Some aspects of the safety of elderly pedestrians and cyclists

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1. Introduction

The numbers of elderly people are increasing worldwide. Also, the mobility of the elderly people increases and the elderly generation of the coming years will spend much more time and distance in traffic than the present elderly generation; as car drivers, but also as pedestrians and/or cyclists. Pedestrians and cyclists are among the most vulnerable road users, in the sense that they are both most at risk in traffic and generate little risk to other road users. Among vulnerable road users, some are more vulnerable than others, in particular the elderly, the disabled, and children.

In this paper some aspects of the safety of elderly pedestrians and cyclists will be addressed. First, fatality data concerning older pedestrians and cyclists will be presented for a number of countries. Then, attention will be paid to fatality rates per 100,000 inhabitants, and the risks of elderly pedestrians and cyclists to become a victim in a road accident relative to kilometres travelled. Furthermore, a number of underlying factors that may have contributed to the involvement of elderly pedestrians and cyclists in accidents, and to the accident severity will be discussed. Finally, some (strategies for) countermeasures to increase the safety of elderly pedestrians and cyclists will be presented. The paper concludes with raising the issue why, despite the amount of available knowledge on the safety of the elderly road users, so few intervention programmes have actually been implemented. In this paper, I will use some of the work of a scientific expert group of the OECD which is currently preparing a report on the topic of the safety of vulnerable road users (OECD, 1996 in prep.); in addition some other (Dutch) research findings will be used.

2. The safety of elderly pedestrians and cyclists: an overview

In this section, international data provided by the IRTAD database is used to illustrate the safety of elderly pedestrians and cyclists. The data of the following countries is used: Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, United Kingdom, and the USA.

2.1. Fatalities

In *Figure 1* the composition of fatalities by age group for pedestrians and cyclists in a number of countries is shown (1992 data).

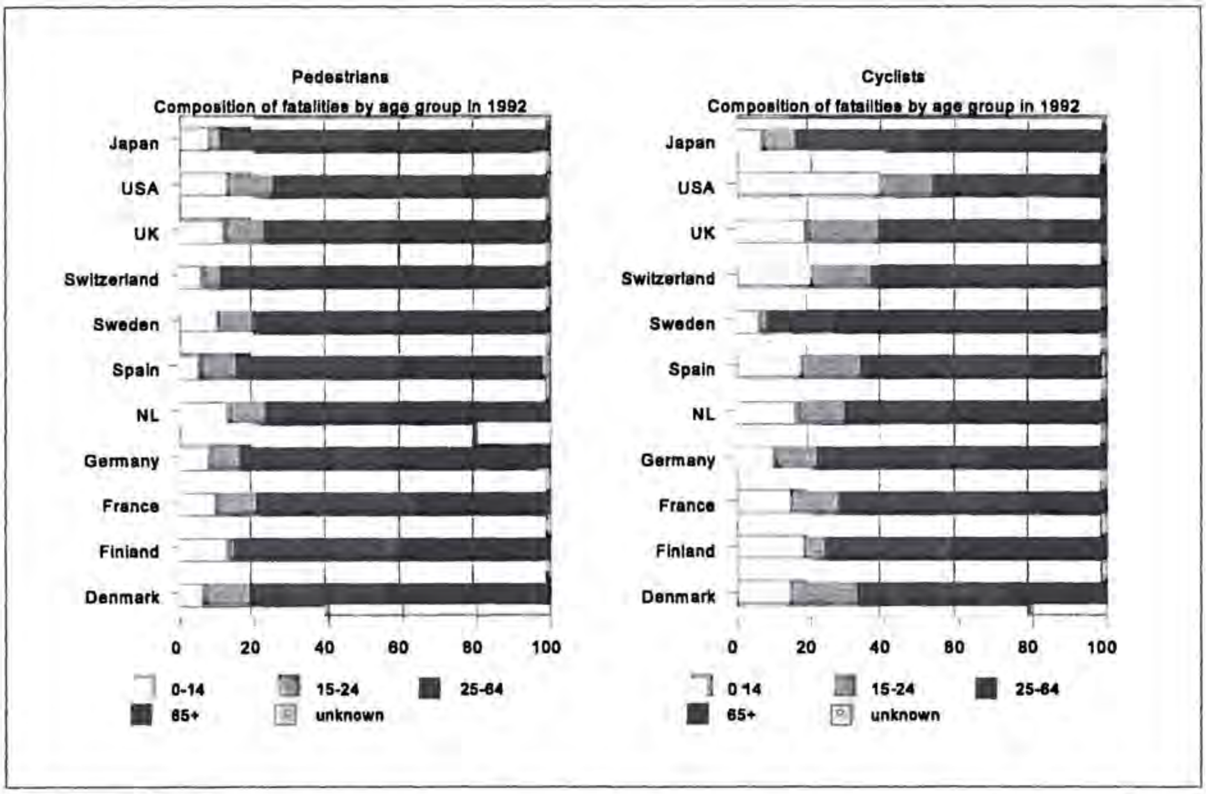


Figure 1. *Composition of fatalities among pedestrians and cyclists in a number of countries, by age group in 1992 (Source: Seo, 1996, in prep.).*

It appears that for most countries the elderly pedestrians of 65 years and older make up the largest share of all pedestrian fatalities. This share is greatest in Switzerland, where pedestrian fatalities among people from 65 and older have a share of 64%, followed by Japan (50%); in Germany, UK, Spain, the Netherlands, Sweden, Denmark and Finland their share is around 40-45%. In the USA the share of elderly pedestrians is relatively small, 23%.

