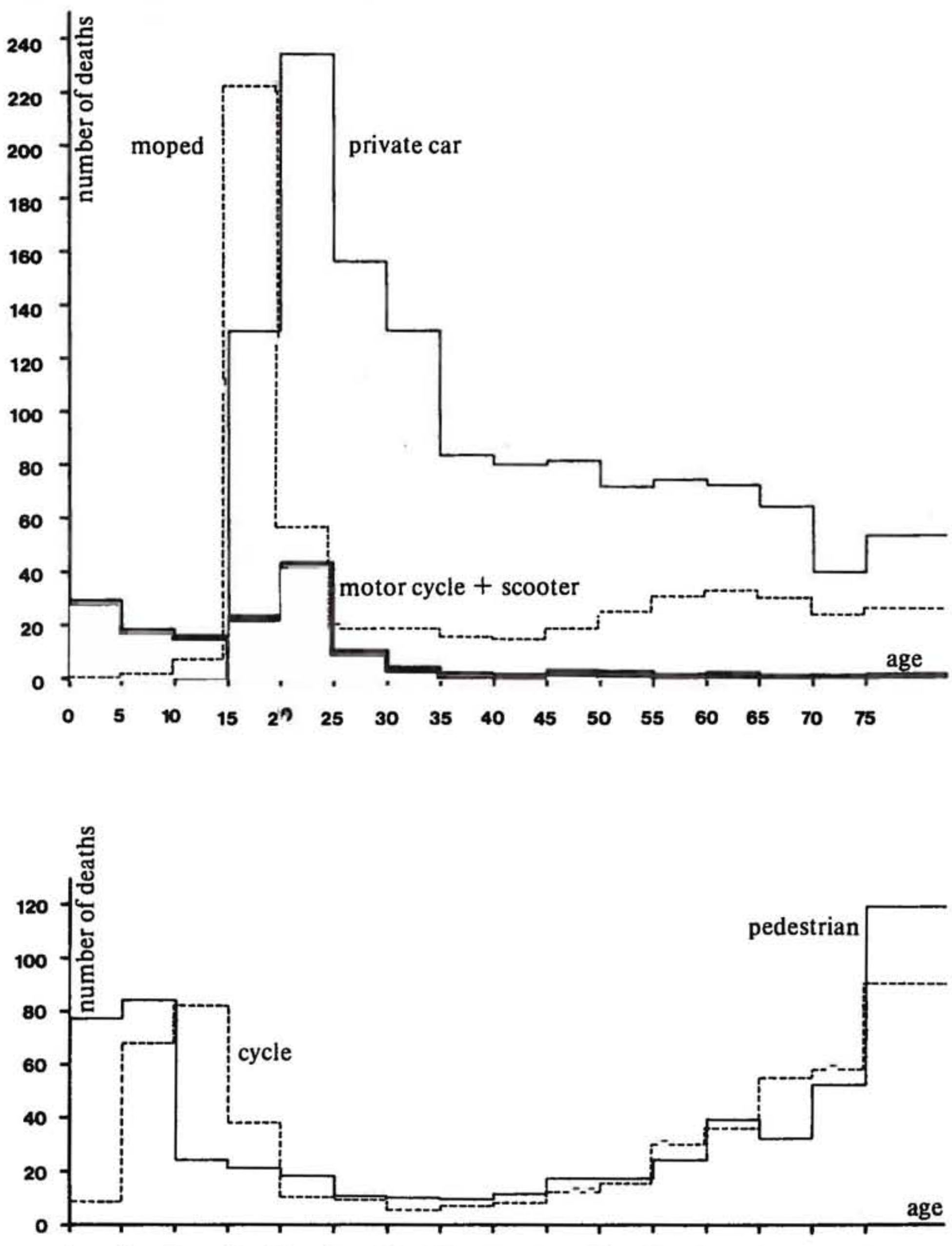


Figure 9: Comparison of average numbers of road-traffic fatalities according to mode of road usage by age groups from 1970 to 1973.

inside and outside built-up areas and by the fact that a car provides its occupants with comparatively more protection inside built-up areas because of the lower speeds. More precise determination of the two effects will only be possible when adequate figures are known for the traffic and/or travel performance of the various modes of transport, classified according to inside and outside built-up areas.
Among nearly all road-user categories, the percentage of fatalities inside built-up areas tended to rise from 1964 to 1973; for all categories combined, it remained more or less constant during that period. This is not as improbable as it sounds, if we realise that an ever increasing proportion of traffic fatalities are car occupants, and that in their case the percentage of fatalities inside built-up areas is far less than the average.

Comparison of the days of the week reveals no great differences between the respective days (Table 15). Most fatalities occur on Sunday. Friday also has a comparatively large number. The proportion on both days also increased somewhat from 1964 to 1974, while on Saturday it remained about constant. Tuesday, Wednesday and Thursday have the lowest proportion.

According to the classification by types of accident, used by the Central Bureau of Statistics in The Netherlands (CBS), collisions between moving vehicles cause most deaths (Table 16). Up to 1971 there was also a pronounced increase in this category. About half the deaths in this type of collision occur in side-ways impacts; a smaller number (between 500 and 500) in head-on collisions and fewer still (between 300 and 400) in head-to-tail impacts.
As regards other accidents, 'impacts with pedestrians' caused most casualties until recently. In 1973 most casualties were caused by crashing into stationary objects (trees, posts, walls, parapets, and so on), a type of collision in which the number of deaths has nearly doubled since 1964! The death rates in other types of accidents are lower and have hardly changed since 1964.

Lastly, Table 17 shows the numbers of fatal accidents according to road situations. Both inside and outside built-up areas, about 50 to 60 per cent of these accidents happen on straight road sections (with no intersections). Inside built-up areas, mainly junctions (crossings, squares, T-junctions etc.) are next in fatal accidents: about 40 per cent. In bends or at corners the proportion is less than 10 per cent. Outside built-up areas, where the road-system is more spread out and hence has comparatively fewer intersections, crossings account for about 25 per cent. But the percentage 'at corner or in bend' is high: 15 to 20 per cent. Besides there perhaps being more bends in the roads, the higher speeds will be a major cause.

The description of road safety is this chapter is concise and gives a broad outline of trends since 1964. The next chapter will deal more fully with a striking aspect: the big decrease in the number of fatalities in 1974 and 1975.

# 4. The drop in road fatalities in 1974 and 1975

## 4.1. General

The number of fatalities in The Netherlands were greatly reduced after the closing months of 1973 compared with preceding years. The same phenomenon was noted in a number of other West European countries (See section 3.3.) and also in the United States, for instance, where there were about 20 per cent fewer fatalities in 1974 than in 1973.
Such a decrease could never have been expected from a 'normal' trend in road safety and had never occurred before since the Second World War. The greatest relative decrease in The Netherlands was in 1958: a decline of about 6 per cent, partly atributed to the introduction of a speed limit in built-up areas.
An explanation is obviously being sought, and it would be very valuable indeed if it provided information of importance to road safety policy. It is all the more regrettable, therefore, that available data are not always adequate for effective analysis; those on 'exposure' (the number of vehicle and traveller kilometres) and driver behaviour (such as speeds) are too limited. An overall analysis will therefore have to suffice, in which the possible influence upon road safety of a number of changes can only be established approximately.

Data on road safety are available in the form of traffic accidents involving injury, with fatal consequences and numbers of casualties. Owing to the changes in recording level mentioned earlier, an analysis of the trend of accidents involving Injury and the numbers of persons injured is no longer possible. All we can state is that the number of persons injured as recorded in 1974 was about 6 per cent lower than in 1973 and in 1975 about 15 per cent lower than in 1973. It is impossible to say how the decreases in both years compared with the trend-wise figures. Consequently, this chapter deals with fatalities only.

This limitation means that we have to deal with relatively small numbers, so that the effect of chance fluctuations may be comparatively great. Furthermore, it is not possible to ascertain any movements from severe to less severe accidents, which would be very likely owing to measures such as the compulsory use of crash helmets for moped riders and of seatbelts.
Another limitation is that when this section was being compiled (mid-March 1976) complete accident statistics for the year 1974 were not yet available and only provisional figures had been published for the year 1975.

Following the comparison of road safety in sections 4.2. to 4.6., section 4.7. gives and discusses data on a number of factors that (may) influence road safety, such as

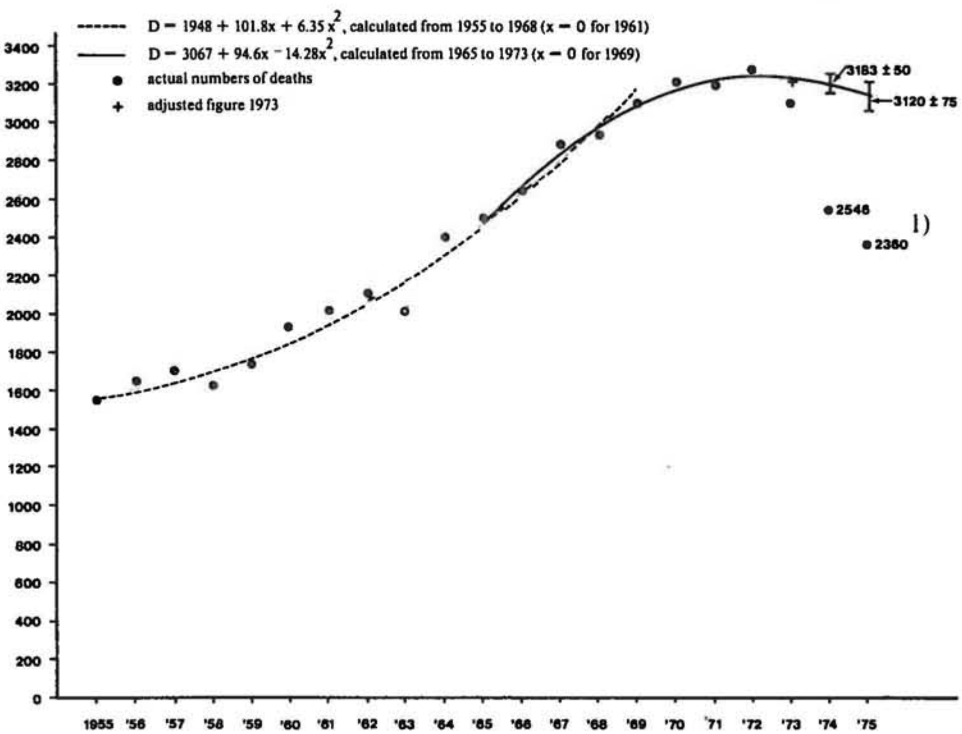


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Figure 10: Movement in total number of traffic fatalities since 1955

traffic densities, speeds, car-sales figures, use of seatbelts and crash helmets and volume of precipitation.
Section 4.8. discusses the results, indicating how the decline in fatalities might be explained.

## 4.2. The number of fatalities in 1974 and 1975 compared with trends in previous years

Fatalities in 1974 numbered 2,546, or many fewer than in 1973, when 3,092 were recorded. We have to go back as far as 1965 to find a lower figure. In 1975 there was a further decrease and there were 2,321 fatalities, comparable with those in 1964. These comparisons become even more significant if we look at the number of private cars in these years (See Table 1):
1964: 1.1 million – 1975: 3.4 million;
1965: 1.3 million – 1974: 3.2 million.
The movement in the number of fatalities per year since 1955 is shown in Figure 10. It can be split into a trend, showing the general movement over a greater number of years, and the more or less incidental annual fluctuations. The trend can be visualised as a flowing curve closely approximating the annual figures (regression curve). In this case, a good approximation of the trend for 1955 – 1973 proved possible with the aid of two quadratic curves. An approximation with one curve would be more attrative but was not as useful as that chosen).
We note a movement in which there was a greater and greater increase in deaths up to 1966/1967. After that, the curve flattened out and reached a peak in 1972. The big decrease in 1974 and 1975 was already noticeable in the closing months of 1973, after the beginning of the 'energy crisis' (including the ban on Sunday driving and voluntary speed limitation) (SWOV, 1974 b).
The most realistic picture of the decrease in 1974 and 1975 is obtained by comparing fatalities in those years with those according to the trend. The latter figure was calculated by extrapolating the trend for 1965 to 1973. Calculation of this curve was based on an adjusted figure for 1973 in order to eliminate the effect of the decrease at the end of that year. With such a simple regression calculation, extrapolation for one to two years is justified.
For 1974 an estimate of 3,183 ($\pm$ 50) deaths was made in this way. The actual figure was 2,546, or about 20 per cent fewer.
In 1975 deaths numbered 2,321 as compared with an estimated 3,120 ($\pm$ 75), corresponding to a reduction of about 26 per cent.

## 4.3. Comparisons per month and per quarter

As indicated in the previous section, continuation of the trend in 1974 and 1975 would have given 3,180 and 3,120 deaths respectively. This section endeavours to indicate to what extent the reduction can be allocated to certain months or quarters.

Comparison of monthly figures for two succesive years shows the influence of change divergences to be relatively greater still. In order to limit the effects of these fluctuations somewhat, the average proportion for each month was calculated from the figures for 1970 to 1973 (with adjusted figures for November and December 1973). With these monthly percentages, the numbers of deaths calculated for 1974 and 1975 were divided over the twelve months. If we compare these with actual numbers recorded per month, we find differences from the expected figures. The differences, in absolute numbers and percentages, are given in Table 18. A similar comparison was made for the quarterly figures.
The months of March, May, July and especially November 1974 show decreases greater than the average 20 per cent in the figure for the year. Quarterly subdivision shows that the fourth quarter of 1974 had the greatest share of the reduction (25 per cent).
In 1975, April, October and November had the greatest reductions. There were relatively slight reductions in January and August. Per quarterly, the drop in the first quarter was noticeably less than the average for the year, while the biggest decrease was in the fourth quarter, similarly to 1974.
It is striking that the great fluctuations in the percentage decreases per month are not as evident in the quarterly percentages. This might indicate that the quarterly figures are a better basis for judging the differences.

## 4.4. **Comparisons of inside and outside built-up areas**

As already stated in section 3.2., the ratio between annual numbers of fatalities inside and outside built-up areas in 1974 did not noticeably change. The relative decrease in both cases was apparently about the same.
In 1975, the decline inside built-up areas was greatest; the proportion of fatalities inside built-up areas fell to just below 40 per cent.
These conclusions relate solely to annual figures; quarterly, more differences are found.
Differences between actual and expected deaths, subdivided for inside and outside built-up areas for 1974 are given in Table 19. Inside built-up areas the greatest decrease was in the fourth quarter. Moreover, there is a pronounced difference in the percentage decrease as between inside and outside only in the first quarter. This may be of importance in seeking the explanations.
For 1975, such a quarterly breakdown for the two areas cannot be given because the requisite figures are not yet available.

## 4.5. **Comparison by provinces**

From the distribution of fatalities over the provinces in 1971, 1972 and 1973, the average proportion per province was calculated for this period. With this distribution, the expected numbers for each province were calculated for 1974 and 1975 from the expected national figures (3,183 and 3,120 deaths).

The calculated and actual numbers for both years are given in Table 20. The differences as calculated in numbers and percentages are also stated.
In 1974, the decline in two provinces was much greater than the national decrease of 20 per cent: in Noord-Brabant (26 per cent) and Limburg (26 per cent). There were relatively small decreases in the provinces of Friesland, Overijssel, Utrecht and Zuid-Holland (13 to 14 per cent).
In 1975, the differences between the provinces were somewhat smaller; Noord-Brabant had the greatest decrease (31 per cent), Overijssel the smallest (19 per cent).
In view of the numbers of fatalities to which the decreases in both years relate, it seems that none of the differences so found differ significantly from the national percentage decrease.

