Pedelecs and speed pedelecs

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Summary

In 2020, over a quarter of the total number of bicycle kilometres were cycled on pedelecs; particularly the over-65s opt for pedelecs. This is also borne out by the crash figures: in 2019 and 2020, almost one in three of the cyclist fatalities was a pedelec rider. It is not clear whether using a pedelec carries a greater risk than using a bicycle without pedal assistance: some studies do and others do not report an increased risk for pedelec riders. Many of the measures that improve safety for conventional cyclists, will also improve safety for pedelec riders. This mainly concerns infrastructural measures and measures aimed at improving bicycle stability. See also SWOV fact sheet *Cyclists*. Measures that are particularly (also) important for pedelec riders are related to the higher cycling speed. They concern helmet use, improving recognisability of (speed) pedelecs, stimulating rear-view mirrors and putting a stop to tuning-up.

In the Netherlands, there are not yet a great many speed pedelecs, fast pedelecs with pedal assistance up to 45 km/h, but their number is growing steadily. In October 2020, 26,000 speed pedelecs were registered compared to about 3 million regular pedelecs. Since 1 January 2017, a speed pedelec has been categorised as a moped (previously it had been categorised as a light moped). Since then, moped rules have also applied to speed pedelecs; such as their position on the road and mandatory helmet use. The number of crashes with, and casualties among, speed pedelec riders is unknown. As yet, only one (foreign) survey is available which concludes that speed pedelec riders and ‘ regular’ pedelec riders run an equal risk of being involved in single-bicycle crashes, but that injury risk is higher for speed pedelec riders. Measures specifically aimed at the safety of speed pedelec riders are mainly related to helmet use, improving expectations of other road users, preventing registration number fraud, and reducing speed differences with other road users. It is still unclear what position on the road is safest for speed pedelecs: on the bicycle track, speed pedelecs have to share the road with slower cyclists, but on the carriageway, conversely, they have to ride amid heavier and faster vehicles.

1 What is a pedelec, a speed pedelec and an e-bike?

An electric bicycle is an umbrella term for electrically powered bicycles. Usually, as in this fact sheet, it means a bicycle which only generates power when the cyclist is pedalling. Formally, however, such a bicycle is called a pedelec; short for Pedal Electric Cycle.

In this fact sheet, we distinguish between two kinds of electric bicycles: the 'regular' pedelec and the speed pedelec. A pedelec offers pedal assistance up to approximately 25 km/h, a speed pedelec up to 45 km/h, and the latter is therefore legally categorised as a moped (see the question *What rules apply to pedelecs and speed pedelecs?*). A pedelec and speed pedelec may look very much alike (see *Figure 1).*

Some people talk about e-bikes while pedelecs are meant. According to European regulations [1], e-bikes are not pedelecs with pedal assistance, but two-wheelers with an electric motor which do not require pedalling. This turns them into light mopeds (no faster than 25 km/h) or into mopeds (no faster than 45 km/h)

Figure 1. A pedelec (left) and a speed pedelec (right; Source: ANWB [2])

2 What rules apply to pedelecs and speed pedelecs?

Legally, a pedelec is a conventional bicycle (bicycle without pedal assistance). Therefore, the same rules apply to both pedelecs and conventional bicycles. The legal rules which cyclists have to abide by are included in the 1990 Traffic Code ([3]; for an overview, see the website of the Dutch Cyclists' Union (Fietsersbond)).

A speed pedelec, however, has been categorised as a moped since 1 January, 2017 (before this date, it was categorised as a light moped). For speed pedelecs and mopeds the same rules apply. Thus, speed pedelec riders have to use the combined bicycle/moped track, or, if absent, the carriageway. Using a dedicated bicycle track is prohibited. On the carriageway, speed pedelec riders are allowed to cycle at a maximum speed of 45 km/h; on combined bicycle/moped tracks at a maximum speed of 30 km/h (in the urban area) or 40 km/h (outside the urban area). In addition, speed pedelec riders are obliged to wear an approved helmet (see *Figure 2*). The helmet may be a ' regular' moped helmet that was certified according to the motorcycle helmet standard ECE-22.05/06) or a helmet that meets the NTA 8776 standard specifically developed for speed pedelecs [4]. This helmet looks like a bicycle helmet, but it has a number of specifications (designed for higher impact speed, lower around the ears, the temples and the base of the head)

that differ from regular bicycle helmets [5]. For more information, see SWOV fact sheet *Bicycle helmets*.