When fatalities among bicyclists are considered, it appears that there is more variability between countries in the size of the shares of elderly cyclists. In general, though, the share of elderly (65+) cyclists is generally somewhat smaller as compared to the pedestrian fatalities. However, the fatalities among bicyclists of 65 years and older in Sweden make up the largest share (73%) of all age groups, and this share is larger than in all other countries. In Japan, the Netherlands, and Finland the share of cyclists aged 65 or older is of the same magnitude as their share among pedestrian fatalities (51, 44, and 42%, respectively). The share of fatalities among elderly cyclists in the USA, the UK, and Switzerland is relatively small (6, 15, and 20%, respectively) as compared to the fatalities in other age groups.

One could conclude from *Figure 1* that in many countries the relative large shares of cyclist fatalities among those aged 65 or older indicates a safety problem of importance. However, one cannot conclude that a relative small share of these fatalities in some countries - such as, e.g. in the UK or Switzerland - indicates that cycling is relatively safe there for the elderly. (The same reasoning can be applied in the case of elderly pedestrians.) They can still be over represented in the fatality statistics relative to the number of persons in a particular age group, and/or the number of kilometres travelled. These two issues will be discussed in the next paragraphs.

2.2. Fatality rates per 100,000 inhabitants

Considering that about 13-16% of the population of the selected countries is 65 years or older, the percentage of older pedestrians killed is greater than their representation in the overall population in all countries; the same can be said for killed cyclists of 65 and over - although less pronounced (and not in the UK and the USA).

When the number of fatalities is viewed with respect to the number of people in the population for the various age groups, it appears that - although the absolute rates differ markedly between countries - the fatality rate for elderly pedestrians (65+) is two (USA) to eight (Switzerland) or almost nine (Denmark) times higher as compared to the figure for those aged 25-64. In most countries the fatality rates for elderly pedestrians are three to five times higher as compared to pedestrians aged 25-64 (e.g. Germany: 4.6; UK: 4.5; France: 3.1; Spain: 3.5; Netherlands: 3.8; Sweden: 4.6; Finland: 4.1; Japan: 5.1; see also *Table 1*).

Age group		Denmark	Finland	France	Germany	NL	Spain	Sweden	Switzerl.	UK	USA	Japan
Pedestrians	25-64	0.97	1.52	2.30	1.78	0.63	3.30	0.97	1.24	1.88	2.55	2.43
	65+	8.61	6.19	7.08	8.19	2.41	11.57	4.48	10.08	8.50	4.81	12.32
Cyclists	25-64	1.56	1.08	0.68	0.84	1.18	0.37	0.63	0.66	0.40	0.27	0.81
	65+	4.49	8.01	1.28	3.05	6.09	0.83	1.91	1.54	0.45	0.21	4.64

Table 1. *Fatality rates for pedestrians and cyclists per 100,000 inhabitants by age group and country in 1990 (Source: Seo, 1996, in prep).*

For elderly cyclists the fatality rates are considerably lower than for elderly pedestrians in most countries, except in Denmark, Finland, and the Netherlands where fatality rates for elderly cyclists are higher than for elderly pedestrians. The fatality rate for elderly cyclists (65+) is generally two or three (France, Spain, Switzerland, Denmark, Sweden) to four or five (Germany, the Netherlands, Japan) times higher as compared to the figure for those aged 25-64. In Finland the fatality rate of elderly cyclists is even more than seven times higher. In the UK and the USA the fatality rate for elderly cyclists is equal or even somewhat lower as compared to that of cyclists aged 25-64 (see also *Table 1*).