## 4.6. Distribution according to mode of road usage

The distribution of fatalities according to mode of road usage in 1964 to 1975 is given in Table 12.
Comparison of the numbers in 1974 with those in 1973 shows that the relative decrease in the number of pedestrian fatalities is about the same as in the total number of fatalities. In the case of cyclists and moped riders the decline is less and for motor cyclists and scooter riders there is even an increase. The greatest decrease was in the case of car occupants (about 27 per cent). The proportion of these in fatalities, which had shown a pronounced tendency to increase in the previous years (from 28 per cent in 1974 to 44 per cent in 1973), fell again in 1974.
In 1975, the big decrease in the number of moped riders killed was the most striking (28 per cent fewer than in 1974). The number of pedestrian fatalities also decreased further. On the other hand, there was a slight increase in the number of car occupants killed. As to cyclists and moped riders, the numbers were practically unchanged compared with 1974. A noticeable aspect is also the decrease in fatalities among motor-truck occupants in 1975, whereas there was no change in 1974 as compared with 1973.

## 4.7. Comparisons of a number of factors that may have influenced road safety

### 4.7.1. *Introduction*

In 1974, a number of measures were taken (some relating to the energy crisis) which influenced traffic and road safety. For instance:
- fuel rationing (11th January to 5th February);
- higher fuel prices;
- an overall speed limit on roads outside built-up areas of 100 km/h on motorways, 80 km/h on other roads;
- the new legislation on drinking and driving of 1st November;
- the announcement of compulsory wearing of crash helmets for moped riders.

These measures will have influenced the number of vehicle kilometres, driver behaviour and the severity of accidents.
In 1975, the following measures took effect:
- on 1st February compulsory wearing of crash helmets by moped riders;
- on 1st June the compulsory use of seat belts by front-seat occupants of all private cars built since 1971.

This section will go - briefly - into these matters. Several other factors will be dealt with which may have contributed to the changes in the accident pattern in 1974 and 1975, such as sales of (new) cars and weather conditions.

4.7.2. *Mobility - Traffic flows*
Counts at a number of major check-points, mostly outside built-up areas, gave average weekday traffic flows in the form of index figures (index year 1972 = 100) (SWOV, 1974b). The monthly movement in these calculated index figures for the years 1971 to 1973 is shown in Table 21. The figures that would have been expected with 'normal' growth in 1974 are also stated. Moreover, the figures for September 1973 to October 1975 are given, as calculated by the Central Bureau of Statistics in The Netherlands CBS from observations at 265 check-points. Comparison of the figures for the last four months of 1973 shows that the results of both calculation methods hardly differ. It is therefore justifiable to compare the CBS figures for 1974 with the forecast calculated from the SWOV figures for that year.
We then find the following: in the first quarter of 1974, the average flow was 8 to 10 per cent lower than expected, and also lower than in 1973; in the second quarter of 1974 observed flow were 2 to 4 per cent lower than expected, but a little higher than in 1973; in the third quarter of 1974, except for the month of September, the mean flow was even higher than could have been expected with normal growth; as to the fourth quarter of 1974, a forecast was made only for October; for November and December, extrapolation was not possible because in those months a decline had already started in 1973 owing to the energy crisis.
In 1975, increased flow was again observed, not only in the first half year when flows in 1974 were relatively low, but also in the months thereafter.
To sum up, it can be said that the (relative) limitation of car driving was clearly observable only in the first quarter of 1974, at least *outside built-up areas*.

Similar data for traffic *inside built-up areas* are not available. Here, too, fast traffic will have been reduced in the first quarter, because part of most inter-urban journeys takes place inside built-up areas because they start or end there or pass through them. But it is not known to what extent purely local car journeys decreased.

The reduction in car usage may have resulted in a change to other means of transport or to decreased mobility. No figures are known about any increase in walking and the use of cycles and mopeds. In 1974 as compared with 1973, there was indeed some increase in public transport, as shown in Table 22. If we compare this table with Table 21, we find that the relationship between the increased use of public

transport and the decrease in car usage is not entirely clear. The figures correspond only for January (fuel rationing).
The number of traveller kilometres with private cars is a multiple of that with public transport (seven times as many in 1973); this means that if, say, 10 per cent less use is made of cars and public transport is chosen instead the latter will increase by 70 per cent. The reduction in car traffic in January 1974 was obviously absorbed only partly by public transport.

4.7.3. *New (inexperienced) drivers*
It is a known fact that inexperienced drivers are involved in accidents relatively more than experienced ones. The fact that sales of new cars in 1974 lagged behind those in previous years might indicate that fewer 'new' drivers were on the road in 1974. The number of new, inexperienced drivers is determined in the first instance by:
- sales of new cars in the period in question;
- the number of cars taken off the road in that period;
- the number of drivers that stop driving in that period.

In addition, several secondary factors have an influence, such as one car being used by several drivers.

Of all these data, only new car sales are known; the other numbers can only be estimated; especially the number of cars taken off the road is very uncertain because it may be influenced by the reduction in new sales.
Examination of sales figures (Table 23) shows that especially in the first quarter of 1974 these were relatively low. In the second half-year sales were even on the high side, and those for the year as a whole were some 6 per cent lower than in the two preceding years. The difference is so slight that even if no fewer old cars had been discarded in 1974 than for normal new sales, the effect on the number of new drivers would be negligible.
In 1975, sales of new cars exceeded those in all previous years. Apparently, the reduced sales in 1974 were in most cases a question of deferring buying a new car, so that arrears were made up in 1975. This may have led to there being rather more inexperienced drivers in 1975, but even so the difference compared with the number normally expected will only have been slight.

4.7.4. ***Use of seat belts and moped riders' crash helmets***
The increased use of seat belts by car occupants from 1971 to 1973 stopped in 1974. This is revealed by the results of enquiries in those years, the main data for which are given in Table 24 (SWOV, 1975a).
Fewer deaths among car occupants in 1974 cannot therefore be explained either wholly or partly by increased seat belt wearing.
On the other hand, the use of seat belts did increase very greatly in 1975 owing to the regulations of 1st June 1975. There are strong indications that this increase had already started prior to 1st June. The somewhat lower percentages observed in October 1975 might suggest a slight decrease in use of seat belts after June. Owing to the changes before and after June it is not possible to make an exact calculation

of the average user percentage for 1975. A fair assumption would be that the average user percentage in 1975 was between 40 and 50 per cent. In comparison with 1974, this is a considerable increase, which will have had a substantial influence on the number of fatalities. How great it was can be calculated approximately from the increase in user percentages and the effectiveness of seat belts. As the percentage of users outside built-up areas is always higher than inside, these calculations are usually made separately for both cases. This is impossible for 1975, however, because the breakdown of the approx. 1,000 private-car deaths between the two is not yet available. Hence, a single calculation was made, using average percentages. Starting with the following approximations:

- average user percentage in 1974: approximately 15 per cent;
- increase in average user percentage in 1975 on 1974: about 30 per cent;
- proportion of front-seat fatalities: about 80 per cent;
- reduction in risk of being killed by wearing seat belts: average about 60 per cent (Edelman & Van Kampen, 1973),

then the reduction in the number of car-occupant deaths in 1975 on 1974 (other conditions being equal) can be estimated at:

$$\frac{0.3 \times 0.8 \times 0.6}{1 - (0.15 \times 0.8 \times 0.6)} = 0.16 \text{ or 16 per cent}$$

Without the increase in seat-belt usage, 1,000 : (1−0.16) = 1,190 persons were likely to have been killed in private cars in 1975, or nearly 200 more than the actual number.

Matters are rather different as regards crash-helmet wearing by moped riders, as the figures in Table 25 show. Although these are the results of limited sampling (SWOV, 1975b), they are so striking that crash-helmet wearing can certainly be claimed to have contributed towards the reduction in moped-rider fatalities in both 1974 and 1975.
It is not possible to calculate the reduction in the number of deaths resulting from increased wearing of crash helmets; the figures in Table 25 can hardly be used for this because this was a small sample, the results of which cannot be regarded as representative for the whole of The Netherlands. Moreover, it is not exactly known how great the reduction in the risk of being killed in an accident is when moped riders wear crash helmets; based on research in other countries, it is mostly assumed that it is about 40 per cent (SWOV, 1973a).
(If the sample data were approximately representative and the 40 per cent reduction is also applicable, then the following results would emerge: in 1974 about 50 fewer fatalities than in 1973, and in 1975 about 100 fewer fatalities than in 1974 owing to an increase in wearing crash helmets).

### 4.7.5. *(Private) car speeds*

Petrol rationing from 11th January to 6th February 1974, and the subsequent general speed limits on roads outside built-up areas influenced motorists' speeds in 1974 and probably also in 1975. Speeds may also have been influenced by other

causes, such as the energy crisis in general or higher fuel prices. But no sufficiently systematic speed measurements on all the relevant roads, which would enable changes in time and place to be established, are available. The following data can be regarded as an indication of the change in driving speeds.
According to statements by the Minister of Transport & Waterways, the speed not exceeded by 85 per cent of motorists (the 85 per cent speed) on motorways was about 107 km/h from April to July 1974, went up after this to about 110 km/h and then fell again to 108 km/h in mid-November. Prior to October 1973, the 85 per cent speed on these roads was said to have been about 120 km/h. More recent measurements on motorways show that in 1975 speeds have changed little since November 1974.
Speed measurements on provincial roads in Drenthe, Gelderland, Zeeland and elsewhere produce varying results. In most cases, there was a more or less big drop in speeds after the limits were introduced. On some roads speeds increased. Nothing at all is known about any change in speeds in built-up areas.

4.7.6. *The drinking and driving legislation*
Since 1st November 1974, drivers of vehicles have been punishable if their blood alcohol concentration (BAC) proved to exceed 50 mg/100 ml blood. There was a lot of publicity prior to introduction of the Act, and the knowledge that there would be a high level of supervision greatly reduced drinking-driving. This applied in any event to November 1974, as found in SWOV research into drinking and driving habits in October and November 1974.
The results of this research (SWOV, 1977) indicate a very great reduction in the number of non-sober drivers. The long-range effects can only be judged when more recent research results become available. In view of experience of similar regulations in a number of other countries, not too much should be expected of any long-term impact. This is not relevant in assessing road safety in the closing months of 1974 and it would seem a fair assumption that the legislation was a factor in reducing fatalities in those months.
Data on its influence on the number of deaths in 1974 and 1975 are given by Noordzij (SWOV, 1977).

4.7.7. *Weather conditions*
Weather conditions such as rain, snow and gales may influence the accident risk. The influence may be direct (poor visibility, slippery surfaces, etc.) or indirect (whether to drive or not, choice of means of transport).
Comparison of the numbers of hours and volumes of precipitation in 1974 with preceding years (Table 26) shows that 1974 was a comparatively wet year. This applied in the first place in the third and fourth quarters, less in the first quarter and definitely not in the second quarter which tended to be dry. The number of snowy days in 1974 was far behind that in previous years.
In 1975, the second half-year was on the dry side; the number of snowy days in that year does not seem to be abnormal.
The relationship between hours and volumes of precipitation on the one hand and road safety on the other is probably very complicated. Since little is known about

this, the very broad data can hardly indicate the extent to which weather conditions in 1974 and 1975 influenced the number of fatalities in those years. It does, however, seem clear that weather conditions in both years were not so extreme as to explain very much of the change in road safety.

## 4.8. Summary and discussion

### 4.8.1. *The 1974 drop*

Fatalities in 1974 about 20 per cent lower than the expected trend and about 18 per cent lower than in 1973 definitely cannot be regarded as a chance fluctuation. This phenomenon was noted not only in The Netherlands but in many other Western countries as well. The explanation will therefore have to be sought firstly in changes that were not confined to The Netherlands. The obvious thing is to think of the implications of the energy crisis and the consequent measures. But such a general comment tells us nothing about what really happened; this requires detailed analysis of all the relevant changes. As already observed in the introduction, this is impossible because the necessary information is lacking or not (yet) complete.
Yet several things can be deduced from the available data, on the understanding that fuller information on the changes might lead to different conclusions.

The fall in the number of fatalities occurred in all four *quarters* of 1974: most in the fourth quarter and least in the third (Table 18).
For the year as a whole, the reduction *inside and outside built-up areas* was about the same, but taken quarterly this does not apply to the first quarter, in which the decrease outside built-up areas was greatest (Table 19). This suggests that the speed limits and the preceding fuel rationing had a favourable effect.
The reduction in motor *traffic flows* in the first quarter might also be a cause, but only on the assumption that it was much greater on roads outside built-up areas (Table 21) than inside. This does not seem very likely, especially bearing in mind that part of the traffic in built-up areas is directly related to that outside. Obviously the lower traffic performance will have contributed to the general decline in the number of fatalities, especially in the first quarter. But it is not known whether there was a contrary increase in cycle and/or moped traffic.
It will not be coincidence that the introduction of the *drinking and driving* legislation and the decrease in the proportion of non-sober drivers was attended by a further reduction in the number of fatalities in the fourth quarter. This reduction took place both inside and outside built-up areas (Table 19) and was much greater than the average reduction for the year as a whole.
Increased wearing of *crash helmets* by moped riders (Table 25) is bound to have had an effect; this explains a large part of the decrease in moped-rider deaths. Related to the aggregate number of fatalities, this reduction is of course not very significant (1 to 2 per cent).
No increase in *seat-belt usage* was established in 1974 (Table 24), and hence this cannot explain the reduction in car-occupant deaths.

The decrease in the percentage of *'new' car drivers* can certainly have contributed to greater road safety. But its influence must not be overrated; at best, it could not have led to a reduction in fatalities of more than about 2 per cent.
The difference in percentage decline *province-wise* are remarkable. They may be partly due to chance fluctuations. As long as these differences cannot be analysed further, they are nothing to go by in seeking to explain the increased road safety. Nor can the finding that 1974 was a *wet year with little snow* be translated into a consequent reduction in road fatalities. It is not even clear whether a lot of rain causes more or fewer fatalities.

If we put all these causes of greater safety together, not more than about a 10 per cent decrease in the number of fatalities can be attributed to them. One or more other causes will have to be found for the other 10 per cent. The fact that speeds outside built-up areas, at least on motorways, remained lower - even after the first quarter - than prior to 1973 seems important. But we then have to assume that speeds also fell inside built-up areas or that there are other causes there bringing about the same improvement as the lower speeds outside. All this suggests a persistent general effect of the energy crisis. But this cannot be precisely defined and one grasps at general terms such as 'driving calmer'. It is quite possible that such a change did take place but there is little point in seeking a correlation with road safety without objective observations proving such a change in driving habits.

In seeking further for the causes, attention will definitely have to be paid to the difference between slow traffic and private cars. In the case of car occupants there was a very great, sudden drop in the number of fatalities in 1974, whereas in previous years there had been a rising trend. In the case of pedestrians, cyclists and moped riders on the other hand, the number of deaths had already been decreasing since 1971 or 1972. This might mean that especially the volume, driving habits and so on of private car traffic was a decisive factor in the reduction in fatalities in 1974.
Many other improvements, for instance to roads, vehicles and so on, of course, have also helped to improve road safety. But as far as is known, there were no spectacular changes in these respects in 1974. Such improvements will therefore be (partly) responsible for the reversal in the trend of fatalities already noted for some years (Figure 10), but do not explain the abrupt drop in 1974.