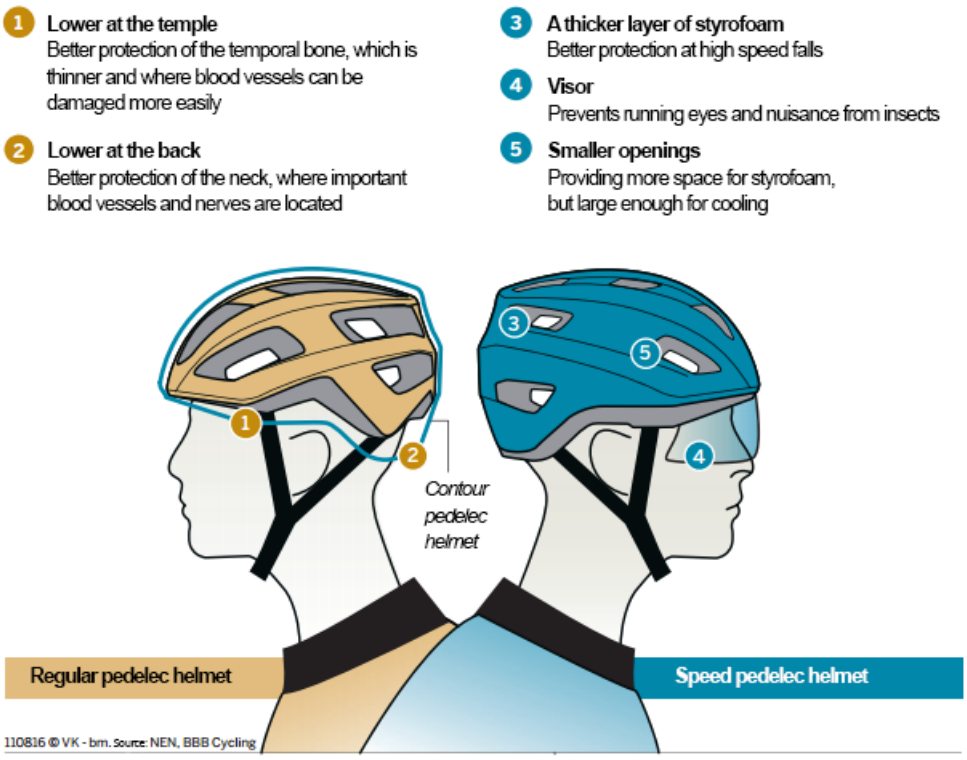


Figure 2. Specification differences between regular bicycle helmets and speed pedelec helmets (Source: Volkskrant; NEN, BBB Cycling).

A speed pedelec rider must have a minimum age of 16, a moped licence (type AM) or a driving licence. Speed pedelecs must be equipped with a yellow moped number plate and the owner must have third party insurance.

3 How many pedelecs and speed pedelecs are currently used and by whom?

In 2020, there were about 2.9 million pedelecs in the Netherlands [6]. This is over 12% of the total number of bicycles (23.1 million in 2020). Since 2013, pedelecs have started making headway. In 2020, over a quarter of the total number of bicycle kilometres were cycled on pedelecs [7]. Further analysis of bicycle use in the Netherlands by the Netherlands Institute for Transport Policy Analysis (KiM) [7] shows that, many cyclists aged 65 and over use pedelecs; in 2019, more than half their bicycle kilometres were cycled on pedelecs. On average, pedelec riders cover longer distances than conventional cyclists. The share of pedelec kilometres cycled is

not only growing among the over 65s, but also among cyclists aged 12-50. Pedelecs are increasingly used for commuting as well.

In the Netherlands, regular pedelecs far outnumber speed pedelecs. In October 2021, there were over 26,000 registered speed pedelecs [8]. Yet, their popularity is growing steadily. The annual sales figures of new speed pedelecs increased from 171 in 2013, to 4,701 in 2020 [9]. In only three years, the number of registered speed pedelecs doubled from over 10,000 in 2017, to 21,100 in 2020 (1 July) [10]. This is still only a fraction of the almost 3 million pedelecs in the Netherlands.

RDW (the Netherlands Vehicle Authority) figures from 2017 show that owners of speed pedelecs are mostly male (80%). On 1 July 2020, private owners of speed pedelecs were aged 51.5 on average. Two thirds of the private owners were aged 45-65. In other age categories, speed pedelecs are less popular. Almost 18 % of the private owners were aged 35-45, almost 8 % were aged 65-75 and less than 7 % of the private owners were aged 16 to 35 [10].

4 How many crashes involve pedelecs and speed pedelecs?

Pedelecs

In 2020, the number of fatalities among cyclists amounted to 229. As was the case in 2019, almost one in three of them had been riding a pedelec at the time of the crash [11] [12]. Since bicycle type is not known for all of the cyclists killed, this number should be considered a lower limit; possibly, more of the fatalities were pedelec riders [13]. The share of pedelec fatalities is higher for older cyclist casualties and seems to grow as age increases [14].

In 2020, 68% (about 12,000) of the serious road injuries registered in hospital (about 19,700) were cyclists [15]. How many of them were pedelec riders cannot be ascertained [15].

Speed pedelecs

The number of crashes with and casualties among speed pedelec riders is unknown, because crash database BRON does not distinguish between speed pedelecs and (light) mopeds.

5 Is a pedelec or speed pedelec more dangerous than a conventional bicycle?

No reliable data are available about crashes and numbers of kilometres travelled that can determine and compare the risk run by pedelec riders, speed pedelec riders and conventional cyclists. For pedelecs, some targeted (questionnaire) studies have been carried out. Their conclusions are not unequivocal: some studies do and others do not report an increased risk for pedelec riders. Regarding speed pedelec riders, as yet, only one (foreign) survey is available which concludes that speed pedelec riders and pedelec riders run an equal risk of being involved in single-bicycle crashes, but that injury risk is higher for speed pedelec riders

Pedelecs

In the Netherlands, some surveys were carried out comparing bicycle crash casualties treated at an Emergency Department (ED) to a control group of cyclists not involved in a crash. A study which also checked for *frequency* of bicycle use, showed that pedelec riders ran a greater risk of ending up at an ED after a crash than users of conventional bicycles [16]. However, studies with a similar design which checked for *travelled distance,* found no average difference between these two groups [17] [18]. Yet, a breakdown by age and gender did show differences. The most recent survey [18] showed that an average of 2.8 ED visits were paid per 10 million cycled kilometres. The over-70s were most likely to have to visit an ED, with 5.2 visits by women and 3.2 visits by men. In addition, cyclists aged 12-17 ran a more than average risk of an ED visit after a pedelec crash, with 4.1 ED visits per 10 million pedelec kilometres by female cyclists and 3.2 visits by male cyclists.

A Norwegian survey [19] showed the risk of a pedelec crash to be greater than the risk of a crash with a conventional bicycle, but only for women. A German Naturalistic Cycling study [20] showed no differences in crash involvement between pedelecs and conventional bicycles, with the exception of intersection crashes. At intersections, crash involvement was twice as high for pedelecs as for conventional bicycles. Mostly, these intersection crashes occurred due to drivers not giving right of way. The results of a German experimental study that asked drivers to assess crossing situations involving cyclists shows that drivers keep a shorter distance from pedelecs than from conventional bicycles travelling at the same speed [21].