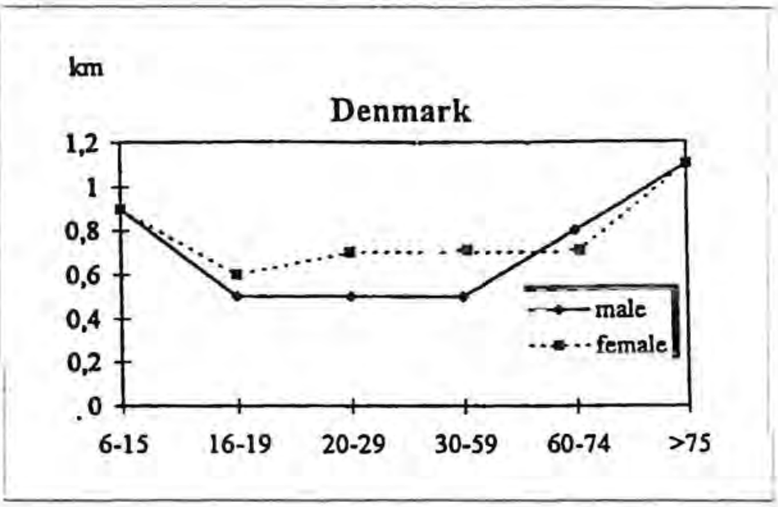
The data of *Table 1* indicate even more strongly than the data presented in *Figure 1* that elderly pedestrians and cyclists are generally over represented - based on the number of persons in that age group - in the fatality statistics of most countries. These fatality rates are, in most countries (except for Finland and the Netherlands), much higher for elderly pedestrians than for elderly cyclists. However, one can still not conclude from this data that it is, for instance, safer for an elderly person to ride a bicycle in, say the UK (fatality rate of 0.45), than in the Netherlands (6.09), because it is very well possible that people - including the elderly - cycle more in the latter country. Unfortunately, exposure data (number of person kilometres travelled) for pedestrians and cyclists are not available in the IRTAD database. Only in a limited number of countries this type of data is regularly collected (and even when collected this data is not always very reliable, and due to variation in the collection procedures it is not clear if the data of various countries are directly comparable).

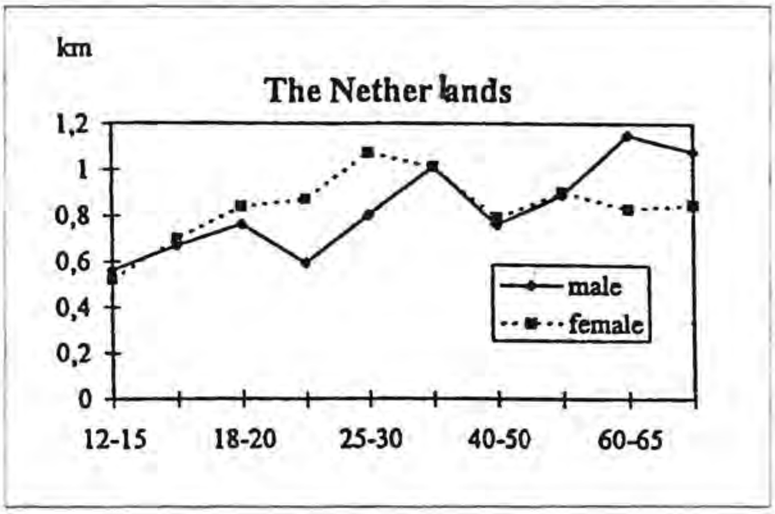
2.3. Exposure and risk

For a few countries data have been obtained to indicate the average distances travelled by (elderly) pedestrians and cyclists (Bernhoft, 1996, in prep.).

Figures 2 a-c show the average distances *walked* per person per day by age and sex in Denmark, the Netherlands and Great-Britain in 1992 (see Bernhoft, 1996 for more examples).
As becomes readily apparent from these figures, there are substantial variations between countries in walking patterns. In Denmark and the Netherlands elderly people walk most, whereas a gradual decrease in distances walked is seen with increasing age in Great Britain. The distances walked per day vary between about 0.5 and 2 kilometres for all age groups and both sexes, except for middle-aged English men who do not (seem to) walk at all.

Figures 3 a-c illustrate the distances *cycled* per person per day by age and sex. The Netherlands is the country where most kilometres are covered by bicycle (2-8 km/day/person), but Denmark as well covers a relatively high number of kilometres. In Great Britain less than 1 km is travelled by cycle per day per person. In all three countries the average distance travelled by bicycle decreases with age.





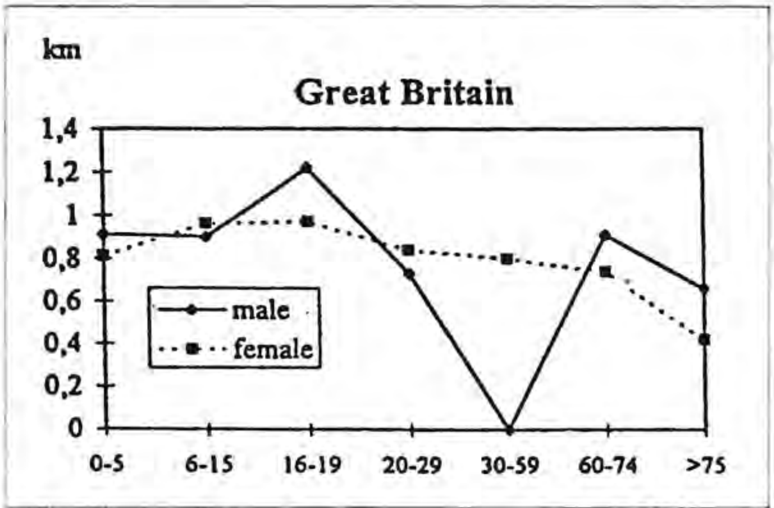


Figure 2 a-c. *Distances walked per day per person by age and sex in Denmark, the Netherlands and Great Britain in 1992 (Taken from Bernhoft, 1996, in prep.).*