#### 4.8.2. *The 1975 drop*

In 1975, there were about 26 per cent fewer deaths than was expected trend-wise and about 9 per cent fewer than in 1974.
The introduction of compulsory crash-helmet wearing for moped riders on 1st February 1975 and of seat belt wearing for a large proportion of motorists on 1st June 1975 will have contributed to a further decrease in the number of fatalities in that year. In addition, the drinking and driving legislation of 1st November 1974 will also have had a favourable effect in 1975, though its extent cannot (yet) be indicated.
But there are several other facts pointing in the opposite direction. Whereas in

1974 there was at first a reduction in private car mobility, in 1975 there was a substantial increase, at any rate outside built-up areas.
The record car sales may have had a - slight - adverse effect on safety due to the rather higher percentage of inexperienced drivers.
It is also reasonable to assume that the favourable effect of the speed limits on roads outside built-up areas was somewhat slighter in 1975 than in 1974.
Possibly of equal importance is the fact that much of the reduction in deaths in 1974 could not be explained; all that could be stated was that it was presumably a direct or indirect effect of the energy crisis and that most effect was observed among car occupants. We can, of course, assume that this 'energy-crisis effect' still existed in 1975, but to a less extent than in 1974. It can then be examined whether this hypothesis is confirmed or refuted by the available figures.

An important statistic for this is the classification of fatalities according to mode of road usage (Figure 8 and Table 12). A slight decrease in the number of private-cars deaths seems to accord with the increased use of seat belts, which is estimated to have saved almost two hundred lives (see also Section 4.7.4.). However, the greater traffic performance in 1975, the possibly slighter effect of the speed limits and a rather higher percentage of inexperienced drivers can, in combination, have destroyed partly the 'seat belt gain'. The impact of the drinking and driving legislation can also be indicated as a cause, because the regulation was in force throughout that year compared with only two months in 1974.
In casualties among cyclists, moped riders and pedestrians, we observe a different development. As stated earlier, the reduction in fatalities in these categories already started after 1971 or 1972. It is not easy, therefore, to establish what proportion of the decline in 1974 was due to the energy crisis. Nor can we, therefore, establish whether the smaller reduction in 1975 (pedestrians) or ending of the reduction in that year (cyclists) is due to a reduced energy-crisis effect in 1975. The increased decline in the number of moped-rider deaths is in complete agreement with the increased wearing of crash helmets (section 4.7.4.) and the reduction in the number of moped riders in 1975.
To sum up, it can be said that the trend in the numbers of slow-traffic fatalities neither confirms nor refutes the hypothesis of the (lessened) energy-crisis effect. The other categories (motor trucks, motor cycles + scooters, other vehicles) have too few casualties for confirming or refuting assumed changes of a general nature.

As to the year 1975, there are some other phenomena which cannot yet be explained adequately, if at all. For instance, the quarterly percentage decreases in the last column of Table 18.
The fact that the percentage decrease during the first half year increases in time corresponds to the operative dates of the regulations referred to: compulsory crash-helmet wearing at 1st February and compulsory seat belt usage at 1st June. The fall in the third-quarter percentage is also explainable by the combination of slightly declining seat-belt usage and a gradually decreasing energy-crisis effect. But it is difficult to explain the percentage increase in the last quarter. We must allow for the differences being partly the consequence of chance fluctuations.

The conclusion is that the overall trend in road safety in 1975 can be reasonably explained by the regulations, and by taking into account a gradually lessening energy-crisis effect. The last-mentioned effect, however, can only be established but not (yet) explained; this applies both to 1974 and 1975.
The examination of road safety in 1975 in greater detail, as far as this is possible at present, still gives rise to questions in some cases. The future will have to show whether more detailed information can change this.

# 5. The total damage of road-traffic accidents

## 5.1. Introduction

Damage in this sense should be defined in the first place as the harm done to an organic entity, distinguishing between:
(a) injury; damage to living tissue, especially in human beings;
(b) material loss; damage to property;
(c) social damage; disturbance of social relationships (either temporary or permanent).

Establishment of the damage of traffic accidents can firstly be focused directly on *quantifying the primary effects.* A distinction must be made at least giving the number of accidents involving loss or damage to the particular category and the extent of the loss or damage suffered by the particular category per accident.
The degree of injury can, for instance, be subdivided into:
1. Injuries left to heal naturally, at most with treatment at home (for instance scratches and bruises). Such very minor injuries will rarely be recorded as such.
2. Injuries adequately treated at the out-patient level.
3. Injuries leading to temporary invalidity for varying length of time.
4. Injuries causing permanent partial invalidity.
5. Injuries causing full permanent invalidity.
6. Injuries with fatal consequences.

The number of categories can no doubt be extended. The more there are, however, the more rank-order problems there will be. Quantification of the degree of injury with this approach will certainly not work out above the rank-order level. The present accident records in The Netherlands distinguish only between (accidents involving) fatal and non-fatal injuries.
In principle, the degree of material damage should be quantifiable comparably to injuries. This does not seem opportune because more exact quantification can be obtained in another way.
The degree of social damage can also be quantified in a rank-order scale. An increasing degree of social damage is likely to correlate with increasing duration and degree of invalidity.

A second way of assessing the cost is to *quantify the consequences of the damage.* The focal point should be human experience of these consequences. Accidents causing injuries can be the cause of pain, sorrow and fear. They can also cause discomfort, hardship and exasperation. These are nominal distinctions not fitting into a given rank order. Gradations however can be distinguished within each category.

A third way of assessing the cost relates to the *sacrifices required to make good the damage* where possible, or to compensate for it. These can be split up into manpower, equipment, materials and space for establishments needed for the activities for remedying the damage.

A fourth quantification method can be derived from this by determining the *financial consequences* of the various kinds of sacrifies.
Much experience of this last-mentioned method of quantification has been gained in many different areas of society. That is why this is the most common approach. If quantification remains limited to this, a most incomplete picture emerges of the extent of the consequences of road-traffic accidents.
Although the financial consequences of traffic accidents are certainly not unimportant, even compared with national resources, the government's anxiety about road safety is due primarily to the human aspects: the injuries and the consequent suffering. To enhance the quality of any judgment it is important to develop more effective scales of severity of injuries and how people experience them.
The importance of a complete judgment quantitatively as accurate as possible can be illustrated with a decision-making problem: establishing priorities within a set of measures. If this establishment of priorities is based solely on financially quantified data, measures that can be effected at the same cost and provide the same financial savings will be given the same priority. But if savings with one measure are the result of reducing material damage and with another the number of casualties, then in the latter case there is also a reduction in the amount of suffering which does not arise in the first case.
As long as the saving is greater than the cost, the problem seems to be slight because both measures are economically feasible. In fact there are also budgetary limitations because the savings come later (cost precedes benefit) and moreover flow back only partly, if at all, to the budget from which the measures were financed. An example: for improving road safety in The Netherlands, most of the cost is borne by the Ministry of Transport and Waterways while most of the benefit is gained by the Ministry of Public Health and Environmental Hygiene.

If the saving is less than the cost, neither measure is economically justified. In the former case there are no other relevant considerations. Socially, the second measure may be fully justified. This applies especially when there is a small financial loss as compared with the price society is prepared to pay for the expected reduction in the amount of suffering.
The example can be elaborated. If, with both measures, not only the cost and financial saving are the same but moreover the same reduction in the number of persons injured is achieved, there may still be a difference in the reduction of suffering, if the average severity of the injuries was not the same in both cases.
Thus, in a number of successive steps the need for the fullest possible quantitative picture of road safety and the effects of road-safety measures can be illustrated. On the whole, the differences between measures that have to be compared will not be limited to one of the quentitative aspects. For instance, priorities will have to be established as between measures in which better financial results are weighted

against a smaller reduction in the number of persons injured but with less severe average injuries.
One of the possible consequences of road accidents is temporary, local traffic hold-ups, i.e. an increase in journey time. This effect is mostly disregarded in considering the economic consequences. The effect is indeed fairly small compared with the local cost to the economy.
The primary object of road-safety measures is to reduce the amound of human suffering caused by injuries. In practice, this means that measures should be concentrated on reducing the number of accidents involving injury and/or the severity of the injuries.
Hence, the benefits should *not* be expressed as the financial saving usually obtained by reducing the number and severity of accidents, but as the reduction in the number of injuries (if possible weighted according to severity). The financial saving should be deducted from the gross cost of the measure in question, thus giving the net cost. The measure with the most favourable ratio between accident reduction and net cost makes the greatest contribution to the common good in terms of road safety compared with the necessary financial sacrifice.

This section has reviewed the basically quantifiable consequences of road-traffic accidents which can be covered by the term loss and damage. This quantification can, in general, only be put in practical terms as far as the customary recording systems provide the necessary information for this.
As regards the economic consequences of road accidents, a number of investigations have been made in the course of the years which are reviewed in the following section.

The above line of thought relating to the establishment of priorities has been worked out as a decision model described in various publications (Flury, 1972 and 1974).

## 5.2. Economic cost of road-traffic accidents

As the previous section has shown, the economically quantifiable consequences of road-traffic accidents under prevailing concepts are not the only relevant factor and not even the most important factor in road-safety policy. But this economic factor is certainly not negligible. A fair number of attempts have already been made to quantify the economic consequences of road accidens, for instance for cost/benefit analyses. A number of research workers have tried in the course of time to establish the economic consequences of road accidents. Their results vary greatly, both from country to country and from year to year in one and the same country, as shown in Table 27 and 29.
Differences are of course likely due to prosperity levels and relative total number of motor vehicles. In recent decades, the number of motor vehicles has greatly increased in proportion to the population and, with it, the number of road accidents. Owing to the incessant inflation, moreover, the cost per accident has also greatly

increased. Owing to these effects, there is also an inevitable increase in the cost of road accidents.
The differences in the findings of the various workers can only be partly explained by this. Especially if the individual cost headings are considered, considerable differences exist which cannot be explained by the factors mentioned.

Comparison of Dutch figures for 1967, 1968 and 1969 gives unacceptably great differences for some items (See Table 29). Particularly striking is the very high sum for 1968, as compared with the year before and the year after, of the cost ascribed to deaths caused by road accidents.
This disparity can be explained by various investigators having different views about the appropriate calculation method.
To determine the economic cost of deaths, the objective evaluation method is often used in addition to the subjective method. With the former, there are roughly two ways of calculating the cost of lost productivity: the gross method and the net method.
The gross method means that the average cost per road fatality is equated to the capital value in the year of death of the loss of production in future years. The net method reduces this amount by the present capital equivalent of reduced future consumption. The Nil-value concept can be regarded as a special case of net-value calculation. It assumes the economic costs of death to be Nil because average production and consumption cancel each other out.
It may be noted that the gross method clashes with the view accepted here that all relevant consequences of road accidents should be quantified by the most appropriate scale. The gross method disregards the economic consequences of reduced consumption.
The Nil-value concept seems to be a theoretical construction based on certain assumptions. If these are correct for the category of fatalities as a whole, the result of the net calculation should agree with them within the confidence limits of the available data.
Data on the economic cost of road accidents are also important for calculating the expected economic effect of road-safety regulations. The Nil-value concept is certainly not correct for part-populations in a variety of accident categories. As far as forecasts of the effects of regulations are used for establishing priorities within an accumulation of measures, there is no justification for applying the average cost to accidents in their totality.

Measures are aimed mainly at avoiding accidents in a particular part-population (differentiated by type of casualty, type of accident, category of road user, vehicle, type of road or traffic situation).
In establishing priorities, the economic effects of a regulation should be computed on the basis of the cost applying within the accident category to which the regulation relates. Such a differentiation is not made in most investigations.
In calculating the economic cost of deaths in The Netherlands for 1968, the research institute concerned used the gross method; for 1967 and 1969 the researchers used the net method.

But this does not explain the disparity between 1967 and 1969. In view of the increased number of fatalities and the higher prices, a 20 per cent higher figure would have been expected for 1969 than for 1967 instead of a 25 per cent lower figure.
In other respects, too, the calculation for 1968 differs greatly from the other two years, especially as regards damage to vehicles and cost of settling claims.
By increasing these 1967 figures by 10 per cent and reducing those for 1969 by 10 per cent, it became possible to compare three investigations in respect of the same year. Per cost heading, the lowest figures were combined, next the middle figures and then the highest figures (Table 30). The aggregate cost according to the low, middle and high assessments was calculated not only by the net method but also by the Nil-evaluation for fatal injuries, and by the gross method.
The aggregate cost for 1968 so calculated varies from 510 million guilders for the low evaluation by the Nil-value concept to 1,817 million guilders for the high valuation by the gross method.

This great disparity in the outcome according to diverse viewpoints and different investigators makes it clear that the absolute significance of the findings is not great.
The trend in the economic cost of road-traffic accidents can only be indicated if a consistent research method is used. The research projects in 1948, 1962 and 1967 showed this consistency. All individual cost items show the expected steady growth. For overall calculations of the economic cost of road accidents, the data obtained in the above research projects can be used (Table 31). For this purpose, the costs so found have been grouped in such a way that the cost per fatality, and per person injured and per accident involving material damage only, could be calculated. The net method was used for calculating the cost per fatality.
The guide values for the years after 1967 have been obtained by adding 10% to the guide value of the preceding year as a correction for the inflation effect. Other factors which may influence the cost indices have not been taken into account.
The key figures for road safety have been obtained from or are based on publications of the Central Bureau of Statistics in The Netherlands CBS.
The number of accidents with material damage only, which were no more published by CBS since the introduction of the limited accident recording in 1967, has been calculated afterwards as a fixed multiple of the number of recorded accidents involving injury:
$Nb = 6\ Nl$ (recorded)

The number of accidents involving injury has been calculated as
$Nl = 1.18\ Nl$ (recorded)

The total number of accidents is $Nm = Nb + Nl + Nf$

The number of injured people has been calculated as a fixed multiple of the recorded number of injured people as:
$Ng = 1.165\ Ng$ (recorded)

The economic damage by traffic accidents is calculated from the guide values and the key figures with the comparisons

$S = S11 + S12 + S13 + S2 + S3$

in which

$S11 = Nd.Rdf$

$S12 + S\ 13 = Ng.Rgl$

$S\ 2 + S3 = Nm.Rm$

No absolute meaning can be given to the obtained results of the total yearly economic damage. This is caused by the incompleteness and inaccuracy of the recording of accidents and by the original determining of the extent of the economic damage by traffic accidents and the applied corrections.
The damage per province and per municipality can be determined in a similar way as has been done for The Netherlands.
If we suppose that the incompleteness and inaccuracy of accident data and of guide values for accident damage do not vary too much, then the obtained results are reasonably useful for a mutual comparison of the damage of road accidents in The Netherlands.
The value of the figures on damage becomes doubtful if they are compared with figures from other countries or if they are compared with damage of other causes, e.g. industrial accidents or fire, unless an indication of the order of magnitude suffices.

# 6. Completeness and reliability of basic data

## 6.1. General

As stated earlier, the definition and analysis of road safety is possible only if adequate and reliable data are available concerning road traffic and its resulting accidents.
Limitations due to the lack of basic data may greatly impede analysis and research or even make this impossible, but hardly cause any misunderstanding because they can be looked upon as 'inherent defects'. The possible unreliability of basic data is in fact worse because it may distort the picture and lead to the wrong conclusions. It is therefore important for everyone using the data to have an idea of how reliable they are.
There can be many reasons why data are unreliable, depending on the way the material is collected and processed. Such causes may vary from simple arithmetical mistakes to differences in interpreting definitions; from careless observations to errors in the method of planning interviews.
The following will deal briefly with the reliability of road-traffic data, and then go more fully into the reliability of accident data.

