SWOV Fact sheet

Senior cyclists

Summary
The use of the bicycle has increased these last few years, especially among seniors. The number of seniors annually sustaining serious injuries as a result of a cycling crash is substantial (4,280) and has been increasing these last few years. Moreover, circa 120 seniors (55+) die in a cycling crash each year. They are often single crashes, with no other road users involved. Especially people in the age category of 75+ run a relatively high risk of dying or sustaining serious injuries as a result of a cycling crash. One factor playing a role is their relatively high vulnerability. When crashing, the senior cyclist runs a high risk of fracturing a hip or leg. Recent years have shown the increased use of the e-bike. And consequently, the concern about the safety of vulnerable seniors has equally risen, because they can more easily ride at higher speeds with this vehicle. The double ageing of the population will be the reason that more, and possibly more vulnerable seniors will go on cycling until a more advanced age in the future. This goes against the efforts to reduce the number of cycling crashes among this group. It is necessary to develop knowledge about effective preventive measures.

Background and content
In the Netherlands, the number of bicycles (18 million) exceeds the number of residents (16.7 million). Circa 85% of the Dutch population has one or more than one bicycle and each household has three on average. The use of the bicycle has increased in recent years, especially among the 55+ age group (Van Boggelen, 2011), partly because the government promote cycling as a public health measure, (Van Bakel & Wendel-Vos, 2010; Møller et al., 2011). Simultaneously, crash figures indicate that, compared to younger age groups, the number of people of 55+ sustaining serious injuries as a result of a cycling crash is substantial and that the figure has been increasing. For this reason we define the the age group 'seniors' as 55+ for bicycle crashes (see SWOV Fact sheet *The elderly in traffic*). As a result of the double ageing of the population, not only the number of 55+ will be increasing in coming years, but also the share of 75+ of this age group. Later in this fact sheet we will see that he 75+ have a relatively high risk of being involved in a serious bicycle crash (*Figures 1 and 2*). Therefore, the number of bicycle crashes involving senior cyclists is also expected to increase. This fact sheet will discuss the severity and characteristics of cycling crashes among seniors, the risk factors concerned and developments that have an effect on the cycling safety of seniors.

Why special attention for safety of senior cyclists?
Every year, circa 120 people of 55 and over die in a cycling crash. This is approximately one-fifth of the total number of fatalities. Furthermore, an annual number of 4,280 people of 55+ sustain serious injuries (MAIS 2+ on average from 2005-2009) and circa 18,000 people from this age group are yearly admitted to the first aid department (SEH) (Injury information system LIS, 2006-2010). Almost twice as many men as women (55+) die in a cycling crash. The rates for seriously injured and people treated by the SEH are exactly vice-versa: more women (55+) sustain serious injuries and are treated by the SEH.

People who cycle often may be more frequently involved in a cycling crash than those who do not or hardly cycle. To compare groups of people in terms of their risk of being involved in a cycling crash, the distance travelled is taken into account. In crashes with cyclist fatalities, casualties are more often found among the group of 55+ than among those younger than 55, as related to the number of kilometres travelled. This involves men, more often than women (*Figure 1*). Seniors are also more often involved in cycling crashes with serious injuries. Women (55+) in particular are more often involved in this type of crash (*Figure 2*).

In 2011, the number of fatalities among cyclists (50+) increased by circa 20% as compared to the average number over the period 2008-2010 (Wijlhuizen et al., 2012). This increase is relatively high among cyclists of 80 years and older: circa 30%. In 2011, the number of serious road injuries among senior cyclists (55+) increased by about 15% compared with the average number over the period 2008-2010 (Wijlhuizen et al., 2012).

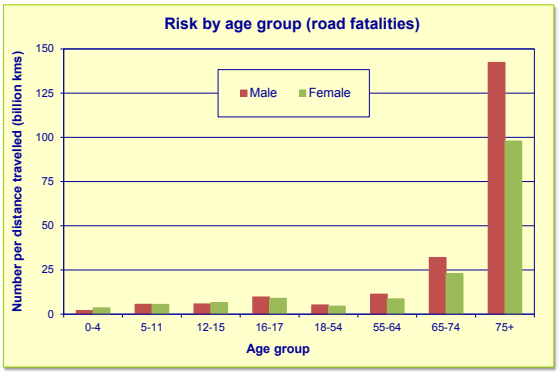

Figure 1. *The number of fatalities among cyclists by distance travelled by bicycle (in billion kilometres), by age and gender in 2005-2009.*[1]