Most European studies looking at injury severity found that, but for two exceptions, the average severity of the outcome is equal for crashes with pedelecs and conventional bicycles [22] [23] [24] [25]. A Dutch study showed that ED casualties of a pedelec crash more often have multiple severe injuries and head/brain injuries, compared to casualties of a crash with a conventional bicycle [26]. A German study [27] also reports that casualties of a pedelec crash were more severely injured, had to be hospitalised more often, and had longer hospital stays than casualties of a crash with a conventional bicycle. What should be noted here, however, is that the average age of casualties of pedelec crashes was much higher that the average age of casualties of crashes with conventional bicycles (62 versus 48). Older people are known to sustain generally more severe injuries than younger people (see SWOV fact sheet *Older road users*). Since the German study did not correct for age, it is unclear to what extent either bicycle type or cyclist age determined the result.

Speed pedelecs

There is no study available which compares crash risk for speed pedelec riders to crash risk for conventional cyclists. A Swiss survey studied the risk of single-bicycle crashes for speed pedelec riders and pedelec riders [28]. The risk proved equal for both cyclist groups. Yet, the pedelec group did run a greater risk of sustaining injuries requiring medical care.

6 What contributes to pedelec and speed pedelec crashes?

As with crashes involving conventional bicycles, a combination of factors leads to a road crash involving pedelecs or speed pedelecs (see SWOV fact sheet *Cyclists*). In addition, pedelecs and speed pedelecs have a number of characteristics which differ from conventional bicycle characteristics, and which seem to contribute to crash occurrence: higher speed (due to pedal assistance) and increased weight. Moreover, the age of the pedelec riders comes into play: most of them are over-65s.

Speed pedelec crash types

The results of in-depth research into speed pedelec crashes shows that five crash types can be distinguished [29]:

- Type 1: Speed pedelec rider loses control due to slippery, soiled or damaged road surface. For this type of crash, the condition of the road surface is a main factor.
- Type 2: Speed pedelec rider collides with an obstacle. Several factors are at play, but mostly factors involving road users themselves.
- Type 3: Speed pedelec rider takes risks causing a collision with another road user or causing a fall due to a required swerving manoeuvre. Important factors are a too high speed unsuitable to the circumstances, but also other behaviour, and poor visibility of other traffic, e.g. due to trees/shrubs, other road users, or a curve.
- Type 4: Other road user takes risks causing a collision with the speed pedelec rider or a fall of the speed pedelec rider. Often the behaviour of the other road users is the crash cause, for example when they use the wrong side of the road or when they carry out a strange, or unexpected manoeuvre.
- Type 5: Speed pedelec rider collides with another road user at a confusing or complex intersection. Once again, the behaviour of the other road user is an important factor, but also intersection characteristics such as a traffic light which is not conflict-free or unclear priority regulations.

In a recent survey [18] of the 17 speed pedelec crashes studied slightly less than half proved to be a single-vehicle crash (mostly slipping), over a third appeared to be a crash with an object (curb, animal), and almost a quarter a crash with another road user (cyclist or motor vehicle).

Speed of pedelecs and speed pedelecs

Due to pedal assistance, pedelecs and speed pedelecs can, with the same effort, attain higher speeds than conventional bicycles. Also in practice, pedelec riders go faster than conventional cyclists (see the question *How fast do pedelec and speed pedelec riders cycle?*). This applies even more to speed pedelecs [30]. Speed is a major factor in the occurrence and outcome of road crashes: the higher the speed, the more crashes and the more severe the injuries (see SWOV fact sheet *Speed and speed management*). In theory, this also goes for bicycles (with and without pedal assistance) but, as far as we know, there are no objective, empirical data to either support or refute this.

Both the Swiss survey among pedelec and speed pedelec riders [28] and the in-depth study of speed pedelec crashes [29] showed that speed was an important factor contributing to their crashes. This did not concern absolute speed, but a speed that was too high under the prevailing conditions.

Weight of pedelecs and speed pedelecs

Pedelecs and speed pedelecs are much heavier than conventional bicycles. This affects riding characteristics, particularly when mounting, dismounting and balancing at low speeds [31]. In a Swiss survey [28] among pedelec and speed pedelec riders, one third of the respondents (34%) indicated that a lack of balance, for example after a swerving manoeuvre, had contributed to their single-vehicle crash. Most (82%) said this would also have happened if they had used a conventional bicycle, but the 18% that did designate the bicycle characteristics as a crash factor often mentioned weight and balance. In a Danish survey of crash involvement of pedelec riders, one in ten respondents (10.2%) mentioned the weight and/or balance of their pedelec (32).

The over-65s as pedelec riders

At present, pedelecs are particularly popular among seniors aged 65 or over (see the question *How many pedelecs and speed pedelecs are currently used and by whom?*). Although the stereotypical senior citizen does not exist, due to large individual differences in fitness and impairments, the average risk of serious injuries is higher for over-65s than for younger cyclists, even when crash impact is equal. Due to age-impaired cognitive skills and motor skills, the over-65s and over-75s also run a higher risk of crash involvement. In-depth research into bicycle crashes of cyclists aged 50 or over showed that older cyclists (over-70s) relatively more often fall when mounting and dismounting [33]. For more information, see SWOV fact sheet *Older road users*. The fact that a large number of pedelec riders are older than 65, probably affects the crash and injury risk of the pedelec rider group as a whole.

7 How fast do pedelec and speed pedelec riders cycle?

The speed of pedelec and speed pedelec riders varies, but is generally higher than that of conventional cyclists [34] [35] [36]. Dutch research among 46 commuters (aged 25-56) showed an average speed of 21.0 km/h for pedelecs and 28.8 km/h for speed pedelecs, compared to 17.6 km/h for conventional bicycles; the three cyclist groups all cycled faster outside than within the urban area (*Table 1*, [30]). A different study in which older cyclists (65-69) also participated, showed that, on average, they also cycled faster on pedelecs than on conventional bicycles: depending on the situation, they cycled 1.7 to 3.7 km/h faster on pedelecs than on conventional bicycles [35].

Table 1. Average speed (km/h) of commuters on conventional bicycles, pedelecs, and speed pedelecs (at that time still categorised as light mopeds) [30].