## 6.2. Road-traffic data

Some of these data are not very reliable because they are not the result of exact observations or records but of assessments or estimates (for instance data relating to the total number of vehicles). It is mostly impossible to pinpoint any errors in the estimated figures.
Another frequent source of error is the multiplicity and diversity of bodies collecting material. Information on roads, traffic flows etc. is collected and recorded by a large number of road authorities. If it is desired to combine and collate such data, then all the bodies concerned should use the same definitions and the same observation and processing methods. Although uniformity has improved in the course of years, the aggregated information is still not always reliable enough. Special attention should be paid to the fact that definitions of certain concepts may have changed in the course of time, sometimes even more than once.

A kind of unreliability that is often difficult to detect is that due to insufficient numbers of observations or insufficiently intensive observation. The results are then wrongly described as generally valid.
The possible consequences of unreliable data can be indicated by the following example taken from several data in the tables to section 2.3.

Table 4 gives numbers of vehicle kilometres for cars and for motor cycles plus scooters presumably obtained from interviews; among other things, the following figures are given:
1966, private cars: 25,000 x $10^6$ km;
1966, motor cycles plus scooters: 809 x $10^6$ km.
Table 3 contains figures relating to the same statistic, in this case calculated from traffic-flow counts and relevant road lengths.
1966, private cars: 26,595 x $10^6$ km;
1966, motor cycles plus scooters: 575 x $10^6$ km.
The difference in the case of private cars is not very great (about 6 per cent), but in the case of motor cycles plus scooters it is disquieting.

Lastly, there is the error resulting from inaccurate measuring equipment: this is not so serious because the extent of such potential errors is usually known.

## 6.3. **Road-accident data**

As a second example of the difficulties that may arise if there are suspicions that the quality of basic data has been impaired, for instance owing to changes in recording and processing, it is useful to examine how Dutch road accident records have been organised in the recent past.

### 6.3.1. *Accident recording*
Records of road accidents have traditionally been kept by the police, who in principle complete a set of record forms for every accident coming to their notice. Until about 1966, the recording method was fairly uniform, though there was a feeling that not all minor road accidents were recorded (any longer) especially in the bigger cities. But there were no well-founded reasons for doubting the representativeness of the road-accident figures recorded until that time and processed as statistics by the Central Bureau of Statistics in The Netherlands CBS.
In September 1966, however, the Ministers of Justice and Home Affairs announced a radical change in recording practice. What this meant in practice was that from 1st January 1967 the police would only record accidents involving death, injury, damage exceeding Fl. 1,000 and/or serious traffic offences. Consequently, even in the later months of 1966, i.e. even before this system became officially operative, there was a substantial reduction in the number of road accidents recorded. This was due not only to the change in police recording practice, but also to the reaction by the public who, having heard of the plans, no longer notified the police of certain traffic accidents.
In the middle of 1973 a new set of forms was introduced. With these, it was no longer necessary to describe the injuries. This made it impossible for the Central Bureau of Statistics in The Netherlands CBS to ascertain whether the (injuries to the) casualty met their own definition (of the injuries). With the old form this had been possible; notified accidents involving injuries not meeting the definition were *not* processed as such. The consequence should have been an increase in the

number of accidents involving injuries after introduction of the new form. The fact that this was not the case might indicate that the police had used the CBS definition better. Another possibility is that the standard of recording dropped owing to introduction of the new form.

6.3.2. *Despatch of statistical forms*

Besides the national processing of road accidents, local authorities such as police, municipalities, provincial and national highway authorities process accident data. Before introduction of the new record forms, municipalities and one or two provinces which kept accident records obtained their data direct from the police. The other provinces and the government obtained the information from the Central Bureau of Statistics in The Netherlands CBS after it had processed the police data. In addition, the Netherlands Association for Automobile Insurance NVVA as from 1970 also received a copy of the statistical form which was sent to the Association directly by the police.

After introduction of the new set (of four forms), some changes were made in supplying accident data to local accident records. There was no change in despatch to CBS, except that the request was made to send the copy intended for CBS to this Bureau within two weeks of the accident. The new set of forms contains not only a copy for CBS but also one for police records, one for the NVVA and one for the forthcoming Road Accidents Recording Department VOR. Pending establishment of VOR, this last copy could be used for local accident records. For this purpose, the National Police (in municipalities with fewer than 25,000 inhabitants) sent the VOR copy at the same time as the CBS copy to CBS which in turn passed on the VOR copy to the Traffic and Transportation Engineering Division of Rijkswaterstaat DVK/RWS. The latter was to arrange for distribution to highway authorities where needed by them. Municipal police (in municipalities with over 25,000 inhabitants) were requested to deal with the VOR copies relating to accidents on national highways and provincial roads in the same way as the National Police, i.e. to send them to CBS. But it is felt that this did not always happen and that some provincial road authorities and the national road authorities were deprived from mid-1973 of accident data on road sections for which the municipal police concerned attended to accidents records.

The VOR copy relating to accidents on roads under municipal authority and for which accident statistics are kept was sent by the municipal police direct to the appropriate recording body. In municipalities where no accident statistics are kept, the VOR copy was sent to CBS.

When the Road Accidents Recording Department VOR started functioning at the end of 1974, this despatching procedure was modified. From then on, *all* VOR copies first had te be sent to the VOR. The forms are sorted by the VOR and sent to the various road authorities (DVK, provinces and municipalities). If municipalities do not have their own accident records, the forms are sent to the Provincial Department of Roads and Waterways.

Besides the VOR copy, VOR received from CBS a copy of the statistical form for accidents involving injury and the original for accidents involving material damage only.

As from 1st January 1976, however, VOR has taken over processing of traffic accidents from CBS. The despatching procedure for the statistical form was modified for this purpose.
This statistical form is now sent by the police directly to VOR at the same time as the VOR copy.

6.3.3. *Processing of accident data*
Since 1976 national processing of accident data recorded by the police has no longer been done by the Central Bureau of Statistics in The Netherlands CBS but by the Road Accidents Recording Department VOR. At a later stage, however, CBS ensures that casualties (persons injured) in traffic accidents who die within thirty days are recorded as traffic fatalities. For verifying this, CBS uses information from their Health Statistics Department, the public prosecutors at cantonal courts, Dutch Press Association telex messages and other sources (such as press cuttings).
It has been found that each source makes its individual contribution to providing more accurate figures of the number of road accidents with fatal consequences and the number of fatalities.
The total number of fatalities found with this verification is about 8 to 10 per cent higher than that based only on the record forms sent in by the police. On the one hand this is because the form may report injuries, whereas the injured person or persons died after the form had been sent to VOR. On the other hand, there were traffic accidents with fatal consequences for which no record form at all had been received.
So far, local accident records receive no information on the supplementary processing by CBS of the store of accident data. The figures arrived at by municipalities and provinces for numbers of road accidents with fatal consequences will therefore often be lower than in reality.

6.3.4. *Consequences of discontinuities in records, despatch and processing on available accident data*
Owing to the introduction of the system of not recording minor material damage, in 1966/1967 CBS stated that new recording standards regarding road-traffic accidents involving material damage only could no longer produce reliable statistics. Statistics or road accidents with fatal consequences and those for accidents involving injury only are still published, as are those for fatalities and injuries.
The effects of the foregoing on records of the number of persons injured is shown in Figure 11 (1).
Owing to the reactions to the new system in 1967, supplementary guidelines were issued at the end of 1968 for recording road accidents. It is striking that it was not until then that there was again an increase in the number of recorded injuries (2).
A year later, the despatch of copies of the CBS forms to the Netherlands Association for Automobile Insurance NVVA was officially regulated. Although there is no drop in the number of recorded injuries, it can be concluded that there was no increase in this number which, in view of the increase in traffic, is remarkable (3).

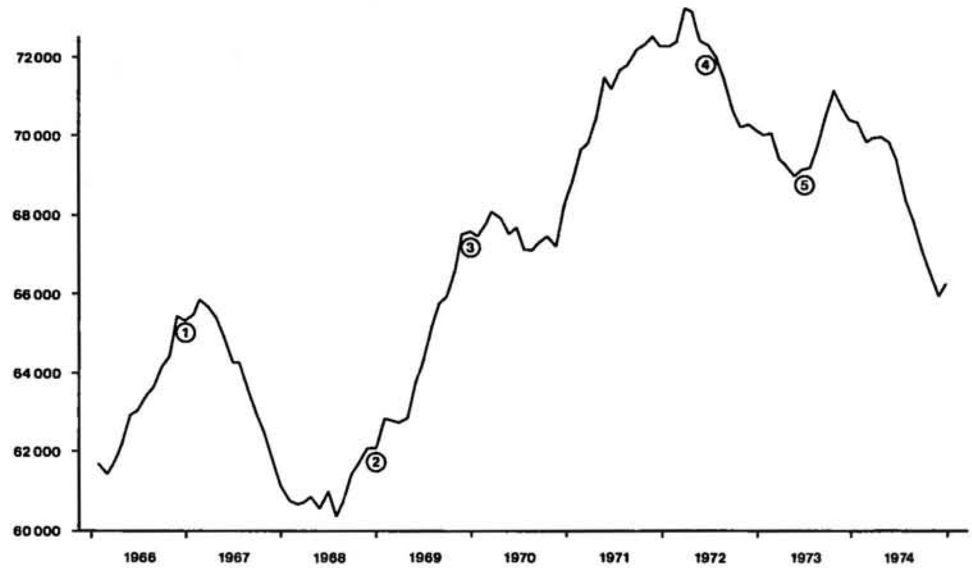


Figure 11: Trend of twelve-monthly moving average totals of recorded road-accident injuries since 1966

As from 15th May 1972, new guidelines were introduced for prosecution and recording practice for traffic accidents. As from that time, there was again a decrease in the number of recorded injuries (4).
In the middle of 1973, a new CBS form was introduced (5). Although no effect on the total number of recorded injuries can be established, it is nevertheless quite possible that there was ultimately a movement *as between* the recorded accidents. This has already been discussed in dealing with accident recording and processing.
It is not yet known whether and, if so, to what extent the changes in the despatching procedure at the end of 1974 and 1975 owing to VOR becoming operative, led to a change in recording level.
But it is clear that owing to the constantly changing despatch procedure in recent years the completeness of accident reporting to the national road authorities and most provincial road authorities has been affected in ever different ways.

It can be concluded first of all from the foregoing that there is no question of real continuity in recording the number of road-traffic accidents and secondly that there are indications that the degree of completeness and hence representativeness of the records has been impaired, though it is not known to what extent.

6.3.5. *Summary*
1. Owing to the steady decline in recording standards, attended by an obvious reduction in representativeness, road-traffic accident analysis is impossible *from traffic accidents involving material damage only.*

2. *The use of traffic accident data obtained otherwise than from the statistical forms received by VOR (or formerly CBS) is inadvisable*, because the constant changes in recent years in the procedure for sending the statistical forms to road authorities has affected their completeness in ever different ways.

3. The use of data on *accidents involving injury* and on injuries must be *strongly advised against* in view of the discontinuities in recording standards in recent years, owing to which this form of recording is no longer complete and can therefore no longer be described as representative.
(Within the period in which recording is continuous, however, the figures are comparable for the trend in a specific phenomenon. The extent of the recorded phenomenon need not in this case be the same as the actual situation).

4. The use of *data on traffic accidents with fatal consequences and traffic fatalities not completed by the Central Bureau of Statistics in The Netherlands CBS is strongly advised against* because the relevant numbers are otherwise incorrect.

# 7. Final observations

After the foregoing, it is justified to ask: are there enough quantitative and qualitative basic data available at present for carrying out research for road-safety policy in the proper way: that is to say, quickly, adequately and at the lowest possible cost?

Unfortunately, it has already become apparent that many indispensable data are still lacking. In a number of cases general data exist, but as soon as specific aspects of traffic and road safety are raised the desired information is very difficult to obtain and is usually not available quickly.
This problem is nothing new - nor does it apply only to The Netherlands. Both nationally and internationally, many attempts have already been made to improve the situation.

## 7.1. What are the problems?

Traffic accidents are often due to a large number of circumstances coinciding. Description and study of this phenomenon therefore requires a considerable amount of information.
What information is needed in a specific case depends very much on the viewpoint from which the road safety problem is approached. A road authority will usually be interested in different data than a physician; a lawyer in different data than a behavioural scientist. Also, the question whether the information is needed for policy formulation or for research may take a difference in choice of data. Moreover, as time goes on, needs change. This is in fact a repetitive process: problems arise, a solution is found, but the solution often brings forth new problems, and so on and so forth.
The consequence has been that in practice various users of traffic (accident) data have set up their own processing systems (from manual to computer processing) to obtain the information they need for their own purposes.

Since enough is still not known about the overall problem and since road safety constitutes a problem closely involving public opinion, the questions that arise are often difficult to predict. The data the various authorities need may vary greatly, depending on their nature and the time they have to be available.
On the whole, the users' specific needs vary greatly depending on content (nature of the information) and time (when the information is of importance).

As far as they investigate practical problems, research institutes are interested in

practically the same accident data as official bodies such as:
1. The Central Bureau of Statistics in The Netherlands CBS as the producer (required by law) of national road accident statistics.
2. Government, provincial and municipal authorities concerned with preparing general (political) policy decisions.
3. Bodies responsible for public health aspects of road traffic, such as Medical Inspectorates and Municipal Medical Departments.
4. Bodies responsible for and/or involved in judicial aspects of road traffic, such as the courts, the public prosecutor, police forces and police authorities (General Traffic Department, Central Police Traffic Committee CPVC).
5. Independent road authorities of the government, provinces, municipalities, water boards and so on responsible for road safety.

The information which research institutes need to do their work, however, is often much more detailed; moreover the period for which the information has to be available is often more specifically determined, and very high standards of reliability are demanded.
*Note:* For some research projects, accident data are sometimes even totally or partly unusable and behaviour measurements have to be used for research purposes.

## 7.2. What has been done so far?

Since the Institute for Road Safety Research SWOV as a research institute is interested in collecting basic data not only as a user, but in a wider sense is also responsible for making specific recommendations on its own initiative, it has made proposals in the past for establishing an 'integrated accident recording system' (INVORS). These proposals were one of the motives in setting up the Road Accidents Recording Department VOR, Heerlen. As yet there has been no integration with data collected by others - firstly of course for their own purposes - which would not only tremendously increase the value of material already available but also that of the data themselves.

The wide variety of needs, however, makes it clear that a properly functioning system or recording and processing road-traffic accidents, both in input and output, must be very flexible. It can be foreseen that a single data bank providing *all* data to *all* users at *any* given moment cannot possibly meet this need for flexibility. The input and output of such an extensive data bank would inevitably be subjected to rather inflexible software. In that case, the users would have to specify their needs well in advance and fix them for a comparatively long time. Since this cannot be regarded as realistic at present, it can be concluded that devising and effectuating an accident recording and processing system makes sense:
a. if its organisation and effectuation can be programmed so that after an initial period modifications and additions can be introduced without being tied to a big, inflexible system;

b. if all users can retrieve the most essential information they need;
c. if it is possible for users to put in any missing data or interpretations themselves;
d. if the overall system is built up in the initial period so that it links up very closely with existing recording systems.

The possibility and advisability of improving a data bank depend very much on how the quality and/or quantity improvement is related to cost. The usefulness and necessity of the (quality and quantity of the) data can be determined solely by the users themselves. Besides this, the data which all the users together need cannot all be collected. Therefore, the central records must provide information on the degree to which the data meet specific requirements. Users needing more or better data must first try to obtain them by improving central records. Failing this, they will have to collect the data through additional channels or with their own resources.

