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# Crashes involving cyclists aged 50 and over in the Netherlands: An in-depth study

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ABSTRACT

The number of seriously injured cyclists is increasing in the Netherlands. The majority of these seriously injured cyclists were involved in single-bicycle or bicycle-bicycle crashes. Little is known about the circumstances in which these crashes occur, as the police only registers 4% of these crashes. Therefore, an in-depth study was carried out to gain insight into the factors and circumstances that influence the occurrence and consequences of these crashes. The focus was on crashes involving cyclists aged 50 and over, as this group has a large share in the number of cyclist-only crashes. Detailed information on 41 single-bicycle and bicycle-bicycle crashes was collected and analysed. This resulted in a description of the course of events for every analysed crash, including a list of factors that had contributed to the occurrence of the crash and possible injuries. Subsequently, crashes with a similar course of events and a comparable combination of contributory factors were grouped into types of crashes. Results showed that cyclists aged 75 and over are more often involved in falls from a bicycle than younger cyclists. Contributory factors that played a role in a large number of crashes were behaviour of another road user, distraction and narrow cycling facilities or traffic lanes. However, which factors played a role in the occurrence of a crash depended on the type of crash. Eight types of crashes were identified. Based on the factors that played a role in the occurrence of these crashes, remedial measures can be developed to prevent similar crashes from occurring in the future.



## 1. Introduction

Cycling is a common mode of transport among all age groups in the Netherlands. Cycling is popular and has benefits for transport efficiency, the environment, economic and social issues, and of course for health and fitness (Martino et al., 2010). However, one important aspect needs to be tackled and that is road safety for cyclists. In the Netherlands, more than half of all serious road injuries in 2011 were the result of a bicycle crash. Moreover, the share of seriously injured bicyclists has increased: from 42% in 2000 to 60% in 2011 (Weijermars et al., 2016). The majority of these seriously injured cyclists – more than 80% – were involved in single-bicycle crashes or crashes between bicycles (Reurings et al., 2012; Schepers and Klein Wolt, 2012). It is important to understand the causes and circumstances that influence the occurrence of single-bicycle and bicycle-bicycle accidents to be able to develop countermeasures. Most road crash studies with a focus on crash causation are based on police reported crashes. Unfortunately, single-bicycle and bicycle-bicycle crashes are very rarely reported in police registration. Only 4% of these crashes not involving a motor vehicle are registered (Reurings and Stipdonk, 2011). As a result, little is known about the circumstances in which these crashes occur.

At the start of this study, in 2012, the most detailed information available on bicycle crashes in the Netherlands stemmed from a retrospective study that was carried out in 2008 (Ormel et al., 2008). That study focused on single-bicycle crashes and used a survey to gather information on crash causation. Questionnaires were sent to victims of bicycle crashes who were treated at an Emergency Department. Fifteen percent of the victims of single-bicycle crashes were hospitalized. Nearly 60% of the crashes they were involved in occurred while mounting or dismounting their bicycle, and a quarter were the result of hitting an object such as a bollard or the kerb. Furthermore, the results showed that more than 60% of the hospitalized cyclists who were involved in a single-bicycle crash were aged 55 and over.

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Schepers (2008) used the results of the above-mentioned questionnaire study to further explore the role that the infrastructure plays in the occurrence of single-bicycle crashes. He contacted a subgroup of the victims to gather additional information about the crash and crash location. Additionally, several crash locations were surveyed. Based on the questionnaire material and the additional information gathered, it was concluded that infrastructure plays a role in about half of all single-bicycle crashes. Examples of infrastructure-related single-bicycle crash types are cyclists skidding on slippery roads and cyclists colliding with a kerb or off-road obstacle. In another report, Schepers (2010) reported about data on bicycle-bicycle and bicycle-slow traffic collisions (e.g. crashes between bicycle and moped or bicycle and pedestrian) that were also gathered with the questionnaire study of Ormel et al. (2008). Of all hospitalized cyclists, 12% sustained their injuries in a collision with another bicycle and 4% in a collision with other slow traffic. The majority of the bicycle-bicycle collisions (76%) was a collision between cyclists that cycled in the same direction as the colliding partner.