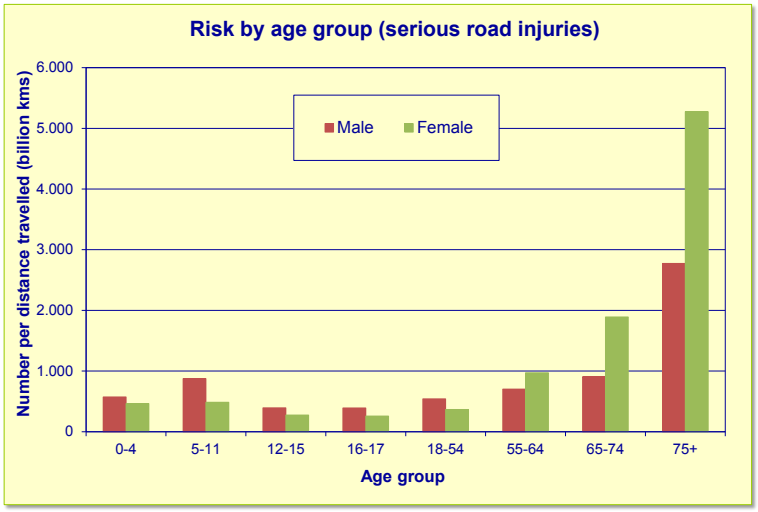

Figure 2. *The number of serious road injuries among cyclists by distance travelled by bicycle (in billion kilometres), by age and gender in 2005-2009.*[2]

What are the crashes concerned?

It is of the greatest importance for the prevention of crashes to gain perfect understanding of the facts and circumstances of cycling crashes among seniors. This data is generally obtained by means of the Data Registered Crashes in the Netherlands (BRON). However, in recent years, the registration rate of cycling crashes in which the cyclist sustains serious injuries has greatly declined, so that merely a limited and possibly also selective number of data of cycling crashes among seniors is available for analysis. This hampers the identification of risks and the prioritization of preventive measures.

Single vehicle crashes

With the majority of people of 55+ that are annually treated at the SEH department as a result of a cycling crash (14,000 of the circa 18,000), it concerns a single vehicle crash, in which no other road user is involved. Major causes of single crashes among seniors (Ormel et al., 2009) are: falling over while mounting or dismounting, and being surprised by other road users. In circa 9% of these single vehicle crashes, the cyclist collides with an object, for instance, a kerb (2%) or bollard (2%).

[1] Sources: Data Registered Crashes in the Netherlands (BRON; Ministry of Infrastructure and the Environment) and Mobility Study in the Netherlands (MON; Centre for Transport and Navigation).
[2] Sources: National Medical Registration (LMR; Dutch Hospital Data), BRON (Ministry of Infrastructure and the Environment) and MON (Centre for Transport and Navigation).

Collision of cyclist with other road user
In 1992, crashes involving senior cyclists were closely studied on the basis of the police reports (Goldenbeld, 1992). It showed from this study that most crashes constituted a crash between a car and a bicycle (63% of the crashes. The majority of the crashes happened while the senior cyclist was turning left at an intersection or was crossing the intersection. Senior cyclists were not only overrepresented in crashes while turning left, but also in crashes in which the cyclist was hit by motorized traffic coming from the rear.

What are the types of injuries sustained?
Among the people of 55+ who are admitted into the hospital after a cycling crash, leg injuries are the most common type of injury: circa 45%. In addition, hip fracture (circa 30%) and brain damage (circa 14%) are major injury categories (LMR). Among those of 55+ who are admitted by the accident & emergency department (a&e) of a hospital, head and neck injuries constitute the major group (20%) (*Table 1*).

Bodily injury (55+) due to cycling crash	**Number**	**%**
Head/neck	3,700	20
Chest/spine	1,600	9
Upper arm/elbow/lower arm	1,900	11
Hand/fingers/wrist	3,300	18
Shoulder/collarbone	1,800	10
Foot/toes/ankle	1,150	6
Hip/upper leg/lower leg	2,630	15
Other	1,410	7
Total	**18,000**	**100**

Table 1. *Injuries with a&e injured cyclists (55+) in 2005-2009 (annual averages) (Source: VeiligheidNL, 2011).*

What factors contribute to the risk?
Exposure: greater exposure, seniors cycle more
Among all seniors, those of 75+ cycle least, but the distance they travel has increased over the years. In fact, this group shows the highest increase in mobility among all age categories, namely an increase of 62% in 2009 as compared to 2000 (*Figure 3*). The mobility of 60- to 74-year olds increased by 42% during the same period. The increase is a result of the growing number of those aged 75+ and the larger distance they travel on average per person (from 250 to 350 km annually).