### 7.3. Marginal conditions for data for research purposes

It will be clear that SWOV needs many data for its work, which must moreover be of a certain quality. The data on the relevant characteristics of a reserch project must meet specific needs as regards the following factors:
1. Existence of data on a characteristic;
2. Subdivision of data on a characteristic;
3. Completeness in volume of data;
4. Completeness in content of data per characteristic;
5. Reliability (accuracy) of data on the characteristic;
6. Uniformity of data on the characteristic;
7. Availability and accessibility of the data;
8. Time during which the data for the characteristic become available;
9. Cost/benefit ratio.

In this enumeration, the first two points indicate the minimum data requirement, points 3, 4 and 5 determine the representativeness of the required data, while 6, 7, 8 and 9 are not basically of immediate importance to research itself, though they are directly related to its effectiveness.
1. *Existence.* The need for the existence of data on a characteristic increases the more this characteristic is essential for carrying out a given research project.
2. *Subdivision.* The characteristic can be differentiated to a greater or lesser degree. The need for a given subdivision depends on the research.
3. *Completeness in volume.* This means the extent to which the total population is described. In other words: do all parts of the data exist and, if not, to what extent does this affect the value of the data. The latter is largely determined by the purpose for which the data are used. In principle, the data must relate as fully as possible to the phenomenon as a whole.
4. *Completeness in content.* This means the extent to which information is furnished per characteristic, and the extent to which non-provision of the informa-

tion affects the usefulness of the data. Here again, the valuation is largely determined by the purpose of the research; one time it will be necessary to use certain data, another time it will be pointless.

5. *Reliability.* Even if information is available on the particular characteristic, this does not necessarily mean that this output information is correct. There are endless points on which a difference may arise between the correct information and the processed information. In particular, this may occur in recording, in coding, in punching, and so on. All data should be as reliable as possible. Only data should be put in which are arrived at objectively.

6. *Uniformity.* Uniformity depends partly on the method of questioning and the method of collecting. Uniformity of available data partly determines their completeness, reliability and the speed at which they can be processed. Uniformity should be as great as possible in the case of research.

7. *Availability and accessibility.* It is also very important for the required data to be available and accessible for research purposes. This means that the body collecting them must be willing and able to furnish the data, in such a way that they can be used for research.

8. *Time.* The time within which the data become available is important because it indicates the period within which they must be available for them to be value in research.

9. *Cost/benefit ratio.* The cost of collecting data will produce an indirect benefit if they are used for research purposes. By means of this, priorities can be established for the requisite measures, which will promote their ultimate effectiveness and hence have a cost-saving effect.

## 7.4. What else has been done?

In the past, data needed for SWOV's policy-preparing research often proved to be non-existent or not to have been collected systematically and continuously. SWOV has therefore repeatedly carried out roadside research or undertaken or arranged interview projects.

For instance: Speed limits outside built-up areas, Roadside survey's into drinking and driving habits, Moped-riders' crash helmets, Fitment and use of car seat belts, Road safety in rural areas.

Data have also been collected on moped riders' and cyclists' speeds, tread thickness of motor tyres, characteristics of vehicle owners and users. Supplementary to the data published by the Central Bureau of Statistics in The Netherlands CBS, road-traffic accidents with fatal consequences have been analysed in greater detail from 1968, in order to process all available material regaring the nature of the accident for further research.

In February 1976, SWOV started a second Accident Investigation Project. For about eighteen months, data will be collected for a total of 15,000 cars and the occupants who will be involved in an accident in that period. This has special reference to the effects of car construction and of safety devices (such as energy absorbing steering columns, head supports, automatic seat belts, restraint systems for children) on the effects of car accidents. This research follows up similar research carried out earlier by SWOV which provided a volume of information.

## 7.5. What can still be done?

As earlier chapters have shown, research demanding very high priority is that into specified data on road usage by the various categories of vehicles and road users. If was often found in the past that the relationship between a large number of variables cannot be established without these exposure data. Because of this, the effect of measures cannot be predicted or explained, and hence research for policy-preparing purposes cannot be carried out effectively.
It matters little who collects the necessary data. The most efficient manner should be chosen on a cost/benefit basis.
SWOV has made a plan for research into road users' exposure data. In view of the urgent need for this information, SWOV hopes this work can be carried out with the least possible delay. It may be the starting point for systematic and continuous collection of such data.

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* Only in Dutch

## Tables 1 – 31

| Year 1) | Private cars | Motor trucks | Buses | Motor cycles + scooters | Mopeds | Cycles 2) |
|---|---|---|---|---|---|---|
| 1964 | 1059 | 218 | 9 | 149 | 1400 | 6300 |
| 1965 | 1273 | 233 | 9 | 140 | 1500 | 6500 |
| 1966 | 1502 | 253 | 9 | 133 | 1600 | 6600 |
| 1967 | 1661 | 260 | 9 | 113 | 1700 | 6700 |
| 1968 | 1852 | 271 | 9 | 98 | 1800 | 6800 |
| 1969 | 2049 | 282 | 9 | 84 | 1900 | 6900 |
| 1970 | 2258 | 293 | 9 | 72 | 1900 | 7000 |
| 1971 | 2511 | 305 | 9 | 66 | 1900 | 7100 |
| 1972 | 2719 | 316 | 9 | 60 | 1850 | 7300 |
| 1973 | 2957 | 327 | 9 | 60 | 1750 | 7500 |
| 1974 | 3153 | 337 | 10 | 64 | 1750 | 7600 |
| 1975 | 3399 | 348 | 10 | 68 | 1650 | 8600 |

1) at 1st August
2) at 1st January

*Table 1.* Numbers (x 1000) of vehicles in The Netherlands in 1964 to 1974

| Paved roads outside built-up areas | Number of kilometres 1.1.1966 | 1.1.1970 | 1.1.1973 | Percentage distribution 1.1.1966 | 1.1.1970 | 1.1.1973 |
|---|---|---|---|---|---|---|
| Motorways | 586 | 868 | 1,245 | 1.3 | 1.8 | 2.5 |
| Other (major) national highways | 2,067 | 2,095 | 2,176 | 4.5 | 4.4 | 4.3 |
| Secondary roads | 3,730 | 3,223 | 3,187 | 8.1 | 6.7 | 6.4 |
| Tertiary roads | 4,945 | 4,300 | 4,160 | 10.7 | 9.0 | 8.3 |
| Others | 34,812 | 37,291 | 39,306 | 75.4 | 78.1 | 78.5 |
| Total | 46,140 | 47,777 | 50,074 | 100 | 100 | 100 |

| Paved roads inside built-up areas | Number of kilometres 1.1.1970 | 1.1.1973 | Percentage distribution 1.1.1970 | 1.1.1973 |
|---|---|---|---|---|
| Motorways | 5 | 3 | 0.0 | 0.0 |
| Other (major) national highways | 312 | 327 | 1.1 | 1.0 |
| Secondary roads | 540 | 567 | 1.8 | 1.7 |
| Tertiary roads | 1,065 | 1,052 | 3.6 | 3.2 |
| Others | 27,291 | 30,854 | 93.4 | 94.1 |
| Total | 29,213 | 32,803 | 100 | 100 |

*Table 2:* Classification of paved roads inside and outside built-up areas in 1966, 1970 and 1973.

| Road category | Year | Road length (km) | Average daily density | Vehicle-kilometres per annum[1] (x 10.6): Total | Private cars | Motor trucks | Buses | Motor cycles + scooters |
|---|---|---|---|---|---|---|---|---|
| Motorways | 1966 | 586 | 18,800 | 4,011 | 3,331 | 600 | 37 | 43 |
| | 1970 | 868 | 24,720 | 7,833 | 6,631 | 1,098 | 72 | 31 |
| | 1973 | 1,245 | 25,070 | 11,393 | 9,684 | 1,572 | 80 | 57 |
| Other (major) national highways | 1966 | 2,067 | 6,960 | 5,248 | 4,218 | 868 | 84 | 78 |
| | 1970 | 2,095 | 7,940 | 6,072 | 5,066 | 922 | 61 | 23 |
| | 1973 | 2,176 | 8,310 | 6,597 | 5,522 | 989 | 53 | 33 |
| Secondary roads | 1966 | 3,730 | 2,770 | 3,774 | 3,088 | 561 | 65 | 60 |
| | 1970 | 3,223 | 3,940 | 4,634 | 3,885 | 653 | 64 | 32 |
| | 1973 | 3,187 | 4,890 | 5,686 | 4,754 | 836 | 68 | 28 |
| Tertiary roads | 1966 | 4,945 | 1,340 | 2,420 | 1,936 | 411 | 34 | 39 |
| | 1970 | 4,300 | 1,940 | 3,051 | 2,572 | 407 | 50 | 22 |
| | 1973 | 4,160 | 2,300 | 3,487 | 2,978 | 467 | 25 | 17 |
| Other roads outside built-up areas | 1966 | 34,812 | 200 | 2,510 | 1,950 | 503 | 16 | 41 |
| | 1970 | 37,291 | – | – | – | – | – | – |
| | 1973 | 39,306 | – | – | – | – | – | – |
| *Total outside built-up areas* | 1966 | 46,140 | 1,070 | 17,963 | 14,523 | 2,943 | 236 | 261 |
| | 1970 | 47,777 | – | – | – | – | – | – |
| | 1973 | 50,074 | – | – | – | – | – | – |
| *Total inside built-up areas* | 1966 | 25,278 | 1,600 | 14,718 | 12,072 | 2,035 | 297 | 314 |
| | 1972 | 29,213 | – | – | 20,199 | – | – | – |
| | 1973 | 32,803 | – | – | – | – | – | – |

1) 'fast traffic' only
2) including delivery vans, special vehicles, etc.

*Table 3:* Road lengths, desities and (motor) vehicle-kilometres for various road categories outside built-up areas (and inside built-up areas) in 1966, 1970 and 1973.

| Year | Private cars: Average km/yr per vehicle | Total km/yr (x $10^6$) | Occupancy | Total traveller-km (x $10^6$) | Motor cycles + scooters: Average km/yr per vehicle | Total km/yr (x $10^6$) | Occupancy | Total traveller-km (x $10^6$) | Mopeds: Average km/yr per vehicle | Total km/yr (x $10^6$) | Occupancy | Total traveller-km (x $10^6$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 17,000 | 18,000 | 1.62 | 29,160 | 6420 | 957 | 1.2 | 1150 | 4720 | 6610 | 1.1 | 7530 |
| 1965 | 16,900 | 21,490 | 1.65 | 35,460 | 6250 | 875 | 1.2 | 1050 | 4650 | 6980 | 1.1 | 7930 |
| 1966 | 16,600 | 25,000 | 1.66 | 41,500 | 6080 | 809 | 1.2 | 970 | 4580 | 7330 | 1.1 | 8310 |
| 1967 | 16,600 | 28,580 | 1.68 | 48,020 | 5910 | 662 | 1.2 | 800 | 4510 | 7670 | 1.1 | 8680 |
| 1968 | 16,700 | 33,400 | 1.69 | 56,450 | 5740 | 551 | 1.2 | 670 | 4440 | 7990 | 1.1 | 9040 |
| 1969 | 16,500 | 37,850 | 1.71 | 64,720 | 5570 | 451 | 1.2 | 550 | 4370 | 8300 | 1.1 | 9130 |
| 1970 | 16,200 | 42,120 | 1.73 | 72,870 | 5400 | 367 | 1.2 | 450 | 4300 | 8170 | 1.1 | 8990 |
| 1971 | 16,000 | 44,800 | 1.75 | 78,400 | 5230 | 319 | 1.2 | 400 | 4230 | 8040 | 1.1 | 8720 |
| 1972 | 16,100 | 48,980 | 1.76 | 86,200 | 5400 | 297 | 1.2 | 360 | 4160 | 7700 | 1.1 | 8240 |
| 1973 | 16,200 | 52,430 | 1.77 | 92,800 | 5500 | 302 | 1.2 | 360 | 4160 | 7280 | 1.1 | 8010 |

*Table 4:* Annual mileage, occupancy, traffic and travel performance of several vehicle categories from 1964 to 1973.

| Year | Commuting: km (x $10^9$) | % | Business: km (x $10^9$) | % | Holidays: km (x $10^9$) | % | Other private uses km (x $10^9$) | % | Total km (x $10^9$) | % |
|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 2.2 | 12 | 9.8 | 54 | 1.5 | 8 | 4.7 | 26 | 18.2 | 100 |
| 1965 | 2.6 | 12 | 11.0 | 51 | 1.7 | 8 | 6.3 | 29 | 21.6 | 100 |
| 1966 | 3.6 | 14 | 12.2 | 48 | 2.0 | 8 | 7.6 | 30 | 25.4 | 100 |
| 1967 | 4.4 | 15 | 13.1 | 45 | 2.3 | 8 | 9.3 | 32 | 29.1 | 100 |
| 1968 | 5.3 | 16 | 14.4 | 43 | 2.7 | 8 | 11.0 | 33 | 33.4 | 100 |
| 1969 | 6.4 | 17 | 15.0 | 40 | 3.0 | 8 | 13.1 | 35 | 37.5 | 100 |
| 1970 | 7.6 | 18 | 16.0 | 38 | 3.4 | 8 | 15.2 | 36 | 42.2 | 100 |
| 1971 | 8.5 | 19 | 15.7 | 35 | 3.6 | 8 | 17.0 | 38 | 44.8 | 100 |
| 1972 | 9.8 | 20 | 16.2 | 33 | 3.9 | 8 | 19.1 | 39 | 49.0 | 100 |
| 1973 | 11.0 | 21 | 16.2 | 31 | 4.2 | 8 | 21.0 | 40 | 52.4 | 100 |



*Table 5:* Numbers and percentages of vehicle-kilometres for private cars by reasons for journey 1964 to 1973.

| Private cars: Reasons for journey in 1973 | Vehicle-kilometres (x $10^9$) | Average occupancy | Traveller-kilometres (x $10^9$) | % |
|---|---|---|---|---|
| Commuting | 11.0 | 1.2 | 13.2 | 14.2 |
| Business | 16.2 | 1.15 | 18.7 | 20.2 |
| Holidays | 4.2 | 3.5 | 14.7 | 15.8 |
| Other private uses | 21.0 | 2.2 | 46.2 | 49.8 |
| Total | 52.4 | 1.77 | 92.8 | 100 |

*Table 6:* Vehicle-kilometres, average occupancy and traveller-kilometres for private cars by reasons for journey in 1973.

| Year | Regular services | | | Other professional passenger transport (bus) | | | | Total 1) |
|---|---|---|---|---|---|---|---|---|
| | Train | Bus,tram and metro | Total | Group transport | Coaches | Unscheduled transport | Total | |
| 1964 | 7.9 | 6.2 | 14.1 | 2.2 | 2.1 | 0.6 | 4.9 | 19.0 |
| 1965 | 7.7 | 6.2 | 13.9 | 2.3 | 2.1 | 0.6 | 5.0 | 18.9 |
| 1966 | 7.6 | 6.0 | 13.6 | 2.3 | 2.2 | 0.6 | 5.1 | 18.7 |
| 1967 | 7.4 | 5.6 | 13.0 | 2.2 | 2.3 | 0.7 | 5.2 | 18.2 |
| 1968 | 7.4 | 5.8 | 13.2 | 2.2 | 2.2 | 0.7 | 5.1 | 18.3 |
| 1969 | 7.5 | 5.5 | 13.0 | 2.3 | 2.3 | 0.7 | 5.3 | 18.3 |
| 1970 | 8.0 | 5.4 | 13.4 | 2.5 | 2.4 | 0.7 | 5.6 | 19.0 |
| 1971 | 8.1 | 5.1 | 13.2 | 2.5 | 2.5 | 0.7 | 5.7 | 18.9 |
| 1972 | 8.0 | 5.1 | 13.1 | 2.5 | 2.5 | 0.7 | 5.7 | 18.8 |
| 1973 | 8.2 | 5.1 | 13.3 | 2.5 | 2.5 | 0.8 | 5.8 | 19.1 |
| 1974 | 8.6 | 5.2 | 13.8 | 2.5 | 2.5 | 0.8 | 5.8 | 19.6 |