These three studies (Ormel et al., 2008; Schepers 2008, 2010) gave some insight in the self-reported experiences of cyclists involved in single-bicycle and bicycle-bicycle crashes and in infrastructure-related crash factors. However, detailed information on contributing factors leading to the crash is still lacking, including information on the interaction between contributing factors. Other methods are needed to gain more knowledge on crash causation. Therefore, an in-depth crash investigation study has been carried out. This study focused on single-bicycle and bicycle-slow traffic crashes of cyclists aged 50 and over. These cyclists have the highest risk of being involved in crashes without high-speed traffic (Ormel et al., 2008; Weijermars et al., 2016). We have distinguished three age groups. The first age group includes cyclists aged 50–64 years. We have included this relatively young age group because research has shown that more than half of all racing cyclists involved in a single-bicycle crash was a cyclist aged 50 and over (Schepers, 2008), and we wanted to learn more about these crashes. The second age group includes cyclists aged 65–74 years, because most people in the Netherlands have retired or retire at the age of 65. The third age group, of cyclists aged 75 and older, can be described as the age group with the highest proportion of people with functional limitations and an increased physical vulnerability (SWOV, 2013). The aim of the study was to gain insight in the causes and circumstances that influence the occurrence and consequences of crashes involving cyclists aged 50 and over in which no high-speed traffic was involved.

## 2. Method

An in-depth study was carried out on crashes involving a cyclist aged 50 and over in which no high-speed motorized vehicles were involved, and as a result of which this cyclist was taken to hospital by ambulance. The study entailed collecting and analysing detailed information about all aspects of the crash. This included behaviour and background of the road users involved, type and condition of the bicycles involved, road layout and other characteristics of the crash location (e.g. presence and characteristics of obstacles on cycling facilities). Furthermore, information was gathered on general conditions such as weather and light conditions, sustained injuries and damage to the bicycles.

### 2.1. Selection of relevant crashes

Data was collected from 1 August until 1 December, 2012 (4 months). The in-depth team was notified of relevant crashes by the ambulance service and the police in the northern part of the province of South-Holland in the Netherlands (Fig. 1). They informed the team about all crashes they registered, as soon as possible. The team received basic information on 136 relevant crashes, i.e. crashes involving a cyclist aged 50 and over in which no high-speed motorized vehicles were involved and this cyclist was taken to hospital by ambulance. The basic information included the address of the crash location, type of crash, age and gender of the cyclist involved. Based on this information, the team tried to contact the cyclists who were involved in the crash. If the cyclist was willing to cooperate with an interview (informed consent), data collection was started. A psychologist carried out an interview (semi-structured), inspected the bicycle using a standardized coding form and took a standard set of pictures of the bicycle and any damage caused by the crash. Using the information from the interview, two other team members, including one road safety engineer, carried out a scene investigation. They measured all road elements, took pictures and made a video of the last 500 m that the cyclist had ridden. Information from the injuries that the cyclist had sustained were collected during the interview and from the hospital, provided that the cyclist had given permission to obtain this information (informed consent). Data collection was carried out retrospectively, according to protocols which were composed in 2009, when the investigation team was set up and received dedicated national and international training (Davidse, 2007, 2011).

**Table 1**
Distribution of age group in the total set of crashes.

| Age | Analysis | Non-response | No contact information | Total |
|---|---|---|---|---|
| 50–64 years | 16 (39%) | 16 (47%) | 29 (48%) | 61 (45%) |
| 65–74 years | 19 (46%) | 7 (21%) | 7 (12%) | 33 (24%) |
| 75+ | 6 (15%) | 11 (32%) | 18 (30%) | 35 (26%) |
| Unknown | 0 (0%) | 0 (0%) | 6 (10%) | 6 (4%) |
| Total | 41 (100%) | 34 (100%) | 60 (100%) | 135[a](100%) |

[a] One case has been excluded from the analysed dataset, because of too little information to identify the crash factors.

### 2.2. Data collection

The team was able to collect information on 41 of the 136 relevant crashes (30%). About 45% of the relevant crashes was excluded in the final set of crashes because of absence of contact information (telephone number or address). Of this group more men than women were not able or willing to give contact information to the police or ambulance service. Another 25% of the cases was excluded because the cyclists involved in the crash were not willing or able to cooperate. Chi square analysis was used to compare these 3 sets on their general characteristics to determine whether the reduction of cases had caused any bias ($\alpha = .05$). The effect size of the Chi square test is described by Cramer's V, where 0 implies no relationship, and 1 a perfect relationship (Hays, 1994).

Analyses ($\chi^2(4,129) = 15.13$; $p = 0.004$; Cramer's $V = 0.242$) showed that the youngest and oldest age groups (50–64 and 75+) were underrepresented in the set of 41 investigated crashes (see Table 1). In addition, single-bicycle crashes in which the cyclist merely fell from his bicycle seem to be underrepresented in the set of 41 investigated crashes compared to the crashes that we could not investigate ($n = 94$), although this difference was not significant. Consequently, the results of this study might not be comprehensive for all falls from a bicycle of cyclists aged 50 and over. The distribution of type of crash per age group, however, was comparable in both sets (i.e. 41 investigated crashes and 136 relevant crashes; see Table 2 for the distribution in the set of investigated crashes).