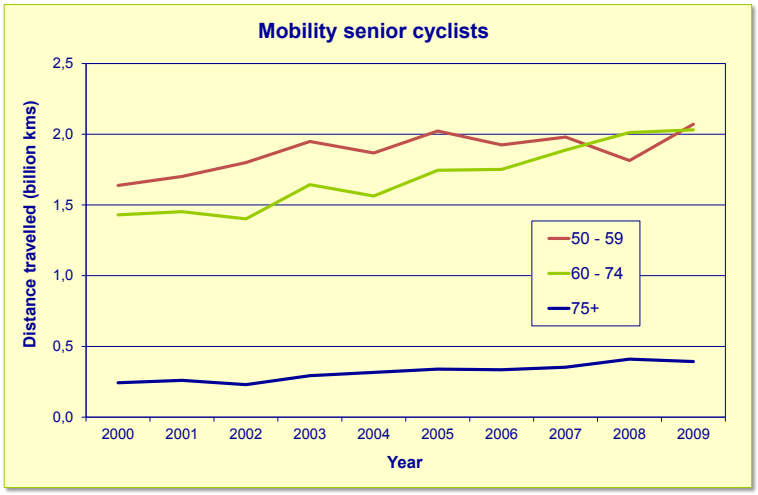

Figure 3. *The distance travelled by bicycle (in billion kilometres) by age category in the years 2000-2009 (Source: MON).*

Greater vulnerability of seniors
A bicycle offers no protection. When a cyclist of 75+ falls over, he or she runs a relatively high risk of fracturing a hip or leg (see *Table 1*). In order to arrive at an indication of the effect of vulnerability on the casualty rate, a vulnerability index has been established. This is the ratio between cyclist fatalities and seriously injured cyclists per age group. *Figure 4* presents the vulnerability index of both cyclists and car occupants over various age categories. It shows that the vulnerability index among those of 65+ increases far more substantially for cyclists than it does for car occupants. Other studies also show that vulnerability increases with age (Zeegers, 2010). Rodarius, Mordaka & Versmissen (2008) indicated that head injuries sustained by senior cyclists as a result of a crash with a car driving at 40 km/h is comparable with head injuries of a middle-aged cyclist hit by a car driving at a speed of 55 km/h.

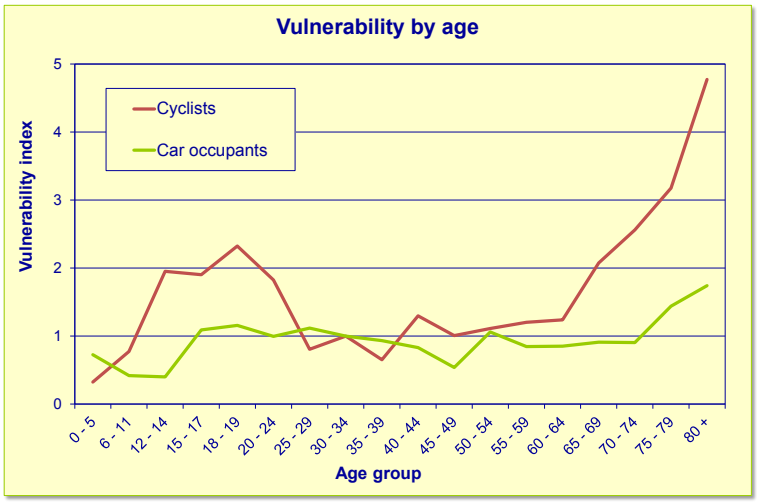

Figure 4. *Vulnerability index: the number of fatalities divided by the number of seriously injured per age category for cyclists and car occupants over the years 2007-2009.*

What have been relevant developments over the last few years?

Promoting the use of the bicycle
Due to the societal advantages, governments greatly promote the use of the bicycle. Certain regions - Haaglanden among them - aim at having the number of cycling kilometres increased by 20 to 50%. This implies that the intensity on cycling facilities will highly increase, and, subsequently, also the interactions and conflicts between cyclists, light moped and other road users on the bicycle track. Traffic will also increase on intersections between bicycle tracks. No studies have been conducted into the consequences for road safety and the requirements to be set to cycling facilities in order to enable such a growth.