1) traveller-kilometres x $10^9$

*Table 7:* Numbers of traveller-kilometres (x $10^9$) by professional passenger transport 1964 to 1974.

| Year | Professional passenger transport: Regular services | | Others | | Total | | Motorised private transport: Private cars | | Motor cycles, scooters, mopeds | | Total | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | km[1] | %[2] | km | % | km | % | km | % | km | % | km | % | km | % |
| 1964 | 14.1 | 25 | 4.9 | 9 | 19.0 | 33 | 29.2 | 51 | 8.7 | 15 | 37.9 | 67 | 56.9 | 100 |
| 1965 | 13.9 | 22 | 5.0 | 8 | 18.9 | 30 | 35.5 | 56 | 9.0 | 14 | 44.5 | 70 | 63.4 | 100 |
| 1966 | 13.6 | 20 | 5.1 | 7 | 18.7 | 27 | 41.5 | 60 | 9.3 | 13 | 50.8 | 73 | 69.5 | 100 |
| 1967 | 13.0 | 17 | 5.2 | 7 | 18.2 | 24 | 48.0 | 63 | 9.5 | 13 | 57.5 | 76 | 75.7 | 100 |
| 1968 | 13.2 | 16 | 5.1 | 6 | 18.3 | 22 | 56.4 | 67 | 9.7 | 11 | 66.1 | 78 | 84.4 | 100 |
| 1969 | 13.0 | 14 | 5.3 | 6 | 18.3 | 20 | 64.7 | 70 | 9.7 | 10 | 74.4 | 80 | 92.7 | 100 |
| 1970 | 13.4 | 13 | 5.6 | 6 | 19.0 | 19 | 72.9 | 72 | 9.4 | 9 | 82.3 | 81 | 101.3 | 100 |
| 1971 | 13.2 | 12 | 5.7 | 5 | 18.9 | 18 | 78.4 | 74 | 9.1 | 9 | 87.5 | 82 | 106.4 | 100 |
| 1972 | 13.1 | 12 | 5.7 | 5 | 18.8 | 17 | 86.2 | 76 | 8.6 | 8 | 94.8 | 83 | 113.6 | 100 |
| 1973 | 13.3 | 11 | 5.8 | 5 | 19.1 | 16 | 92.8 | 77 | 8.4 | 7 | 101.2 | 84 | 120.3 | 100 |

1) traveller-kilometres x $10^9$

2) proportion of total number of traveller-kilometres for year (excluding those by cycle, motor truck and/of pedestrians).

*Table 8:* Numbers and percentages of traveller-kilometres by professional passenger transport and motorised private transport in 1964 to 1973.

| Year | Accidents: Fatal Total | Inside built-up areas | Outside built-up areas | Involving injuries (excl. fatal) Total | Inside built-up areas | Outside built-up areas | Casualties: Fatalities Total | Inside built-up areas | Outside built-up areas | Injuries Total | Inside built-up areas | Outside built-up areas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 2,218 | 948 | 1,270 | 50,071 | 37,001 | 13,070 | 2,375 | 972 | 1,403 | 59,187 | 41,486 | 17,701 |
| 1965 | 2,290 | 932 | 1,358 | 52,606 | 38,824 | 13,782 | 2,479 | 966 | 1,513 | 61,887 | 43,439 | 18,448 |
| 1966 | 2,442 | 1,057 | 1,385 | 54,933 | 40,884 | 14,049 | 2,620 | 1,093 | 1,527 | 65,304 | 46,095 | 19,209 |
| 1967[1)] | 2,636 | 1,054 | 1,582 | 50,772 | 37,517 | 13,255 | 2,862 | 1,092 | 1,770 | 61,102 | 42,484 | 18,618 |
| 1968 | 2,657 | 1,127 | 1,530 | 51,583 | 38,072 | 13,511 | 2,907 | 1,171 | 1,736 | 62,098 | 43,268 | 18,830 |
| 1969 | 2,809 | 1,209 | 1,600 | 55,893 | 40,753 | 15,140 | 3,075 | 1,262 | 1,813 | 67,599 | 46,407 | 21,192 |
| 1970 | 2,879 | 1,268 | 1,611 | 56,004 | 40,701 | 15,303 | 3,181 | 1,319 | 1,862 | 68,225 | 46,551 | 21,674 |
| 1971 | 2,868 | 1,237 | 1,631 | 59,385 | 43,508 | 15,877 | 3,167 | 1,286 | 1,881 | 72,167 | 49,850 | 22,317 |
| 1972 | 2,984 | 1,270 | 1,714 | 57,341 | 41,486 | 15,855 | 3,264 | 1,322 | 1,942 | 70,082 | 47,575 | 22,507 |
| 1973 | 2,802 | 1,225 | 1,577 | 57,454 | 41,507 | 15,947 | 3,092 | 1,277 | 1,815 | 70,361 | 47,762 | 22,599 |
| 1974 | 2,338 | 1,025 | 1,313 | 55,009 | 41,339 | 13,670 | 2,546 | 1,065 | 1,481 | 66,212 | 47,430 | 18,782 |
| 1975[2)] | 2,135 | 880 | 1,255 | 50,265 | 37,320 | 12,945 | 2,360 | 940 | 1,420 | 59,840 | 42,300 | 17,540 |

1) from 1967 changed accident recording affecting records of accidents involving injury and persons injured
2) provisional figures

*Table 9:* Numbers of recorded road-traffic accidents and casualties from 1964 to 1975.

| Year | Traffic fatalities per $10^5$ inhabitants in: Netherlands | Belgium | German Federal Republic | France | Great Britain | Denmark | Italy | Sweden |
|---|---|---|---|---|---|---|---|---|
| 1964 | 19.4 | - | 28.1 | 25.1 | 14.9 | 18.8 | 20.0 | 17.0 |
| 1965 | 20.0 | 25.3 | 26.6 | 27.2 | 15.0 | 21.2 | 18.3 | 16.9 |
| 1966 | 20.9 | 24.4 | 28.1 | 27.0 | 15.0 | 21.1 | 18.0 | 16.7 |
| 1967 | 22.6 | 25.9 | 28.6 | 30.1 | 13.7 | 22.2 | 18.9 | 13.6 |
| 1968 | 22.7 | 27.8 | 27.5 | 30.8 | 12.7 | 22.5 | 19.6 | 15.9 |
| 1969 | 23.7 | 27.9 | 27.3 | 31.4 | 13.7 | 24.3 | 19.7 | 15.9 |
| 1970 | 24.2 | 30.4 | 31.2 | 31.9 | 13.8 | 24.4 | 20.2 | 16.2 |
| 1971 | 23.9 | 31.7 | 30.2 | 33.7 | 14.2 | 24.4 | 20.0 | 14.9 |
| 1972 | 24.4 | 32.2 | 30.3 | 34.4 | 14.3 | 22.3 | 21.7 | 14.7 |
| 1973 | 22.9 | 29.9 | 26.3 | 32.2 | 13.6 | 22.5 | 20.8 | 14.5 |
| 1974 | 18.7 | 26.9 | 22.7 | 27.8 | 12.7 | 15.3 | 18.4 | 11.8 |

*Table 10:* Numbers of fatalities per $10^5$ inhabitants in eight European countries from 1964 to 1974.

| Age | 1964 to 1966 deaths | 1964 to 1966 per $10^5$ inhab. | 1967 to 1969 deaths | 1967 to 1969 per $10^5$ inhab. | 1970 to 1972 deaths | 1970 to 1972 per $10^5$ inhab. | 1973 + 1974 deaths | 1973 + 1974 per $10^5$ inhab. |
|---|---|---|---|---|---|---|---|---|
| 0 to 4 years | 366 | 10.0 | 383 | 10.7 | 397 | 11.3 | 138 | 6.5 |
| 5 to 9 years | 486 | 14.0 | 564 | 15.7 | 541 | 14.9 | 287 | 11.9 |
| 10 to 14 years | 293 | 8.8 | 383 | 11.2 | 426 | 12.0 | 253 | 10.4 |
| 15 to 19 years | 765 | 21.7 | 1078 | 32.2 | 1314 | 39.0 | 939 | 40.7 |
| 20 to 24 years | 802 | 28.2 | 1057 | 31.2 | 1136 | 32.4 | 702 | 31.2 |
| 25 to 29 years | 500 | 20.4 | 581 | 22.1 | 636 | 20.8 | 430 | 18.5 |
| 30 to 34 years | 388 | 16.7 | 455 | 19.3 | 522 | 20.7 | 309 | 17.2 |
| 35 to 39 years | 319 | 14.0 | 362 | 15.5 | 394 | 16.9 | 212 | 13.3 |
| 40 to 44 years | 345 | 15.1 | 357 | 15.9 | 366 | 15.9 | 224 | 14.5 |
| 45 to 49 years | 334 | 16.5 | 375 | 17.0 | 419 | 18.7 | 216 | 14.6 |
| 50 to 54 years | 370 | 18.9 | 423 | 21.9 | 405 | 19.9 | 233 | 15.9 |
| 55 to 59 years | 435 | 23.9 | 454 | 24.4 | 525 | 27.8 | 225 | 18.2 |
| 60 to 64 years | 465 | 29.0 | 519 | 30.9 | 571 | 33.1 | 311 | 26.4 |
| 65 to 69 years | 445 | 34.1 | 524 | 37.7 | 549 | 37.2 | 326 | 31.9 |
| 70 to 74 years | 450 | 44.8 | 515 | 48.0 | 537 | 47.5 | 307 | 38.3 |
| 75 to 79 years | 399 | 58.3 | 449 | 61.3 | 472 | 59.6 | 279 | 50.2 |
| 80 to 84 years | 222 | 58.3 | 250 | 59.5 | 296 | 65.8 | 173 | 53.6 |
| 85 years and older | 90 | 45.5 | 115 | 51.1 | 106 | 42.1 | 74 | 40.0 |
| Total | 7474 | 20.1 | 8844 | 23.0 | 9612 | 24.2 | 5638 | 20.8 |

*Table 11:* Total number of fatalities by age groups in a number of periods, related to average number of inhabitants per age group in that period.

| Year | Total fatalities | Drivers and passengers in: Private cars | Motor trucks | Motor cycles + scooters | Mopeds | Cycles | Other vehicles | Pedestrians |
|---|---|---|---|---|---|---|---|---|
| 1964 | 2375 | 666 | 87 | 147 | 449 | 476 | 30 | 520 |
| 1965 | 2479 | 732 | 96 | 115 | 491 | 431 | 36 | 578 |
| 1966 | 2620 | 796 | 86 | 120 | 470 | 504 | 38 | 606 |
| 1967 | 2862 | 950 | 92 | 117 | 560 | 507 | 35 | 601 |
| 1968 | 2907 | 1070 | 81 | 92 | 538 | 507 | 30 | 589 |
| 1969 | 3075 | 1176 | 94 | 76 | 578 | 532 | 22 | 597 |
| 1970 | 3181 | 1322 | 82 | 85 | 540 | 512 | 31 | 609 |
| 1971 | 3167 | 1290 | 59 | 95 | 601 | 549 | 17 | 556 |
| 1972 | 3264 | 1350 | 75 | 93 | 574 | 558 | 26 | 588 |
| 1973 | 3092 | 1358 | 64 | 90 | 538 | 509 | 29 | 504 |
| 1974 | 2546 | 986 | 64 | 103 | 483 | 460 | 26 | 424 |
| 1975 | 2321 | 968 | 39 | 101 | 334 | 456 | 25 | 396 |
| 1976 | 2432 | 1058 | 49 | 120 | 285 | 500 | 17 | 403 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1964 | 100 | 28.0 | 3.7 | 6.2 | 18.9 | 20.0 | 1.3 | 21.9 |
| 1965 | 100 | 29.5 | 3.9 | 4.6 | 19.8 | 17.4 | 1.5 | 23.3 |
| 1966 | 100 | 30.4 | 3.3 | 4.6 | 17.9 | 19.2 | 1.5 | 23.1 |
| 1967 | 100 | 33.2 | 3.2 | 4.1 | 19.6 | 17.7 | 1.2 | 21.0 |
| 1968 | 100 | 36.8 | 2.8 | 3.2 | 18.5 | 17.4 | 1.0 | 20.3 |
| 1969 | 100 | 38.2 | 3.1 | 2.5 | 18.8 | 17.3 | 0.7 | 19.4 |
| 1970 | 100 | 41.6 | 2.6 | 2.7 | 17.0 | 16.1 | 1.0 | 19.1 |
| 1971 | 100 | 40.7 | 1.9 | 3.0 | 19.0 | 17.3 | 0.5 | 17.6 |
| 1972 | 100 | 41.4 | 2.3 | 2.8 | 17.6 | 17.1 | 0.8 | 18.0 |
| 1973 | 100 | 44.0 | 2.1 | 2.9 | 17.4 | 16.5 | 0.9 | 16.3 |
| 1974 | 100 | 38.7 | 2.5 | 4.0 | 19.0 | 18.1 | 1.0 | 16.7 |
| 1975 | 100 | 41.7 | 1.7 | 4.4 | 14.4 | 19.6 | 1.1 | 17.1 |
| 1976 | 100 | 43.5 | 2.0 | 4.9 | 11.7 | 20.6 | 0.7 | 16.6 |