Bicycle type	Average speed within the urban area [km/h]	Average speed outside the urban area [km/uur]	Average speed total [km/h]
Conventional bicycle (n=12)	17.3	18.3	**17.6**
Pedelec (n=14)	20.1	22.2	**21.0**
Speed pedelec (n=20)	26.9	31.4	**28.8**

Although pedelecs and speed pedelecs have pedal assistance up to 25 and 45 km/h respectively, *Table 1* shows that the actual average speed is clearly much lower. Particularly for speed pedelecs, the difference is considerable. Their cruising speed of 32-37 km/h (depending on location), defined as the speed when sharp curves and large intersections are absent [37] or the speed that is maintained most often or most of the time [38] [39], is also far below the maximum of 45 km/h.

The 2017 legal changes concerning speed pedelecs (see the question *What rules apply to pedelecs and speed pedelecs?*) seem to have had little effect on the average speed of speed pedelec riders. In the studies carried out when speed pedelecs were still categorised as light mopeds – allowed a maximum speed of 25 km/h and bicycle track use being mandatory [30] [37] – the average speeds that were measured were similar to the speeds after the legal changes. After these legal changes the maximum speed allowed for speed pedelecs increased, depending on the position on the road, to 30 km/h on a bicycle/moped track within the urban area, 40 km/h on a bicycle/moped track outside the urban area, or 45 km on the carriageway [30].

Particularly pedelecs are easy to tune up, enabling pedal assistance at higher speeds. It looks as if this regularly happens, but hard figures are missing. Tuned-up pedelecs were indeed found in an in-depth SWOV study of speed pedelec crashes [29]. The Dutch Fietsberaad [40] reports data from Germany where an estimated one in three pedelecs is tuned up. In Belgium a large number of bicycle dealers seems willing to tune up pedelecs [40]. BOVAG [41] and the Dutch ANWB [42] warn cyclists that the pedelec frame, brakes and technology are not designed to support such high speeds. Moreover, it is a criminal offence to use a tuned-up pedelec on public roads [42].

8 Do pedelecs and speed pedelecs reduce safety for other users of the bicycle track?

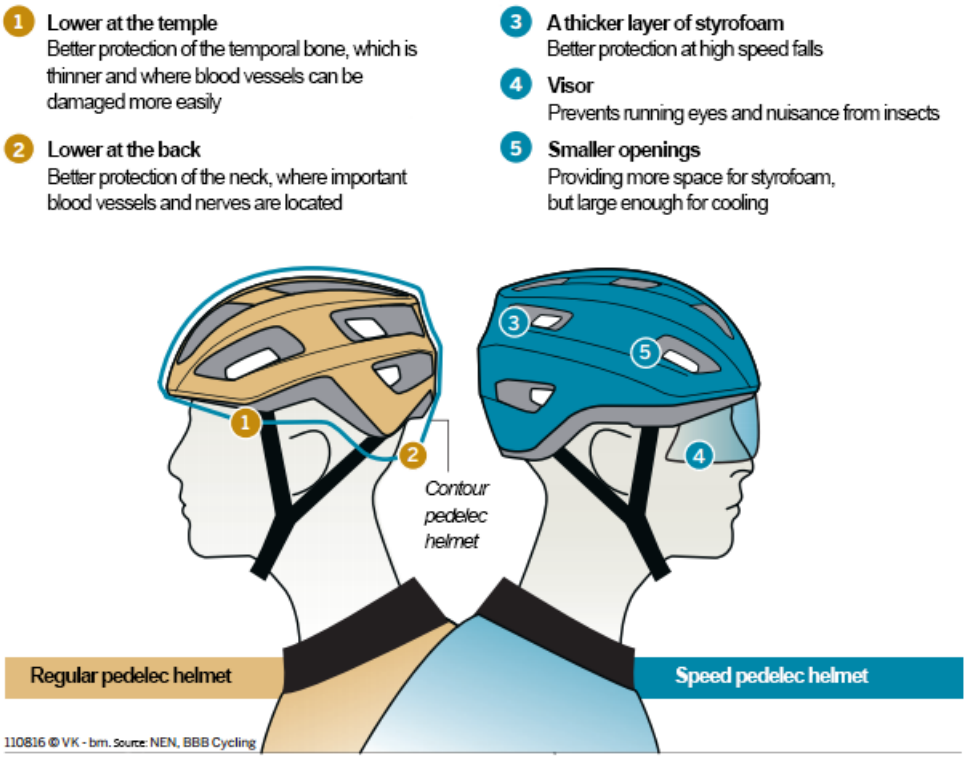
Theoretically, bicycle tracks become less safe when there are greater differences in vehicle speed and mass (conventional bicycles, racing bikes, cargo bikes, pedelecs and light mopeds). However, data about the number of bicycle track crashes involving pedelecs or speed pedelecs are missing.

Speed pedelecs are not allowed to use a dedicated bicycle track, but should use the combined bicycle/moped track or, if this is absent, the carriageway. There are indications, however, that speed pedelec riders regularly use dedicated bicycle tracks. In such cases, their average speed is 29 km/h, which is considerably higher than the average speed of other bicycle track users. An in-depth study of speed pedelec crashes [29] showed that in one third of the crashes the speed pedelec rider had used the bicycle track: in six cases this was against the rules and in two cases according to the rules at that time (when speed pedelecs were still categorised as light mopeds). In one fifth of the crashes, speed pedelec riders had used the combined bicycle/moped track, in one third of the crashes the carriageway. In two crashes, they had used a bicycle lane or non-designated bicycle lane. Regular pedelecs always share the road with non-powered bicycles, while the average speed of regular pedelecs is notably higher [30]. See the question *How fast do pedelec and speed pedelec riders cycle?*. Information about how often speed differences lead to crashes is not available.

9 Why are helmets mandatory for use on speed pedelecs and not on pedelecs?

In the Netherlands, helmets for pedelec riders are not mandatory, since a pedelec is legally deemed to be a 'conventional' bicycle. For speed pedelec riders, however, helmets are mandatory, since a speed pedelec is legally deemed to be a moped (see the question *What rules apply to pedelecs and speed pedelecs?*).