The e-bike
A new development is the e-bike. This bicycle comes with pedal power, generally to a maximum of circa 25 km/h. The use is very much on the increase, especially among seniors, and, subsequently, there is a heightened concern about the safety of the vehicle. Actually, the pedal power makes it possible to cycle at a higher speed with less physical effort than on a tradition bicycle. This 'ease' may also be a reason for cycling more often and even under circumstances when one would not have cycled on a traditional bicycle (strong winds, for instance). Research should indicate whether the e-bike carries a greater risk than a traditional bicycle and whether e-bikes carry an additional risk for seniors.

Dutch sales figures for e-bikes have risen tremendously over the last five years. In 2009, more than 150,000 new e-bikes were sold (Loijen, 2011). Outside the Netherlands the interest in e-bikes is also growing, and the offer of various types is getting more wide-ranging (Rose, 2012). According to the study by Loijen (2011) into the use of the e-bike, we can distinguish three user categories:
- cyclists (60+) using the e-bike for recreational purposes;
- commuters using the e-bike for travelling between home and work;
- the physically impaired who cannot use a traditional bicycle, but can use an e-bike.

Fietsberaad, the Dutch centre of expertise on bicycle policy, recently published a report with a number of facts about the e-bike (Fietsberaad, 2013).
It is the government's policy to improve public health by promoting physical activity. The effects on health of cycling on a traditional bicycle - if any - could also apply to the use of an e-bike (Unwin, 1995). This can be an additional incentive for the purchase and use of an e-bike.

It cannot be ruled out that the use of the e-bike may result in a growing number of casualties, mainly because of the following reasons:
- Seniors are an important target group for the e-bike. Their casualty rate increases because they can travel more kilometres by e-bike and also cycle in less favourable weather conditions.
- Now that people cycle more often, part of the number of journeys by car will now be replaced by journeys by bike. On the whole, cycling is more hazardous than driving a car (Stipdonk & Reurings, 2010).
- Since they cycle at higher speeds, cyclists should be more alert, react more quickly and anticipate more fully than a cyclist riding at generally lower speed levels.
- As a result of the higher speed, the impact of a collision is also more severe. Therefore, injuries will be more serious.

Ageing
Prognoses of the population indicate that the number of seniors will highly be increasing in the coming ten years and that this development will be continuing. It is the objective of the promotion of the use of the bicycle (Møller et al., 2011) to increase the number of seniors that cycle. The e-bike enables a wide-ranging group to participate in cycling traffic. The consequences are that more, and possibly relatively more vulnerable seniors will be cycling. Not much is known about the health characteristics of the current group of senior cyclists and developments in their health patterns. If this group becomes more and more vulnerable, this will have consequences for important indicators of road safety (number of fatalities and seriously injured).

What can still be gained?
What can be gained for cyclists in general is presented in SWOV Fact sheet *Cyclists*. Cycling an e-bike needs certain training because of the special characteristics of the e-bike (weight, pedal power). Road safety might be improved by familiarizing vulnerable seniors with cycling an e-bike away from the public road, before they decide to enter the public road. Various training courses are already on offer in the Netherlands.

At present, knowledge about the nature and the scale of the special characteristics of senior cyclists is lacking (chronic disorders, limitations in functioning). In her Ph.D. thesis, Davidse (2007) discussed the development of a number of functions while ageing, in relation to driving a car; see also the following SWOV Fact sheets: *The elderly in traffic* and *The elderly and infrastructure*. Examples are the increasing visual, cognitive and motor-skill limitations - functions that are also relevant for cycling safety. This type of knowledge about cyclists can contribute a great deal to the development of requirements to be set to the cycling infrastructure and the characteristics of the bicycle, so that it will also be possible for the senior cyclist to cycle safely (Reurings et al., 2012).

Conclusion
Compared to younger cyclists, seniors run a higher risk to die or sustain serious injuries as the result of a cycling crash. Whereas the total number of fatalities has been decreasing for years, the number among senior cyclists has remained practically the same all these years and the number of seriously injured senior cyclists has increased. This is partly the result of their vulnerability, increasing limitation in their functioning and, at the same time, an increase in the (e-bike) cycling mobility among seniors. This increased cycling mobility is in conformity with the government's policy to improve public health by promoting physical activity. Hardly any specific policy has been developed for the prevention of cycling crashes among seniors. The development of knowledge in this field is an important requisite for reducing cycling crashes and serious injuries among seniors.

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