**_Table 12:_ Numbers and percentages of fatalities specified for mode of road usage in years 1964 to 1976.**

| Age | Private cars (driver + passenger) | | | Motor cycles + scooters (driver + pillion rider) | | | Mopeds (rider + pillion rider) | | | Cycles (cyclist + pillion rider) | | | Pedestrians | | | Others | | | Total fatalities | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | %K | %R | No. | %K | %R | No. | %K | %R | No. | %K | %R | No. | %K | %R | No. | %K | %R | No. | %K | %R |
| 0 to 4 years | 115 | 2 | 24 | – | – | – | 7 | – | 1 | 32 | 2 | 7 | 309 | 14 | 66 | 7 | 2 | 2 | 470 | 4 | 100 |
| 5 to 9 years | 73 | 1 | 10 | – | – | – | 10 | – | 1 | 271 | 13 | 38 | 337 | 15 | 49 | 15 | 4 | 2 | 706 | 6 | 100 |
| 10 to 14 years | 65 | 1 | 12 | 2 | 1 | – | 34 | 1 | 6 | 329 | 15 | 60 | 98 | 4 | 18 | 23 | 6 | 4 | 551 | 4 | 100 |
| 15 to 19 years | 520 | 10 | 29 | 92 | 25 | 5 | 897 | 40 | 50 | 152 | 7 | 9 | 85 | 4 | 5 | 40 | 10 | 2 | 1786 | 14 | 100 |
| 20 to 24 years | 937 | 18 | 61 | 171 | 47 | 11 | 231 | 10 | 15 | 40 | 2 | 3 | 71 | 3 | 5 | 79 | 21 | 5 | 1529 | 12 | 100 |
| 25 to 29 years | 625 | 12 | 72 | 40 | 11 | 5 | 81 | 3 | 9 | 38 | 2 | 4 | 44 | 2 | 5 | 45 | 12 | 5 | 873 | 7 | 100 |
| 30 to 34 years | 522 | 10 | 74 | 15 | 4 | 2 | 79 | 4 | 11 | 22 | 1 | 3 | 39 | 2 | 6 | 29 | 8 | 4 | 706 | 5 | 100 |
| 35 to 39 years | 332 | 6 | 65 | 9 | 3 | 2 | 69 | 3 | 14 | 29 | 1 | 6 | 38 | 2 | 7 | 30 | 8 | 6 | 507 | 4 | 100 |
| 40 to 44 years | 317 | 6 | 66 | 5 | 1 | 1 | 65 | 3 | 13 | 33 | 2 | 7 | 43 | 2 | 9 | 20 | 5 | 4 | 483 | 4 | 100 |
| 45 to 49 years | 324 | 6 | 59 | 10 | 3 | 2 | 80 | 4 | 15 | 47 | 2 | 9 | 68 | 3 | 12 | 17 | 4 | 3 | 546 | 4 | 100 |
| 50 to 54 years | 284 | 5 | 52 | 8 | 2 | 1 | 103 | 5 | 19 | 60 | 3 | 11 | 68 | 3 | 13 | 21 | 5 | 4 | 544 | 4 | 100 |
| 55 to 59 years | 295 | 6 | 45 | 2 | 1 | – | 127 | 6 | 20 | 118 | 6 | 18 | 94 | 4 | 15 | 15 | 4 | 2 | 651 | 5 | 100 |
| 60 to 64 years | 288 | 5 | 39 | 5 | 1 | 1 | 137 | 6 | 18 | 144 | 7 | 19 | 155 | 7 | 21 | 16 | 4 | 2 | 745 | 6 | 100 |
| 65 to 69 years | 255 | 5 | 35 | 1 | – | – | 125 | 6 | 17 | 219 | 10 | 30 | 126 | 6 | 17 | 7 | 2 | 1 | 733 | 6 | 100 |
| 70 to 74 years | 156 | 3 | 22 | 1 | – | – | 100 | 4 | 14 | 233 | 11 | 33 | 206 | 9 | 30 | 7 | 2 | 1 | 703 | 6 | 100 |
| 75 and older | 212 | 4 | 18 | 2 | 1 | – | 108 | 5 | 9 | 361 | 16 | 31 | 476 | 20 | 41 | 12 | 3 | 1 | 1171 | 9 | 100 |
| Total | 5320 | 100 | 42 | 363 | 100 | 3 | 2253 | 100 | 18 | 2128 | 100 | 17 | 2257 | 100 | 17 | 383 | 100 | 3 | 12704 | 100 | 100 |

*Table 13*: Total numbers, column (K) and row (R) percentages of fatalities 1970 to 1973 by mode of road usage and age groups.

| Year | Private cars | | | Motor trucks | Motor cycles + scooters | Mopeds | Cycles | Pedestrians | Total traffic fatalities inside built-up areas |
|---|---|---|---|---|---|---|---|---|---|
| | Driver | Pass. | Total | | | | | | |
| 1964 | 19 | 18 | 18 | 20 | 39 | 47 | 51 | 60 | 40.9 |
| 1965 | 16 | 19 | 17 | 20 | 40 | 43 | 53 | 56 | 39.0 |
| 1966 | 19 | 23 | 21 | 22 | 48 | 45 | 52 | 59 | 41.7 |
| 1967 | 18 | 20 | 19 | 23 | 38 | 48 | 47 | 56 | 38.2 |
| 1968 | 19 | 19 | 19 | 23 | 40 | 51 | 54 | 62 | 40.3 |
| 1969 | 19 | 22 | 20 | 24 | 41 | 51 | 55 | 63 | 41.0 |
| 1970 | 24 | 23 | 23 | 30 | 31 | 52 | 53 | 65 | 41.5 |
| 1971 | 21 | 23 | 22 | 25 | 34 | 50 | 55 | 63 | 40.6 |
| 1972 | 20 | 23 | 21 | 24 | 40 | 51 | 55 | 64 | 40.5 |
| 1973 | 24 | 21 | 23 | 28 | 42 | 51 | 56 | 69 | 41.3 |
| Average 1964 to 1966 | 18 | 20 | 19 | 21 | 43 | 45 | 52 | 58 | 40.5 |
| 1967 to 1969 | 19 | 20 | 19 | 23 | 40 | 50 | 52 | 60 | 39.8 |
| 1970 to 1972 | 22 | 23 | 22 | 26 | 35 | 51 | 54 | 63 | 40.9 |

*Table 14:* Proportion of number of fatalities inside built-up areas by mode of road usage (as percentages of total number of fatalities in the particular category of road users) 1964 to 1973.

| Day of week | 1964 to 1969 number | % | 1970 to 1974 number | % |
|---|---|---|---|---|
| Monday | 2,314 | 14.2 | 2,106 | 13.8 |
| Tuesday | 2,190 | 13.4 | 1,991 | 13.1 |
| Wednesday | 2,248 | 13.8 | 1,954 | 12.8 |
| Thursday | 2,111 | 12.9 | 2,017 | 13.2 |
| Friday | 2,458 | 15.1 | 2,417 | 15.8 |
| Saturday | 2,370 | 14.5 | 2,216 | 14.5 |
| Sunday | 2,627 | 16.1 | 2,549 | 16.7 |
| Total | 16,318 | 100 | 15,250 | 100 |

***Table 15.*** **Total numbers of fatalities by day of week from 1964 to 1969 and from 1970 to 1974.**

| Year | Total fatalities | Collision between moving vehicle and: Moving vehicle Total | Head-on | Side ways | Head-tail | Parked vehicle | Pedestrians | Stationary object | Animal | Single-vehicle accidents | Other accidents |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 2,375 | 1,326 | | | | 63 | 527 | 276 | 6 | 171 | 6 |
| 1965 | 2,479 | 1,367 | | | | 66 | 576 | 277 | 9 | 174 | 10 |
| 1966 | 2,620 | 1,409 | | | | 61 | 611 | 349 | 6 | 178 | 6 |
| 1967 | 2,862 | 1,574 | | | | 79 | 608 | 387 | 11 | 200 | 3 |
| 1968 | 2,907 | 1,626 | 505 | 805 | 316 | 79 | 595 | 375 | 11 | 211 | 10 |
| 1969 | 3,075 | 1,771 | 562 | 844 | 365 | 72 | 598 | 432 | 4 | 193 | 5 |
| 1970 | 3,181 | 1,778 | 552 | 858 | 368 | 100 | 606 | 463 | 10 | 214 | 10 |
| 1971 | 3,167 | 1,860 | 583 | 899 | 378 | 75 | 557 | 435 | 8 | 220 | 12 |
| 1972 | 3,264 | 1,863 | 530 | 949 | 384 | 75 | 596 | 506 | 2 | 213 | 9 |
| 1973 | 3,092 | 1,762 | 536 | 899 | 327 | 79 | 506 | 517 | 5 | 214 | 9 |

*Table 16:* Numbers of fatalities by type of accident 1964 to 1973.

| Year | Total Number | Percentage on/in: Straight road | Bend or corner | Crossing or square | Inside built-up areas Number | Percentage on/in: Straight road | Bend or corner | Crossing or square | Outside built-up areas Number | Percentage on/in: Straight road | Bend or corner | Crossing or square |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 2,218 | 55 | 13 | 33 | 948 | 48 | 7 | 44 | 1,270 | 59 | 17 | 24 |
| 1965 | 2,290 | 57 | 11 | 32 | 932 | 54 | 6 | 40 | 1,358 | 60 | 14 | 26 |
| 1966 | 2,442 | 59 | 10 | 31 | 1,057 | 56 | 5 | 39 | 1,385 | 61 | 14 | 25 |
| 1967 | 2,636 | 57 | 11 | 31 | 1,054 | 52 | 6 | 41 | 1,582 | 61 | 15 | 25 |
| 1968 | 2,657 | 57 | 11 | 32 | 1,127 | 52 | 6 | 43 | 1,530 | 61 | 14 | 25 |
| 1969 | 2,809 | 58 | 12 | 30 | 1,209 | 55 | 7 | 39 | 1,600 | 60 | 15 | 24 |
| 1970 | 2,879 | 56 | 12 | 32 | 1,268 | 51 | 7 | 42 | 1,611 | 60 | 16 | 24 |
| 1971 | 2,868 | 54 | 13 | 33 | 1,237 | 50 | 7 | 43 | 1,631 | 58 | 17 | 25 |
| 1972 | 2,984 | 54 | 14 | 33 | 1,270 | 52 | 8 | 40 | 1,714 | 55 | 18 | 27 |
| 1973 | 2,802 | 53 | 15 | 32 | 1,225 | 51 | 8 | 41 | 1,577 | 55 | 21 | 25 |

*Table 17:* Numbers and percentages of fatal accidents by road situation 1964 to 1973.

| Month 1974 | Fatalities Expected | Actual | Difference Absolute | % | Quarter | Fatalities Expected | Actual | Difference Absolute | % |
|---|---|---|---|---|---|---|---|---|---|
| Jan. | 226 | 186 | - 40 | - 18% | | | | | |
| Febr. | 202 | 169 | - 33 | - 16% | 1st | 662 | 526 | - 136 | - 21% |
| March | 234 | 171 | - 63 | - 27% | | | | | |
| April | 234 | 210 | - 24 | - 10% | | | | | |
| May | 291 | 204 | - 87 | - 30% | 2nd | 812 | 657 | - 155 | - 19% |
| June | 287 | 243 | - 44 | - 15% | | | | | |
| July | 283 | 207 | - 76 | - 27% | | | | | |
| Aug. | 289 | 260 | - 29 | - 10% | 3rd | 856 | 722 | - 134 | - 16% |
| Sept. | 284 | 255 | - 29 | - 10% | | | | | |
| Oct. | 301 | 257 | - 44 | - 15% | | | | | |
| Nov. | 293 | 178 | - 115 | - 39% | 4th | 853 | 641 | - 212 | - 25% |
| Dec. | 259 | 206 | - 53 | - 20% | | | | | |
| Total | 3,183 | 2,546 | - 637 | - 20% | | 3,183 | 2,546 | - 637 | - 20% |

| Month 1975 | Fatalities Expected | Actual 1) | Difference Absolute | % | Quarter | Fatalities Expected | Actual 1) | Difference Absolute | % |
|---|---|---|---|---|---|---|---|---|---|
| Jan. | 220 | 205 | - 15 | - 7% | | | | | |
| Febr. | 197 | 145 | - 52 | - 26% | 1st | 646 | 535 | - 111 | - 17% |
| March | 229 | 185 | - 44 | - 19% | | | | | |
| April | 230 | 150 | - 80 | - 35% | | | | | |
| May | 285 | 220 | - 65 | - 23% | 2nd | 797 | 580 | - 217 | - 27% |
| June | 282 | 210 | - 72 | - 26% | | | | | |
| July | 278 | 100 | - 78 | - 28% | | | | | |
| Aug. | 283 | 250 | - 33 | - 12% | 3rd | 840 | 650 | - 190 | - 23% |
| Sept. | 279 | 200 | - 79 | - 28% | | | | | |
| Oct. | 295 | 190 | - 105 | - 36% | | | | | |
| Nov. | 287 | 200 | - 87 | - 30% | 4th | 836 | 595 | - 241 | - 29% |
| Dec. | 254 | 205 | - 49 | - 19% | | | | | |
| Total | 3,120 | 2,360 | - 760 | - 24% | | 3,120 | 2,360 | - 760 | - 24% |

**1) provisional figures**

*Table 18.* Differences between expected and actual fatalities in 1974 and 1975, monthly and quarterly, in numbers and percentages.

| Place of accident | Quarter | Fatalities Expected | Actual | Difference Absolute | % |
|---|---|---|---|---|---|
| Inside built-up areas | 1st | 280 | 244 | - 36 | - 13% |
| | 2nd | 334 | 272 | - 62 | - 19% |
| | 3rd | 332 | 274 | - 58 | - 17% |
| | 4th | 362 | 270 | - 92 | - 25% |
| Total inside built-up areas | | 1,308 | 1,060 | - 248 | - 19% |
| Outside built-up areas | 1st | 382 | 285 | - 97 | -25% |
| | 2nd | 478 | 388 | - 90 | - 19% |
| | 3rd | 524 | 442 | - 82 | - 16% |
| | 4th | 491 | 365 | - 126 | - 26% |
| Total outside built-up areas | | 1,875 | 1,480 | - 395 | -21% |

*Table 19:* **Differences between expected and actual fatalities 1974, by place of accident (inside or outside built-up areas) per quarter (provisional figures).**

| Province | 1974 Fatalities Expected | Actual | Difference Absolute | % | 1975 Fatalities Expected | Actual 2) | Difference Absolute | % |
|---|---|---|---|---|---|---|---|---|
| Groningen | 128 | 106 | − 22 | −17% | 126 | 95 | − 31 | −25% |
| Friesland | 162 | 140 | − 22 | −14% | 158 | 125 | − 33 | −21% |
| Drenthe | 158 | 125 | − 33 | −21% | 155 | 120 | − 35 | −23% |
| Overijssel | 264 | 226 | − 38 | −14% | 259 | 210 | − 49 | −19% |
| Gelderland | 446 | 342 | −104 | −23% | 437 | 325 | −112 | −26% |
| Utrecht | 192 | 167 | − 25 | −13% | 188 | 140 | − 48 | −26% |
| N.-Holland | 437 | 346 | − 91 | −21% | 428 | 335 | − 93 | −22% |
| Z.-Holland | 429 | 369 | − 60 | −14% | 421 | 330 | − 91 | −22% |
| Zeeland | 96 | 74 | − 22 | −23% | 95 | 70 | − 25 | −26% |
| N.-Brabant | 580 | 432 | −148 | −26% | 568 | 390 | −178 | −31% |
| Limburg | 276 | 205 | − 71 | −26% | 271 | 205 | − 66 | −24% |
| Z. IJsselm.-polders | 14 | 14 | 0 | – | 14 | 15 | + 1 | (+7%) |
| The Netherlands | 3183 1) | 2,546 | −637 1) | −20% | 3,120 | 2,360 | −760 | −24% |

1) owing to rounding off, direct addition gives a total of 3,182 and a total difference of -636.
2) provisional figures

*Table 20:* Differences between expected and actual fatalities 1974 and 1975, by provinces.

| Month | Average weekday density 'SWOV calculation' 1971 | 1972 | 1973 | 1974[1)] | CBS 1973 | 1974 | Difference CBS-SWOV 1974 | CBS 1975 |
|---|---|---|---|---|---|---|---|---|
| Jan. | 78 | 82 | 88 | 93 | | 84 | - 10% | 96 |
| Febr. | 93 | 95 | 100 | 103 | | 94 | - 9% | 102 |
| March | 86 | 96 | 100 | 108 | | 99 | - 8% | 106 |
| April | 96 | 103 | 108 | 114 | | 109 | - 4% | 112 |
| May | 97 | 102 | 106 | 111 | | 109 | - 2% | 119 |
| June | 101 | 108 | 110 | 115 | | 111 | - 3% | 122 |
| July | 98 | 105 | 105 | 109 | | 116 | + 6% | 124 |
| Aug. | 102 | 108 | 111 | 116 | | 120 | + 3% | 126 |
| Sept. | 103 | 108 | 110 | 114 | 110 | 111 | - 3% | 118 |
| Oct. | 96 | 100 | 104 | 108 | 107 | 109 | + 1% | 116 |
| Nov. | 93 | 99 | 91 | | 92 | 104 | | 109 |
| Dec. | 86 | 92 | 83 | | 85 | 98 | | 104 |

1) forecast

*Table 21:* Trend in average weekday density per month in index figures (1972 = 100) from 1971 to 1975.

| Month | Change 1974-1973 (1974-1972) as %* Local + district transport Number of travellers | | Rail Number of travellers | | Traveller-kilometres | |
|---|---|---|---|---|---|---|
| January | +15 | | +10 | | +13 | |
| February | − 1 | | + 4 | | +15 | |
| March | + 7 | | + 1 | | + 5 | |
| April | 0 | | + 7 | | +10 | |
| May | + 1 | | − 1 | | + 2 | |
| June | + 3 | | + 1 | | − 6 | |
| July | + 5 | (+ 6) | + 3 | (+1) | + 7 | (+ 4) |
| August | 0 | ( 0) | + 2 | (−2) | + 9 | (+ 6) |
| September | +12 | (+14) | + 5 | (−3) | + 4 | (− 1) |
| October | + 3 | (+12) | − 1 | (−2) | + 2 | (+10) |
| November | − 8 | (+ 5) | −10 | (−3) | − 6 | (+ 5) |
| December | −12 | (+ 7) | −14 | (−6) | −15 | (+ 2) |
| Year | +10 | | + 1,1 | | + 5,1 | |

*Note:* In the last two or three months of 1973 there was an increase in the use of public transport owing to the energy crisis; the reduction in these months in 1974 as compared with 1973 is not therefore realistic. A better comparison may be that between 1974 and the relevant months in 1972; the changes in these are shown in brackets.