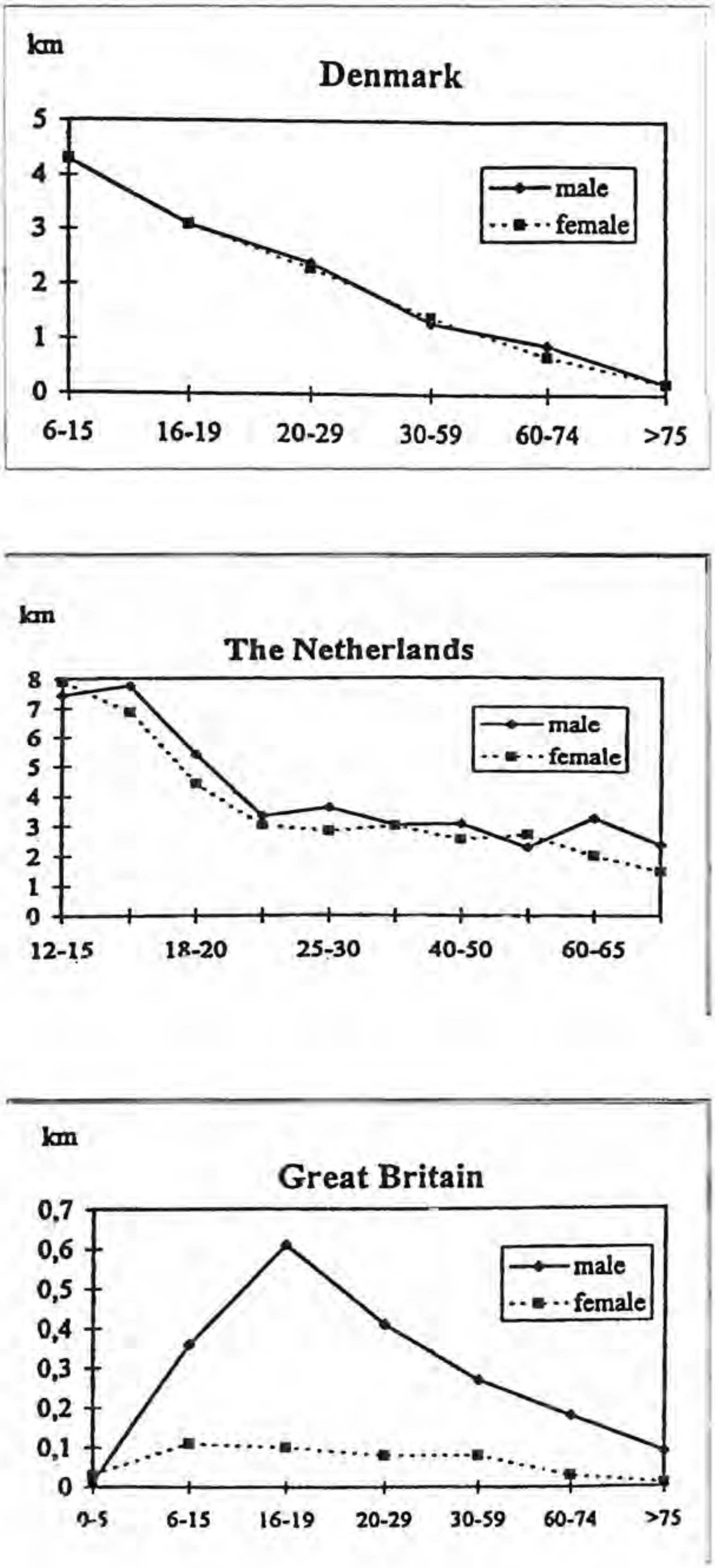


Figure 3 a-c. *Distances cycled per day per person by age and sex in Denmark, the Netherlands and Great Britain in 1992 (Taken from: Bernhoft, 1996. in prep.).*

When the number of fatalities, the number of persons in a particular age group, and the kilometres travelled are combined, the fatality risk can be calculated relative to the amount of exposure. On the basis of these risk figures it can than be determined whether elderly pedestrians and cyclists are more at risk in certain countries as compared to others. As stated, due to a lack of comparable exposure data this 'exercise' cannot be conducted. For illustrative purposes, these risks have been calculated for the situation in the Netherlands (see *Figure 4*).
As can be seen in this figure, per distance travelled, the elderly pedestrians and cyclists are much more at risk than any other age group.