A speed pedelec helmet can either be an 'ordinary' moped helmet which complies with the motor helmet standard ECE-22.05/06 or a helmet which complies with the NTA 8776 standard [5], which was specifically developed for speed pedelecs. This helmet resembles a bicycle helmet, but has a number of different specifications (designed for higher impact speed, and lower at the ears, temples and the base of the head). For more information, see SWOV fact sheet *Bicycle helmets.*



10 What position on the road is safest for speed pedelecs?

Whether - in the absence of a combined bicycle/moped track - the carriageway or the bicycle track is safest for speed pedelecs is still unclear. Research into (near) crashes with speed pedelecs is scarce, often small-scale, and qualitative in nature. Moreover, trustworthy exposure data of speed pedelecs on different road types and bicycle facilities are missing. Due to their speed, speed pedelecs are hardly compatible with other traffic: they are faster than bicycles on bicycle tracks, but slower than cars on carriageways (see the question *How fast do pedelec and speed pedelec riders cycle?*).

One of the available studies is a Naturalistic Cycling study of road conflicts with speed pedelec riders [43]. This showed that crash risk when cycling on a bicycle facility (bicycle tracks, combined bicycle/moped tracks, and bicycle lanes, taken together) is twice as high as when cycling on a non-bicycle facility (OR[1] = 1,81). Cycling on the carriageway, compared to cycling on other parts of the road network did not increase or reduce crash risk. However, the road conflicts studied were all, with one exception, near crashes; meaning situations in which a crash could just be prevented. Near crashes are not necessarily due to the same factors as actual crashes (see [44]).

Apart from conflict/crash information, qualitative observational information is available. An analysis of camera images captured during a Naturalistic Cycling study [45] shows that speed

1. The OR ('odds ratio') is s relative measure which provides information about risk increasing in certain conditions.

pedelec riders on the carriageway often have to deal with negative reactions of drivers, such as honking, calling out, or headlight flashing. Speed pedelecs on the carriageway also give rise to situations that suggest traffic flow problems. This may explain why some speed pedelec riders choose to use the bicycle track: said Naturalistic Cycling study showed that speed pedelecs covered almost one quarter (23%) of the distance they should legally have cycled on the carriageway, on the adjacent bicycle track.

11 What measures may improve safety for pedelec riders?

Many of the measures improving road safety for conventional cyclists, will also improve road safety for pedelec riders. This mainly concerns infrastructural measures and measures focusing on stability improvement. See also SWOV fact sheet *Cyclists*. Measures that are particularly important for pedelec riders (as well), involve the higher cycling speed. These relate to helmet use, a rear-view mirror, improving recognisability of (speed) pedelecs and preventing the possibility to tune them up. In addition the stability of pedelecs could be improved.

Stimulating helmet use

A bicycle helmet reduces the risk of fatal brain injury by 70% [46]. If all cyclists aged 70 and over wore helmets, the Netherlands would have an annual reduction of 45 to 50 road deaths [47]. For more information about the effectiveness of bicycle helmets and how they work, see SWOV fact sheet *Bicycle helmets*. In the Netherlands, there is hardly anly support for general mandatory helmet use, but Danish practice has shown that stimulating voluntary use of bicycle helmets may result in a substantial increase in usage. Average helmet use in Danish city traffic increased from 33% in 2015 to 47% in 2020 [48].

Stimulating rear-view mirrors

Many over-65s ride on pedelecs. With increasing age, motor skills decline (see SWOV fact sheet *Older road users*). Among other things, this implies that looking over the shoulder and keeping balance at the same time becomes harder and harder. A rear-view mirror could remedy this problem. Moreover, younger cyclists will also benefit from rear-view mirrors that improve visibility of the traffic situation behind them. Engbers et al. [49] suggest a rear-view assistant. This supportive system could also warn about vehicles intending to overtake the cyclist, which could prevent startled reactions. As yet, only a prototype is available.

Improving recognisability

One of the concerns relating to the speed of a pedelec, is that it is underestimated by other road users who, therefore, make incorrect and dangerous (crossing) decisions [12]. Improving the recognisability of pedelecs, possibly in combination with public communication about pedelec

characteristics, may help improve other road users' expectations. How to improve recognisability is subject to further research.

Prevention of tuning-up pedelecs

Pedelecs are technically easy to tune up. Tune-up sets are widely available on the internet and foreign research shows that a number of bicycle sellers is willing to assist (see the question *How fast do pedelecs and speed pedelecs cycle?*). To begin with, more focused and more frequent enforcement of the ban on tuned-up pedelecs on public roads will have to reduce their number. In addition, it should become technically impossible (or at least very hard) to tune up a pedelec. This is no easy task, as is apparent from the unsuccessful attempts to prevent tuning up of light mopeds (see SWOV fact sheet *Mopeds and light mopeds*).

Improving balance

Some say that a pedelec is better balanced when the motor and battery are in the lowest possible position. This indeed applies to a stationary pedelec but not to a riding one. The higher the centre of gravity, the easier it is to balance a pedelec [50]. Nowadays, the battery is more often integrated into the frame (the tube from the handlebars to the pedals). The battery in the frame and the motor in the middle ensure that the bicycle mass is in the middle, which also ensures sufficient pressure to the front wheel. Insufficient pressure to the front wheel may cause the wheel to slip, which immediately disturbs the balance.

12 What measures may improve safety for speed pedelec riders?

Measures specifically aimed at the safety of speed pedelec riders particularly relate to the reduction of speed differences, helmet use, improving expectations of other road users, and preventing registration number fraud. In addition, it is advisable to properly research what position on the road is safest for speed pedelecs. Finally, safety measures focusing on a safe infrastructure for cyclists will also benefit the safety of speed pedelec riders (see SWOV fact sheet *Cyclists*).