*Table 22:* Increase and decrease in use of public transport in 1974 compared with 1973 (and 1972).

| Quarter | Sales figures new private cars: 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|
| 1st | 105,000 | 108,000 | 123,000 | 83,000 | |
| 2nd | 135,000 | 133,000 | 129,000 | 120,000 | |
| 3rd | 84,000 | 93,000 | 87,000 | 101,000 | |
| 4th | 79,000 | 98,000 | 90,000 | 100,000 | |
| Year | 403,000 | 432,000 | 430,000 | 404,000 | 475,000 [1)] |

1) RAI estimate

*Table 23:* Sales figures of private cars and estate cars quarterly 1971 to 1975 to nearest thousand).

| Year | Inside built-up areas | | Outside built-up areas | |
|---|---|---|---|---|
| | July | October | July | October |
| 1971 | 4 | 3 | 6 | 9 |
| 1972 | 7 | 7 | 11 | 13 |
| 1973 | 9 | 10 | 18 | 21 |
| 1974 | 9 | 10 | 15 | 21 |
| 1975 | 48 | 41 | 61 | 56 |

*Table 24:* Percentage usage of seat belts by car drivers inside and outside built-up areas in July and October 1971 to 1975. (About the same percentages apply to front-seat passengers).

| Year | Arnhem | | | | The Hague | | | |
|---|---|---|---|---|---|---|---|---|
| | Inside built-up area | | Outside built-up area | | Inside built-up area | | Outside built-up area | |
| | Males | Females | Males | Females | Males | Females | Males | Females |
| 1971 Spring | 9 | 7 | 18 | 4 | 6 | 4 | 19 | 3 |
| Autumn | 21 | 8 | 40 | 27 | 12 | 5 | 23 | 9 |
| 1972 Spring | 23 | 20 | 41 | 27 | 13 | 7 | 18 | 12 |
| Autumn | 21 | 9 | 40 | 25 | 14 | 8 | 15 | 9 |
| 1973 Spring | 23 | 21 | 44 | 31 | 23 | 23 | 39 | 21 |
| Autumn | 55 | 42 | 45 | 48 | 43 | 41 | 54 | 56 |
| 1974 Spring | 41 | 48 | 62 | 58 | 38 | 41 | 57 | 66 |
| Autumn | 68 | 70 | 76 | 71 | 53 | 64 | 65 | 64 |
| 1975 | All observations practically 100% | | | | | | | |

*Table 25:* Percentage wearing of crash helmets by moped riders in Arnhem and The Hague inside and outside built-up areas by sex in spring and autumn 1971 to 1975.

| Quarter | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|
| **Precipitation (hours)** | | | | | |
| 1st | 166 | 130 | 119 | 143 | 172 |
| 2nd | 126 | 189 | 116 | 73 | 110 |
| 3rd | 53 | 107 | 104 | 152 | 65 |
| 4th | 144 | 128 | 180 | 241 | 122 |
| Year | 489 | 554 | 519 | 609 | 469 |
| **Precipitation (mm)** | | | | | |
| 1st | 146 | 107 | 125 | 153 | 178 |
| 2nd | 202 | 211 | 207 | 152 | 181 |
| 3rd | 89 | 198 | 211 | 303 | 132 |
| 4th | 124 | 140 | 237 | 385 | 144 |
| Year | 562 | 656 | 780 | 993 | 635 |
| **Snowy days** | | | | | |
| 1st | 18 | 14 | 12 | 5 | 10 |
| 2nd | – | – | 6 | – | 7 |
| 3rd | – | – | – | – | – |
| 4th | 7 | 3 | 13 | 2 | 2 |
| Year | 25 | 17 | 31 | 7 | 19 |

*Table 26:* Precipitation in 1971 to 1975, quarterly as recorded at De Bilt.

| Source | Year of publication | Year of research | Economic cost | | | |
|---|---|---|---|---|---|---|
| | | | Material damage | Minor injury | Severe injury | Fatal injury |
| **French research** | | | | | | |
| Thédie & Abraham | 1961 | 1957 | 500 NF | | 4,800 NF | 125,000 NF |
| Min.Traveau Publ. | 1964 | – | 2,800 NF | | 6,200 NF | 170,000 NF |
| E.E.C. | 1969 | – | – | | | 150,000 NF |
| **American research** | | | | | | |
| Little | 1968 | 1958 | $ 100 | $ 823 | $ 823 | $ 47,000 |
| Little | 1968 | 1965 | $ 193 | $ 864 | $ 864 | $ 47,000 |
| **British research** | | | | | | |
| Reynolds [1)] | 1956 | 1952 | £ 38 | £ 96 | £ 576 | £ 2,000 |
| Dawson [1)] | 1956 | 1963* | £ 65 | | £ 575*** | |
| Dawson [2)] | 1967 | 1963 | £ 70 | £ 150 | £ 480 | £ 3,430 |
| Beesley & Evans | 1968 | – | £ 90 | £ 235 | £ 1,300 | £ 9,400 |
| Dawson [2,3)] | 1971 | 1968 | £ 90 | £ 220 | £ 1,230 | £ 16,980 [4)] |
| **German research** | | | | | | |
| Rheinhold | 1938 | – | 100 DM | 500 DM | 7,000 DM | 13,000 DM |
| Hosse | 1957 | 1955 | 605 DM | 177 DM | 1,115 DM | 101,600 DM |
| Hansmeyer & Nelsen | 1958 | 1955 | 530 DM | 53 DM | 3,400 DM | 77,800 DM |
| Berkenkopf | 1958 | – | 580 DM | 80 DM | 3,300 DM | 74,000 DM |
| Willeke, Bögel & Engels | 1967 | 1962 | 856 DM | 63 DM | 2,333 DM | 49,412 DM |
| Niklas | 1970 | 1964 | 1,516 DM | 119 DM | 4,027 DM | 119,388 DM |
| Helms | 1971 | 1968 | – | – | – | 308,200 DM |
| Lichter & Sanfleber | 1970 | – | 800 DM | 400 DM | 4,000 DM | 40,000 DM |

* Forecast by increasing Reynolds [1)] (1956) figures.
** Average injury
1) per accident
2) per casualty
3) 1970 prices
4) gross method

*Table 27:* Cost of road-traffic accidents according to severity of accident, from a number of French, American, British and German research projects.

| | |
|---|---|
| S | : Aggregate cost of road-traffic accidents |
| So | : Ditto according to null-value hypothesis regarding cost of deaths |
| Sn | : Ditto according to net method regarding cost of deaths |
| Sb | : Ditto according to gross method regarding cost of deaths |
| S1 | : Cost of physical injury |
| S11 | : Cost of deaths |
| S12 | : Cost of disablement |
| S121 | : Cost of permanent disablement |
| S122 | : Cost of temporary disablement |
| S13 | : Cost of hospitalisation |
| S2 | : Material damage |
| S21 | : Damage to vehicles |
| S22 | : Damage to fixed objects |
| S23 | : Other damage |
| S3 | : Extra costs |
| S31 | : Police |
| S32 | : Courts |
| S33 | : Settlement |
| S34 | : Cost of extra congestion |

| | |
|---|---|
| Nb | : Number of accidents involving material damage only |
| Nl | : Number of accidents involving non-fatal injuries |
| Nf | : Number of accidents involving fatal injuries |
| Nm | : Number of accidents |
| Ng | : Number of persons injured |
| Nd | : Number of deaths |

| | |
|---|---|
| Rm | : Average material damage per accident (guilders) |
| Rmg | : Average material damage per person injured |
| Rmd | : Average material damage per person killed |
| Rgl | : Average cost of injury per person injured |
| Rdf | : Average cost of death per person killed |
| Rg | : Average total cost per person injured |
| Rd | : Average total cost per person killed |

| | | | |
|---|---|---|---|
| Nb | = 6Nl (recorded) | S | = S11 + S12 + S13 + S2 + S3 |
| Nl | = 1.18 Nl (recorded) | S11 | = Nd.Rdf |
| Nm | = Nb + Nl + Nc | S12 + S13 | = Ng.Rgl |
| Ng | = 1.165 Ng (recorded) | S2 + S13 | = Nm.Rm |

*Table 28:* Legend to tables 29, 30 and 31.

| Cost | 1948[1]) | 1962[2]) | 1967[3]) | 1968[4]) | 1969[5]) |
|---|---|---|---|---|---|
| $S$ | 88 | 481 | 1047 | 1206 | 988 |
| $S_1$ | 59 | 243 | 494 | 912 | 422 |
| $S_{11}$ | 20 | 52 | 147 | 654 | 112 |
| $S_{12}$ | *33* | *131* | *269* | | *180* |
| $S_{121}$ | 19 | 39 | 95 | | 94 |
| $S_{122}$ | 14 | 92 | 174 | 258 | 86 |
| $S_{13}$ | 6 | 60 | 78 | | 130 |
| $S_2$ | 16 | 165 | 338 | 163 | 419 |
| $S_{21}$ | 14 | 151 | 312 | 114 | 302 |
| $S_{22}$ | 1 | 5 | 11 | 18 | 54 |
| $S_{23}$ | 1 | 9 | 15 | 31 | 63 |
| $S_3$ | 13 | 73 | 215 | 131 | 147 |
| $S_{31}$ | 1 | 8 | 19 | 24 | 19 |
| $S_{32}$ | 1 | 5 | 11 | 16 | 13 |
| $S_{33}$ | 11 | 60 | 185 | 34 | 115 |
| $S_{34}$ | – | – | – | 57 | – |

1) Netherlands Institute of Transport NVI (1950)
2) Contributions to the Ministerial Road Safety Memorandum (SWOV, 1965)
3) General Board of Rijkswaterstaat (H.Bosma) (1970)
4) Netherlands Economic Institute NEI (1972)
5) Erasmus University Rotterdam (Giezen & De Jong) (1973)

(See for meaning of S legend on page 83)

*Table 29:* Cost to the community of road-traffic accidents on public thoroughfares in millions of guilders for a number of years according to various Dutch research studies.

| | Low | Middle | High |
|---|---|---|---|
| So | 510 | 847 | 1163 |
| Sn | 612 | 978 | 1323 |
| Sb | 1164 | 1501 | 1817 |
| $S_{o,11}$ | 0 | 0 | 0 |
| $S_{n,11}$ | 102 | 131 | 160 |
| $S_{b,11}$ | 654 | 654 | 654 |
| $S_{121}$ | 84 | 95 | 105 |
| $S_{122}$ | 77 | 135 | 192 |
| $S_{13}$ | 86 | 102 | 117 |
| $S_{21}$ | 114 | 272 | 343 |
| $S_{22}$ | 12 | 18 | 49 |
| $S_{23}$ | 17 | 31 | 57 |
| $S_{31}$ | 17 | 21 | 24 |
| $S_{32}$ | 12 | 12 | 16 |
| $S_{33}$ | 34 | 104 | 203 |
| $S_{34}$ | 57 | 57 | 57 |

***Table 30:*** **Cost to the community of road-traffic accidents on public thoroughfares in 1968 (in millions of guilders) according to various calculating methods.**
**(See for meaning of S legend on page 83).**

| | 1948 | 1962 | 1967 | 1970 | 1971 |
|---|---|---|---|---|---|
| Rm | 627 | 1,161 | 1,663 | 2,215 | 2,440 |
| Rmg | 557 | 991 | 1,390 | 1,840 | 2,020 |
| Rmd | 600 | 1,088 | 1,528 | 2,025 | 2,230 |
| Rgl | 2,578 | 3,781 | 4,850 | 6,450 | 7,100 |
| Rdf | 21,008 | 24,976 | 51,363 | 68,360 | 75,200 |
| Rg | 3,135 | 4,772 | 6,240 | 8,290 | 9,120 |
| Rd | 21,608 | 26,064 | 52,891 | 70,400 | 77,430 |
| Nb | 31,938 | 160,004 | 270,000* | 336,000* | 356,000* |
| Nl | 13,422 | 43,134 | 59,800* | 66,100* | 70,000* |
| Nf | 911 | 1,956 | 2,636 | 2,879 | 2,868 |
| Nm | 46,271 | 204,984 | 332,436* | 405,000* | 429,000* |
| Ng | 15,129 | 50,520 | 71,550* | 79,500* | 84,200* |
| Nd | 952 | 2,082 | 2,862 | 3,181 | 3,167 |
| S11 | 20 | 52 | 147 | 217 | 238 |
| S12 + S13 | 39 | 191 | 347 | 512 | 597 |
| S2 + S3 | 29 | 238 | 553 | 897 | 1,047 |
| S[1)] | 88 | 481 | 1,047 | 1,626 | 1,882 |

* estimated numbers
1) in millions of guilders

*Table 31:* Key figures of road-traffic accidents and indicative values of economic cost (in guilders) owing to traffic accidents on public thoroughfares.
(See for meaning of R, N and S legend on page 83).

| 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|
| 2,680 | 2,940 | 3,230 | 3,550 | 3,910 | 4,300 |
| 2,220 | 2,430 | 2,660 | 3,920 | 3,200 | 3,500 |
| 2,450 | 2,690 | 2,950 | 3,230 | 3,550 | 3,900 |
| 7,810 | 8,600 | 9,460 | 10,410 | 11,450 | 12,600 |
| 82,720 | 91,000 | 100,100 | 110,100 | 121,100 | 133,200 |
| 10,030 | 11,020 | 12,120 | 13,320 | 14,650 | 16,100 |
| 85,170 | 93,675 | 103,030 | 113,320 | 124,640 | 137,100 |
| 344,000* | 345,000* | 330,000* | 301,000* | 313,000* | |
| 67,700* | 67,800* | 64,900* | 59,300* | 61,500* | |
| 2,984 | 2,802 | 2,338 | 2,131* | 2,238 | |
| 415,000* | 416,000* | 397,000* | 362,000* | 377,000* | |
| 81,600* | 82,000* | 77,100* | 69,900* | 72,600* | |
| 3,264 | 3,092 | 2,546 | 2,321 | 2,432 | |
| 270 | 281 | 255 | 256 | 295 | |
| 637 | 705 | 729 | 728 | 831 | |
| 1,112 | 1,223 | 1,282 | 1,285 | 1,474 | |
| 2,019 | 2,209 | 2,266 | 2,269 | 2,600 | |