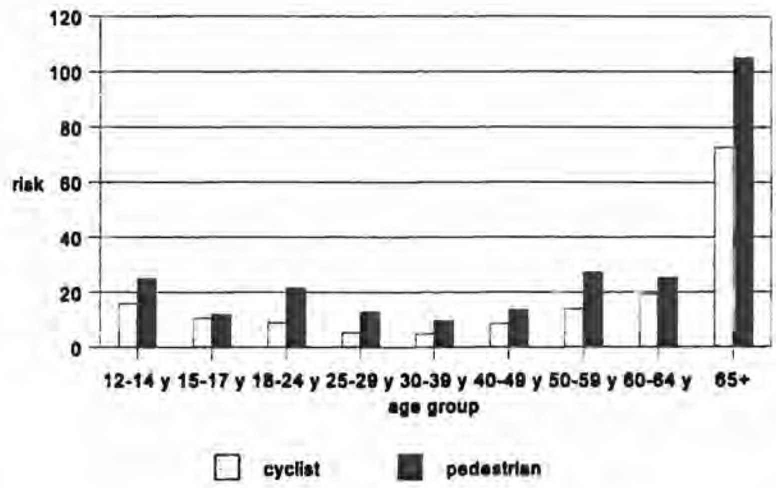


Figure 4. *Fatality risks (per average billion 1992-1994 kilometres travelled) according to age group for cyclists and pedestrians in The Netherlands (Source: SWOV/BIS-V/OVG/VOR).*

In summary, fatality figures have been used to illustrate the (un)safety of elderly pedestrians and cyclists. (The same trends are present when victims who are injured are used, however less pronounced.) It appears that when involved in an accident, the outcome is more severe for elderly pedestrians and cyclists than for road users in other age groups.
For example, in the Netherlands, of the pedestrians injured or killed approximately 18% (and of the cyclists 14%) were 65 or older. This is somewhat higher than their 13 percent representation in the overall population. However, adults 65 or older made up more than 50 percent of pedestrians killed (and 38% of the cyclists killed) in 1994 in the Netherlands. Thus, in the Netherlands the elderly are somewhat more likely than other pedestrians or cyclists to be involved in an (injury) accident, but once in an accident they are much more likely to be killed.
Similar patterns exist in other countries, in particular for the elderly pedestrians (see OECD, 1966, in prep.). When the distances travelled are taken into account, Dutch data show that walking is extremely risky for the elderly (as compared to other age groups); the risk figures for cycling are also much higher for the elderly.

In order to be able to calculate and compare risk figures for various countries, exposure data concerning walking and cycling will be needed; such data are, at present, hardly available.

3. Factors contributing to the unsafety of elderly pedestrians and cyclists

In the previous sections it was shown that elderly pedestrians are relatively overrepresented in the fatality statistics. However, before being able to design and implement (strategies for) countermeasures in order to increase the safety of elderly pedestrians and cyclists, one has to know which factors contribute to their unsafety. For example, in which types of traffic situations or road characteristics are elderly pedestrians and cyclists (over)involved? But also, which general characteristics of the elderly people themselves make them more vulnerable as pedestrians and cyclists than these types of road users of other age groups? These issues will be discussed in the next paragraphs.

3.1. Accident circumstances

Only a few recent studies have been found dealing with age-specific accident circumstances of the elderly bicyclists and pedestrians.

In the US a study was carried out (Zegeer et al., 1993) to create a better understanding of the causes and characteristics of motor vehicle crashes involving *older pedestrians*. The results showed that on a population basis, older pedestrians (65 or older) are slightly less likely than younger pedestrians to be struck by a motor vehicle; however this statistic does not take into account the amount of walking, accident location, and so forth. Once injured, older pedestrians have a much higher likelihood of being killed - 20 percent, compared to 5 to 10 percent for younger age groups. Pedestrians aged 65 or older were over represented in crashes during daylight hours, on weekdays, and in winter. Zegeer et al. also found that older pedestrians are over represented in intersection crashes (particularly involving turning vehicles) and in crashes involving wide street crossings. Similar findings have been reported in the Netherlands (SWOV, 1987).
In addition, compared to other age groups, elderly cyclists are more often involved in accidents in the smaller municipalities (ibid.). A study conducted in Great Britain showed that most pedestrian accidents involving older people occurred in daylight, in fine weather, and in familiar surroundings (Grime, 1987; cited in Carthy et al., 1995).