Reducing speed differences

There are considerable speed differences between speed pedelecs and other road users on the combined bicycle/moped track and presumably (empirical data are missing) also between speed pedelecs and motorised four-wheelers on 50km/h roads (see the question *How fast do pedelec and speed pedelec riders cycle?*). In general, speed differences have a negative effect on road safety (see SWOV fact sheet *Speed and speed management*). These speed differences can be reduced if, within the urban area, a speed limit of 30 km/h becomes more usual. Another option is to allow speed pedelecs to use the bicycle track at some locations, but only if they cycle at a speed which is better aligned with the speed of the other users of the bicycle track. In Rotterdam,

for instance, speed pedelecs have been granted an exemption from the prohibition to use the bicycle track, provided they do not cycle faster than 30km/h. In the urban area, however, this limit is still (over) 10 km/h faster than the speed at which bicycle and pedelec riders cycle. To ensure the safety of cyclists on the bicycle track, the speed limit should really be lower. Naturally, this limit should then be enforced. An innovative way to make speed pedelec riders keep to the maximum speed, is geofencing. This will restrict motor assistance when the speed pedelec starts cycling on the bicycle track as determined by the GPS. At present, the technology is not sufficiently precise to make distinctions between the carriageway and the combined moped/bicycle track. Moreover, geofencing is only able to restrict pedal assistance, but not cycling speed itself. Speed pedelec riders may – just as sports cyclists – use more effort to still reach higher speeds [51].

Another method to reduce speed differences, is increasing the speed of speed pedelecs, so they can follow the speed of cars on 50 km/h roads. It is unclear what the net effect on road safety would be.

Helmet use

Helmets are mandatory for speed pedelec riders, be it a moped helmet or a special speed pedelec helmet (see the question *What rules apply to pedelecs and speed pedelecs?*). However, it turns out that by no means all speed pedelec riders wear the correct helmet [29]. Public communication about the importance of wearing the correct helmet, together with enforcement, could improve helmet choice.

Improving expectations of other road users

A speed pedelec is a relatively new and, as yet, uncommon vehicle. In appearance, it resembles a bicycle or pedelec, but it is subject to different traffic rules. Public communication about speed pedelecs and the associated rules will provide other road users with information about what to expect of this road user group. This may reinforce understanding of speed pedelecs on the carriageway, which could lead to fewer expressions of irritation among motorised road users (see the question *What position on the road is safest for speed pedelecs?*). An increase in the number of speed pedelecs in traffic may also be helpful.

Prevention of registration plate fraud

Some speed pedelec riders remove their registration plate, so they are seen as ordinary pedelec riders and, thus, do not need to wear a helmet and may cycle on the bicycle track (see the question *What rules apply to pedelecs and speed pedelecs?*). If this does not go hand in hand with a lower speed, not only the safety of the speed pedelec riders themselves but also that of other road users on the bicycle track will be negatively affected. Enforcement should help reduce registration plate fraud. Information about the consequences regarding statutory liability may be helpful.

Safest position on the road

It is still unclear what position on the road is safest for speed pedelecs, the carriageway or the bicycle track. In the urban area, speed pedelec riders are, like mopeds, legally obliged to use the carriageway, unless a combined bicycle/moped track is present (see the question *What rules*

apply to pedelecs and speed pedelecs?). In the case of mopeds, this proved to be safer than using the bicycle track [52]. For both these positions on the road, there are still insuffient data on crash involvement in relation to exposure to determine whether this also goes for speed pedelecs. What we do know is that speed pedelec riders do not always feel safe among the cars on the carriageway. To allow speed pedelec riders to use (certain) bicycle tracks, some road authorities derogate from national regulations, for example by putting a 'Speed pedelecs allowed' plate below the bicycle track sign, or by offering a municipal exemption (as was done in Rotterdam). With that exemption, use of the bicycle track is allowed provided that speed pedelecs do not cycle faster than 30 km/h and do not endanger other bicycle track users. Yet, the 30 km/h limit is still higher than the average speed cycled on conventional bicycles and pedelecs. Moreover, local derogations from national traffic regulations will make the traffic system less predictable and may therefore reduce safety.

Publications and sources

Below you will find the list of references that are used in this fact sheet; all sources can be consulted or retrieved. Via Publications you can find more literature on the subject of road safety.

[1]. BIKE Europe (2017). *Rules and regulations on electric cycles in the EU. White Paper*. Vakmedianet, The Netherlands.

[2]. ANWB (2021). *E-bike versus speedbike*. ANWB. Accessed on 05-11-2021 at https://www.anwb.nl/fiets/soorten-fietsen/elektrische-fietsen/e-bike-versus-speed-pedelec.

[3]. Ministerie van IenW (2018). *Reglement verkeersregels en verkeerstekens 1990*. Ministerie van Infrastructuur en Waterstaat,. Accessed on 29-08-2018 at http://wetten.overheid.nl/BWBR0004825/2018-07-01.

[4]. Schepers, P., Jager, K. de & Hulshof, R. (2016). *Speed-pedelec wordt bromfiets: wat verandert er en wat zijn de gevolgen*. CROW.

[5]. Hair-Buijssen, S.H.H.M. de, Rodarius, M. & Goyenechea, M.F. (2016). *Speed-pedelec helmet. Argumentation for the new helmet requirements of NTA 8776 as formulated in the NEN workgroup*. TNO 2016 R11261. TNO, Helmond.

[6]. BOVAG-RAI (2020). *Mobiliteit in Cijfers Tweewielers 2020 - 2021*. Stichting BOVAG-RAI Mobiliteit, Amsterdam. Accessed on 04-05-2022 at https://bovagrai.info/tweewieler/2020/.

[7]. KiM (2020). *Fietsfeiten: nieuwe inzichten*. Kennisinstituut voor Mobiliteitsbeleid (KiM), The Hague.

[8]. RDW (2021). *Open Data RDW: Gekentekende_voertuigen*. RDW. Accessed on 03-11-2021 at https://opendata.rdw.nl/Voertuigen/Open-Data-RDW-Gekentekende_voertuigen/m9d7-ebf2/data.

[9]. RAI Vereniging (2020). *Mobiliteit in Cijfers Tweewielers 2020-2021*. Stichting BOVAG-RAI Mobiliteit, Amsterdam. Accessed on 02-11-2021 at https://bovagrai.info/tweewieler/2020/#.

[10]. CBS (2020). *Aantal speedpedelecs in 3 jaar verdubbeld*. CBS. Accessed on 02-11-2021 at https://www.cbs.nl/nl-nl/nieuws/2020/48/aantal-speedpedelecs-in-3-jaar-verdubbeld.

[11]. Aarts, L., Wijlhuizen, G.J., Gebhard, S., Goldenbeld, C., et al. (2021). *De Staat van de Verkeersveiligheid 2021. Doelstellingen voor 2020 definitief niet gehaald – hoe nu verder?* R-2021-21. SWOV, Den Haag.

[12]. Aarts, L.T., Schepers, J.P., Goldenbeld, C., Decae, R.J., et al. (2020). *De Staat van de Verkeersveiligheid. Doelstellingen 2020 worden niet gehaald*. R-2020-27. SWOV, Den Haag.

[13]. Aarts, L.T., Wijlhuizen, G.J., Gebhard, S.E., Goldenbeld, C., et al. (2021). *Achtergronden bij De Staat van de Verkeersveiligheid 2021; De jaarlijkse monitor [Backgrounds of the State of Road Safety 2021. The annual monitor]*. R-2021-21A [Summary in English]. SWOV, Den Haag.

[14]. Schepers, J.P., Weijermars, W.A.M., Boele, M.J., Dijkstra, A., et al. (2020). *Oudere fietsers. Ongevallen met oudere fietsers en factoren die daarbij een rol spelen [Older cyclists. Crashes involving older cyclists and contributory factors]*. R-2020-22A [Summary in English]. SWOV, Den Haag.

[15]. Bos, N.M., Bijleveld, F.D., Decae, R.J. & Aarts, L.T. (2021). *Ernstig verkeersgewonden 2020. Schatting van het aantal ernstig verkeersgewonden in 2020 [Serious road injuries 2020. Estimate of the number of serious road injuries in 2020]*. R-2021-22 [Summary in English]. SWOV, Den Haag.

[16]. Schepers, J.P., Fishman, E., Hertog, P. den, Klein Wolt, K., et al. (2014). *The safety of electrically assisted bicycles compared to classic bicycles*. In: Accident Analysis & Prevention, vol. 73, nr. 0, p. 174-180.

[17]. Valkenberg, H., Nijman, S., Schepers, P., Panneman, M., et al. (2017). *Fietsongevallen in Nederland - SEH-behandelingen in 2016*. VeiligheidNL, Amsterdam.

[18]. Krul, I., Valkenberg, H., Asscherman, S., Stam, C., et al. (2022). *Fietsongevallen en snor-/bromfietsongevallen in Nederland - SEH-bezoeken: inzicht in oorzaken, gevolgen en risicogroepen*. Rapport 934. VeiligheidNL.

[19]. Fyhri, A., Johansson, O. & Bjørnskau, T. (2019). *Gender differences in accident risk with e-bikes—Survey data from Norway*. In: Accident Analysis & Prevention, vol. 132, p. 105248.

[20]. Petzoldt, T., Schleinitz, K., Heilmann, S. & Gehlert, T. (2017). *Traffic conflicts and their contextual factors when riding conventional vs. electric bicycles*. In: Transportation Research Part F: Traffic Psychology and Behaviour, vol. 46, p. 477-490.

[21]. Petzoldt, T., Schleinitz, K., Krems, J.F. & Gehlert, T. (2017). *Drivers' gap acceptance in front of approaching bicycles – Effects of bicycle speed and bicycle type*. In: Safety Science, vol. 92, p. 283-289.

[22]. Verstappen, E.M.J., Vy, D.T., Janzing, H.M., Janssen, L., et al. (2020). *Bicycle-related injuries in the emergency department: a comparison between E-bikes and conventional bicycles: a prospective observational study*. In: European Journal of Trauma and Emergency Surgery.

[23]. Verbeek, A.J.M., Valk, J. de, Schakenraad, D., Verbeek, J.F.M., et al. (2021). *E-bike and classic bicycle-related traumatic brain injuries presenting to the emergency department*. In: Emergency Medicine Journal, p. emermed-2019-208811.

[24]. Weiss, R., Juhra, C., Wieskötter, B., Weiss, U., et al. (2018). *Zur unfallwahrscheinlichkeit von senioren bei der nutzung von e-bikes. Ein neues themenfeld der gesundheitsvorsorge und damit der beratungsleistung der niedergelassenen ärzte [How probable is it that seniors using an e-bike will have an accident?]*. In: Zeitschrift für Orthopädie und Unfallchirurgie, vol. 156, nr. 1, p. 78-84.

[25]. Weber, T., Scaramuzza, G. & Schmitt, K.U. (2014). *Evaluation of e-bike accidents in Switzerland*. In: Accident Analysis & Prevention, vol. 73, p. 47-52.

[26]. Poos, H.P.A.M., Lefarth, T.L., Harbers, J.S., Wendt, K.W., et al. (2017). *E-bikers raken vaker ernstig gewond na fietsongeval*. In: Ned Tijdschr Geneeskd. , vol. 161, nr. D1520.

[27]. Lefarth, T.L., Poos, H.P.A.M., Juhra, C., Wendt, K.W., et al. (2021). *Pedelec-Fahrer werden bei Unfällen schwerer verletzt als konventionelle Radfahrer*. In: Der Unfallchirurg.

[28]. Hertach, P., Uhr, A., Niemann, S. & Cavegn, M. (2018). *Characteristics of single-vehicle crashes with e-bikes in Switzerland*. In: Accident Analysis & Prevention, vol. 117, p. 232-238.

[29]. Stelling-Kończak, A., Davidse, R., Duijvenvoorde, K. van, Louwerse, R., et al. (2021). *Speed-pedelecongevallen. Hoe ontstaan ze, waar gebeuren ze en hoe zijn ze te voorkomen?* R-2021-19. SWOV, Den Haag.

[30]. Twisk, D., Stelling, A., Gent, P. van, Groot, J. de, et al. (2021). *Speed characteristics of speed pedelecs, pedelecs and conventional bicycles in naturalistic urban and rural traffic conditions*. In: Accident Analysis & Prevention, vol. 150, p. 105940.