Goldenbeld (1992) studied accidents of *elderly bicyclists* in the Netherlands. The study indicated that the passenger car is the principal collision partner in these cases. (Compared to other age groups, the proportion of collisions with cars, trucks and buses is about 25-40 percent higher for the elderly than for younger cyclists in the Netherlands; SWOV, 1987.)
In many of these cases the cyclist has to cross a multi-lane road, which is an indication that it may be difficult to judge the situation, that cars may have high speeds, and that it may take much time to cross. It is also an indication of a high volume of cars on the main road, but the police reports did not mention high volumes at the time of the accident.
Such incidents (63% of all accidents) occurred particularly inside the built up area (50%), at intersections (19%) and at T-junctions (15%). Amongst accidents at intersections and T-junctions, most accidents occurred at T-

junctions and intersections controlled by traffic signs (25%). The difficulties experienced by older cyclists at intersections and T-junctions controlled by signs related primarily to manoeuvres such as crossing the road or turning left at the intersection. Accidents hardly occurred as a result of right-hand turns at these intersections. With the majority of these accidents, the car was driving on a priority road while the cyclist approached from a side road.

Goldenbeld (1992) also reports that the manoeuvre of turning left not only poses problems at intersections and T-junctions for older cyclists, but also on straight roads. 4% of all accidents occurred when the older cyclist turned left on a straight road (to cross) inside the built up area and was hit from behind by a car. It is worthwhile noting that with these accidents, the cyclist involved was always driving on the main road, never on a separate cycle path.
About one fifth of all accidents were found to occur with other light traffic, viz. cycles and mopeds. With collisions between elderly cyclists and light traffic inside the built up area (15%), cyclists and moped riders were found to be involved in equal numbers as collision partner. Outside the built up area, other cyclists were more often the collision partner than moped riders. Accidents involving light traffic often occurred on straight roads (10% of all cases). These accidents often involved a cyclist on the main road who turns to the left, colliding with a car coming from behind. In the majority of cases, the car driver is noted to have seen the cyclist, but either found no indication of the intended left turn or assumed to cyclist would wait.
The cyclist seems to rely on hearing to find out if there is a car coming from behind, because it is physically difficult to look to the rear. As a result, he/she makes a risky decision. The same type of accident is found on road sections inside built-up areas as well (see also Noordzij, Hagenzieker & Goldenbeld, 1993).
Finally, those accidents involving heavy traffic (5% of all cases) are distinguished from the other accident categories because the older cyclist was less often seen by the other party. Often, the driver did not see the cyclist at all when overtaking, turning off or reversing. For this category of accidents, the erroneous expectation of the cyclist or the driver with respect to the behaviour of the other party was noted relatively more often than with the other accident categories.

3.2. Physical and psychological factors

As a consequence of ageing, perceptual, cognitive and motor skills deteriorate. For example, visual acuity, peripheral vision, and the so-called useful field of view decrease with age, and distance perception is impaired at low luminance levels. In traffic situations this could lead for instance to difficulty in estimating distance and speed. Furthermore, overall performance on two simultaneous tasks (divided attention) that require motor responses usually shows age-related decrements; and in selective attention tasks it is shown that older adults have more difficulty ignoring irrelevant information.

Complex situations, such as heavy traffic at high speed, are more likely to cause problems in the selection of information and in decision making. Decisions are less likely to be taken almost simultaneously and executed in

parallel, but rather in sequence. Hearing impairments related to the ageing process occur in 13% of people aged 65 and over. Hearing impairments may cause problems in localising sounds and consequently in ascertaining from which direction a vehicle is approaching. (For more examples, see, e.g. Carthy et al., 1995; Korteling, 1994; Sivak, 1995; Wouters, 1988, 1991, 1994).
Another factor is vulnerability. With increasing age, biological processes result in a reduction of resilience to trauma. Lethality increases progressively with age and is higher for men than for women. The great vulnerability of the elderly is an important aspect of the dangers they run.

These phenomena become obvious at about the age of 45, vary greatly from person to person, and become more marked with age. They can partly be compensated for by, for instance, lessening frequent traffic participation, the avoidance of certain traffic situations, or by taking more time to observe situations. Loss of function is reinforced by a diminishing practice of functions, and is usually coupled with a reduction in routine (Wouters, 1988). However, a clear relation with the occurrence of traffic accidents is not (yet) demonstrated. Because of methodological and statistical reasons, it is very difficult to demonstrate such a relationship anyway; moreover, factors such as self-selection and compensating behaviours complicate matters even more. Although the Some of the above-mentioned phenomena have been demonstrated to be related to driving behaviour (see, e g. Sivak, 1995; Korteling, 1994), but research relating age-related diminutions to pedestrian and cycling behaviour is virtually absent.

More often observational studies have sought to identify behaviour that may account for the higher accident involvement (in certain types of accidents) of elderly pedestrians. For instance, walking speeds and crossing behaviours have been studied in order to investigate the possible relation with the relatively high involvement of elderly pedestrians at intersections (see, e.g. Bowman and Vecellio, 1994; Knoblauch et al., 1995; Virkler and Elayadath, 1994; cited in Wouters, 1995). Elderly pedestrians (65 or older) showed an average speed of 1.19 m/s, whereas younger pedestrians' average walking speed was 1.43 m/s. This difference in walking speed primarily originated from a smaller step-length by the elderly pedestrians. These findings were intended to adjust (guidelines for) traffic light installations to the walking speeds of the elderly.