[31]. Twisk, D.A.M., Platteel, S. & Lovegrove, G.R. (2017). *An experiment on rider stability while mounting: Comparing middle-aged and elderly cyclists on pedelecs and conventional bicycles*. In: Accident Analysis & Prevention, vol. 105, p. 109-116.

[32]. Haustein, S. & Møller, M. (2016). *E-bike safety: Individual-level factors and incident characteristics*. In: Journal of Transport & Health, vol. 3, nr. 3, p. 386-394.

[33]. Davidse, R.J., Duijvenvoorde, K. van, Boele, M.J., Doumen, M.J.A., et al. (2014). *Letselongevallen van fietsende 50-plussers: Hoe ontstaan ze en wat kunnen we er aan doen?* R-2014-3. SWOV, Den Haag.

[34]. Dozza, M., Bianchi Piccinini, G.F. & Werneke, J. (2016). *Using naturalistic data to assess e-cyclist behavior*. In: Transportation Research Part F: Traffic Psychology and Behaviour, vol. 41, p. 217-226.

[35]. Vlakveld, W.P., Twisk, D., Christoph, M., Boele, M., et al. (2015). *Speed choice and mental workload of elderly cyclists on e-bikes in simple and complex traffic situations: A field experiment*. In: Accident Analysis & Prevention, vol. 74, p. 97-106.

[36]. Schleinitz, K., Petzoldt, T., Franke-Bartholdt, L., Krems, J., et al. (2017). *The German Naturalistic Cycling Study – Comparing cycling speed of riders of different e-bikes and conventional bicycles*. In: Safety Science, vol. 92, p. 290-297.

[37]. Bruijne, R.J. de (2016). *Revolutie of risico? Een onderzoek naar de verkeersveiligheids-aspecten van de speed pedelec*. Grontmij, De Bilt.

[38]. Keypoint Consultancy (2018). *Effectmeting uitzonderingsmaatregel speed-pedelecs*. Keypoint Consultancy BV, Enschede/Utrecht.

[39]. Rotthier, B., Stevens, G., Dikomitis, L., Huyck, B., et al. (2017). *Typical cruising speed of speed pedelecs and the link with motor power as a result of a Belgian naturalistic cycling study*. Paper presented at the Annual International Cycling Safety Conference, 21-22 september 2017, Davis, California, USA.

[40]. Fietsberaad (2019). *Opvoeren elektrische fietsen zorgt voor ophef in Duitsland en België*. CROW Fietsberaad. Accessed on 02-11-2021 at https://www.fietsberaad.nl/Kennisbank/Opvoeren-elektrische-fiets-zorgt-voor-ophef-in-Dui.

[41]. BOVAG (2019). *Opvoeren e-bike gevaarlijk*. BOVAG. Accessed on 02-11-2021 at https://mijn.bovag.nl/actueel/nieuws/2019/september/opvoeren-e-bike-gevaarlijk.

[42]. ANWB (2021). *Elektrische fiets opvoeren. Lekker snel, niet zo slim*. ANWB. Accessed on 02-11-2021 at https://www.anwb.nl/fiets/soorten-fietsen/elektrische-fietsen/elektrische-fiets-opvoeren.

[43]. Vlakveld, W., Mons, C., Kamphuis, K., Stelling, A., et al. (2021). *Traffic conflicts involving speed-pedelecs (fast electric bicycles): A naturalistic riding study*. In: Accident Analysis & Prevention, vol. 158, p. 106201.

[44]. Kamphuis, K.G., Stelling-Kończak, A., Schagen, I.N.L.G. van, Jansen, R.J., et al. (2020). *Smartphonegebruik en de kans op fietsongevallen: haalbaarheid van mogelijke onderzoeksmethoden [Smartphone use and the risk of bicycle crashes: feasibility of potential research methods]*. R-2020-11 [Summary in English]. SWOV, Den Haag.

[45]. Stelling-Konczak, A., Groot-Mesken, J. de, Vlakveld, W.P. & Wesseling, S. (2017). *Speed-pedelec op de rijbaan. Eerste praktijkonderzoek naar gedragseffecten*. R-2017-13. SWOV, Den Haag.

[46]. Høye, A. (2018). *Bicycle helmets – To wear or not to wear? A meta-analyses of the effects of bicycle helmets on injuries*. In: Accident Analysis & Prevention, vol. 117, p. 85-97.

[47]. Weijermars, W.A.M., Boele-Vos, M.J., Stipdonk, H.L. & Commandeur, J.J.F. (2019). *Mogelijke slachtofferreductie door de fietshelm*. R-2019-2. SWOV, Den Haag.

[48]. Olsson, B. (2021). *Hjelmrapport: Brug af cykelhjelm 2020*. Rådet for Sikker Trafik, København Ø.

[49]. Engbers, C., Dubbeldam, R., Buurke, J.H., Schaake, L., et al. (2016). *The acceptance of a prototype rear-view assistant for older cyclists: Two modalities of warnings compared*. In: International Journal of Human Factors and Ergonomics, vol. 4, nr. 3-4, p. 264-281.

[50]. Kooijman, J.D.G., Meijaard, J.P., Papadopoulos, J.M., Ruina, A., et al. (2011). *A bicycle can be self-stable without gyroscopic or caster effects*. In: Science, vol. 332, nr. 6027, p. 339-342.

[51]. Godefrooij, H. (2021). *Positie Speed-pedelec op de weg. Praktijkcases en regelingen*. DTV Consultants BV.

[52]. Hagenzieker, M.P. & Lubbers, A.J. (1992). *Gedragswaarnemingen voor het project 'Bromfiets op de Rijbaan'*. R-92-30. SWOV, Leidschendam.

Colophon

URL Source:
https://swov.nl/en/fact-sheet/pedelecs-and-speed-pedelecs

Topics:
Transport mode – Bicycle; Transport mode – Powered two-wheeler; Human behaviour in traffic

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Reduce injuries
Save lives

SWOV

SWOV Institute for Road Safety Research

PO 93113

2509 AC The Hague

Bezuidenhoutseweg 62

+31 70 317 33 33

info@swov.nl

www.swov.nl

@swov / @swov_nl

linkedin.com/company/swov