Wilson and Grayson (1986; cited in Carthy et al., 1994) did not find distinctive crossing behaviours within the older group of pedestrians. Other studies have shown that older pedestrians appear to exercise more caution (for example, stopping at the kerb, making head movements, standing further back etc.) when crossing streets (e.g. Carthy et al., 1994); but this does not necessarily result in greater safety. Furthermore, it appears that elderly pedestrians stop more often before crossing a road, show longer waiting times and make more and longer head movements *before* crossing. On the other hand, *during* crossing elderly pedestrians appear to make less head movements compared to pedestrians of other age groups (Wilson & Grayson, 1980; cited in SWOV, 1987).

When studying police records of accidents involving elderly cyclists, Goldenbeld (1992) found indications that with about 10% of the accidents, inadequate control over the bicycle contributed to the accident. In particular, the following forms of loss of control were noted: startled by another party and falling, not keeping a straight course, driving erratically. This was found more often for female cyclists aged 65 and above than for male cyclists.

All factors mentioned in this section are interrelated: ageing leads to a loss of function; road use decreases with age; less frequent road use leads to a loss of practice of functions, thus leading to an extra loss of functions and of routine. The feeling of the elderly that they are no longer able to function in traffic which is tailored to the 'average' road user, and fear of their own vulnerability - feelings which questionnaires have shown to exist - have the effect that old people become even less frequent road users (Wouters, 1988).

4. Strategies for countermeasures

With the knowledge of factors which relate to the traffic safety problems of the elderly, the question arises as to which strategy this offers for the development of solutions. Three main points can be distinguished (Wouters, 1988):

- Loss of function should be slowed down as much as possible and routine should be continued.
- Where it is no longer possible to retard loss of function, compensatory behaviour should be reinforced.
- When the possibilities of compensating for and halting loss of function and routine have been exhausted, the vulnerability of the elderly - which one can do little to help - demands that certain situations should be adapted or that exposure to such situations should be avoided. Other road users should also (learn to) deal better with the elderly.

Practice and routine help to slow down the loss of function. Walking and cycling are particularly suitable to maintain active participation in traffic. By adapting bicycles they can be easier to mount; rear-view mirrors fitted to the cycle could improve the safety of the left-hand turning manoeuvre. Elderly people can also switch to tricycles. These supportive measures can increase the elderly persons' capacity of anticipation as well as their self-confidence.
The change over from driving a car to walking, cycling and other transport modes (e.g. public transport) - a change over which is encouraged for other age groups by more and more government policies anyway; but elderly people more often start to refrain from driving due to 'self-selection' - can be facilitated by providing the elderly with tailored information on route choice and travel schemes.

Elderly people should know how important it is to keep moving, which possibilities there are for them to use safe walking and cycling facilities and how to practice their skills. Traffic education aimed at elderly cyclists can point out ways to apply suitable compensating behaviour and discourage hazardous compensation strategies. For example, traffic education can point out what situations (e.g. T-junctions and intersections controlled by signs) and manoeuvres (left-hand turns) could pose a danger to older cyclists, why these situations are potentially hazardous, what options for compensating behaviour are available (taking another route, stepwise performance of complex tasks, physical training) and what forms of compensating behaviour (relying too much on hearing) are in fact inappropriate.

The infrastructure determines to a great extent under what conditions one travels. If traffic situations are predictable, early anticipation and compensation are easier. By arranging traffic situations clearly and making traffic rules and the regulation of traffic comprehensible, much can be gained. In this context it is important that traffic signs should be visible and recognisable to poor visual acuity and that traffic rules, particularly new ones, should be known. The incompatibility of pedestrians and cyclists with motorised vehicles can effectively be solved either by separating or integrating these categories. A more specific problem for the elderly is that of complex situations which demand the performance of a number of tasks and rapid and accurate perception, selection of information and reaction. For elderly cyclists, the design of the traffic area should offer sufficient time to assess the situation and perform the various tasks required of them in sequence. For example, measures aimed at reducing the speed of motorised traffic and simplifying the design of intersections. Simplified design in more concrete terms implies that elderly cyclists can easily see where they can safely stop as they approach the intersection. Many infrastructural facilities can be thought of that could help improve the safety of vulnerable road users. I will just name a few examples.

Facilities such as pedestrian refuge islands provide the opportunity to cross a street in stages, thereby subdividing a complex situation into a number of more simple ones. And since most accidents involving elderly pedestrians and cyclists occur inside urban areas, the design of, e.g. safe residential areas such as 30 km/h zones will be beneficial to the safety of (elderly) pedestrians and cyclists. In general, these types of solutions are important for pedestrians and cyclists of all ages; and for elderly people even more so. Instead of designing an infrastructure for the 'average' road user, an adequate infrastructure for a broader group of people - including elderly (and very young) pedestrians and cyclists - should be the primary aim. Wouters et al. (1995) conclude that with the current strategy to aim for a 'sustainable-safe' infrastructure, "no separate measures for the elderly need be applied, although certain forms of application may require some adaptation to better suit the elderly road user". For example, these authors point out that facilities such as the 'drawing pin', the traffic hump with deflected cycle passage, the axis deviation and the intersection plateau should be critically reexamined. Both 'road safety experts' and elderly people themselves judged these facilities as difficult to comprehend and/or to use.

One can also imagine unwanted side effects of facilities particularly adjusted for certain groups of road users. Turning left in two stages, for example, is easier and is considered to be safer than turning left diagonally, and might therefore be particularly suitable for elderly cyclists. However, from observational studies (Twisk & Hagenzieker, 1993) it is known, that (especially younger) cyclists often do not use such facilities and turn left diagonally anyway. It is therefore possible that some facilities are 'good' for (certain groups of) cyclists, e.g. the elderly, but not necessarily so for others. When large groups of cyclists do not use facilities as intended, unsafe rather than safe situations might be a result of them.

Another example might be the adjustment of traffic light installations to elderly (slow moving) pedestrians. The traditional system has some drawbacks. Adapting the clearance time to the small group of very slow-moving pedestrians would cause excessive waiting times for other road users, possibly resulting in an increase of red-light violations and unsafe situations. A better solution is provided by so-called PUSSYCATS (Pedestrian Urban Safety System and Comfort At Traffic Signals; called PUFFINS in the UK). One feature of PUSSYCATS is that the length of the 'green-period' is adjusted to the actual presence of pedestrians on the crossing (detected by infrared sensors), resulting in longer green phases when slow-moving pedestrians cross as compared to faster moving pedestrians (see, e.g. Levelt, 1994).

In the collision phase hardly any specific opportunities for solving the road safety problems of the elderly can be thought of. With the accidents involving light traffic, even light collisions could result in severe injury. The possibility of minimising the severity of injury by means of special clothing might be investigated. Research has shown that the use of bicycle helmets can markedly reduce head injuries among bicyclists. However, in most countries only a small minority of bicyclists wear helmets (usually children, elderly and other adults hardly wear them). It is not an easy task to promote the use of a bicycle helmet, because in general negative attitudes to the usage of helmets exist among cyclists (see, e.g. Hagenzieker, 1996, in prep.).

5. Discussion and conclusions

From road safety studies, it appears that elderly road users are over represented in the fatal and serious injury statistics. This holds in particular for elderly pedestrians and cyclists. Reviews and accident studies focussing on the road safety of elderly road users have typically paid attention to this aspect of the increased probability of becoming a victim in a road accident. However, only a limited number of (in-depth) accident studies have been conducted that specifically investigate the (particular) accident circumstances of elderly pedestrians and cyclists. The results of these studies show, for example, that cyclists tend to be (over)involved in accidents inside urban areas, at intersections, and when turning left.

Studies into the ageing process show that, as a consequence of ageing, perceptual, cognitive and motor skills deteriorate. Complex situations are more likely to cause problems in the selection of information and in decision making. Decisions are less likely to be taken almost simultaneously and executed in parallel, but rather in sequence. In addition, with increasing age, biological processes result in a reduction of resilience to trauma (greater vulnerability). However, a clear relationship of the diminution of functions with the occurrence of traffic accidents is not (yet) demonstrated, and research relating age-related diminutions to pedestrian and cycling behaviour is very scarce.

So, it appears that on the one hand a lot of general knowledge is available indicating and - partly - explaining the safety problems of elderly pedestrians and cyclists, both in terms of fatality rates among elderly as well as in identifying underlying contributing factors related to the ageing-process. This knowledge enables us to formulate strategies for countermeasures, which should focus on the slowing-down of the loss of function, the reinforcement of compensatory behaviour, and the adaptation of certain situations in traffic to a broader group of road users than just the 'average' ones. On the other hand, very few intervention programmes for older pedestrians have actually been implemented (and evaluated). Carthy et al. (1995) note that this is a product perhaps of scarce publicity about the problem, lack of resources and ignorance about empirical evidence on the high pedestrian accident rate. Another explanation may be that although a lot of general knowledge is available, the exact relationship with specific traffic behaviours is not clear at all. Such specific knowledge is needed in order to design and implement tangible countermeasures.
Furthermore, the recommendation that one should design an adequate infrastructure for a broader group of people than the 'average' road user, does not necessarily imply how such an infrastructure exactly looks like. In other words, what needs to be done is to somehow translate (operationalise) the available general knowledge in the area of traffic safety, and physical and psychological abilities and limitation of humans, into specific solutions and facilities (e.g. guidelines). A state of affairs, by the way, which applies to the entire field of road safety, not only for the elderly in particular.

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