

Are Pedelec crashes different to bicycle crashes? A comparison of national accident data in Germany

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1 RESEARCH QUESTION AND OBJECTIVE

Since 2014, a distinction between Pedelec (electrical support up to 25 km/h) and bicycle crashes is made in official police reported accidents with personal injuries in Germany. Yet, no comparative analysis using national data is available, moreover some estimation was done how Pedelec crashes may look like based on bicycle crashes [1]. Hence, the present study aims to compare real-world crashes with personal injuries with both vehicle types – Pedelec and bicycle and show similarities and differences of the vehicle classes. Nearly a decade of reporting allows furthermore to have a closer look at the accident figures in a time series and to estimate possible trends.

2 DATA SOURCES AND METHODS

Accidents involving personal injury are recorded by the authorities in Germany. Once an accident happens the police will be notified and starts to collect crash data using an official report. Important parameters are collected by the police at the scene of the accident and then transmitted to the federal statistics authority (DESTATIS) via the state statistics authority. The data used in the study were provided by the statistics authority via special evaluations, as they are not freely accessible to the extent required. The information is requested at annual intervals. In the study, the processed accident statistics were analyzed comparatively for the years 2014 - 2020 according to various characteristics such as accident situation, collision opponents, locations, injury severity or rider age for cyclists and Pedelec riders [2]. In addition, the accident figures were set in relation to other important parameters (e.g., stock, mileage) to better compare the accident risk against other road user types [3, 4]. The final analysis of the time series provides insights into the trends regarding the accident occurrence of conventional bicycles and Pedelecs in future and enables further targeted measures to improve road safety.

3 RESULTS

The number of accidents with personal injuries was visibly declining until 2010/11. For some years now, a stagnation or slight increase in the number of accidents has been observed [5]. This stagnation can be observed till the Covid 19 pandemic in 2020/2021. Lockdowns, curfews, and home offices have led to a significantly different traffic pattern. Fewer vehicles on the roads therefore also lead to fewer conflicts and thus, fortunately, to fewer accidents on the roads. On the other hand, this led to an increase of Pedelec and bicycle usage during this time.

3.1 Number of registered cycling accidents (including Pedelec) in Germany

The trend regarding accidents involving cyclists has been increasing for more than 10 years (+20% compared to 2004). It should be noted that the number of accidents involving cyclist fatalities has continued to fall since 2004. In relation to the year 2004, there is a reduction of -11% in fatal cycling accidents. An important characteristic is the accident type. The accident type describes the traffic situation (conflict situation) that led to an accident. A comparison of the accident incidents between bicycle and Pedelec accidents shows only one significant difference for the year 2020. The share of riding accidents (accidents with loss of vehicle control) is significantly higher for Pedelecs (26%) than for conventional bicycles (19%). When looking at the time

series, it can be seen for conventional bicycles that the absolute accident figures for intersection and turning conflicts have fallen significantly in recent years, which is essentially due to an improvement in the infrastructure and introduction of vehicle safety systems in car and commercial vehicle segment. However, the significant increase in accidents with loss of vehicle control in the last 5 years is remarkable. Similar trends are found in the absolute accident figures for Pedelecs if the annual increase figures are also considered. The increase in all accident categories can still be largely explained by the significant increase in Pedelecs in the field (sales figures).

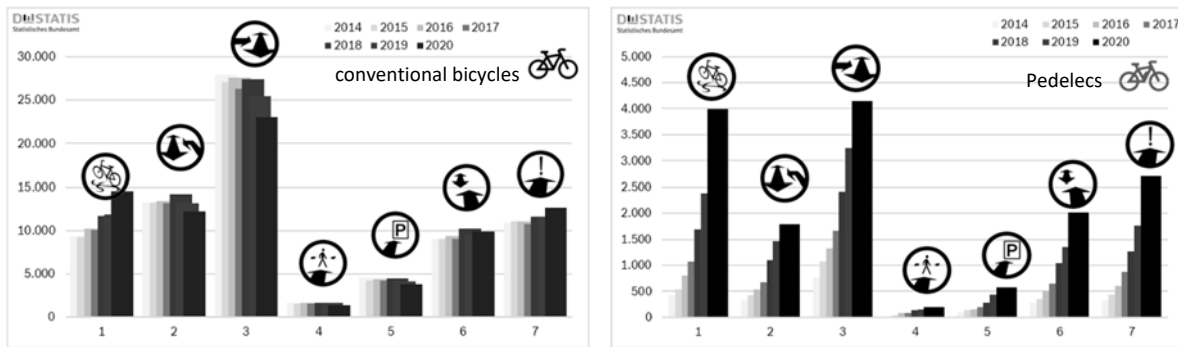


Figure 1: Accident type, Accidents with conventional bicycles (left), accidents with pedelecs (right)

3.2 Further accident characteristics

The official accident statistics provide information on other important accident characteristics. Thus, the type of accident opponents, type of collisions or other characteristics can be taken. The known accident characteristics can also be considered in relation to accident severity or location. The age of the accident victims is shown here as an example. Users of conventional bicycles in accidents with casualties have a significantly lower average age than Pedelec users. Around 49% of cyclists involved in accidents have an age of <40 years. The proportion of this age group among Pedelec riders involved in accidents is just 19% for 2020. The often-higher age of Pedelec riders involved in accidents therefore has a very clear influence on the resulting injury severity. This results in a higher proportion of serious injuries and fatalities among Pedelec users than among conventional cyclists.

3.3 Linking accident figures with other parameters

Since the spread of Pedelecs on the roads will increase significantly, the trend in accident figures is also very variable. Specially to enable a comparison with bicycles, it makes sense to relate the accident figures to other parameters, e.g., inhabitants or registered vehicles. Since bicycles and Pedelecs do not have to be registered in road traffic, it is not possible to draw direct conclusions about the size of the vehicle fleet in the field. Considering an average use of 7 years, it is possible to determine the fleet size in the field based on the annual sales figures. Figure 4 clearly shows how the stock of conventional bicycles has been continuously decreasing over the last few years and is being replaced by Pedelecs. Furthermore, a trend reversal in the total stock (bicycles + Pedelecs) can be observed from 2015 onwards. However, the increase is only due to the growing popularity of Pedelecs. It can be assumed that in the coming years, conventional bicycles will continue to be "replaced" by Pedelecs and that additional new user groups will be developed for Pedelecs (e.g., leasing Pedelecs, Cargo Pedelecs, etc.).

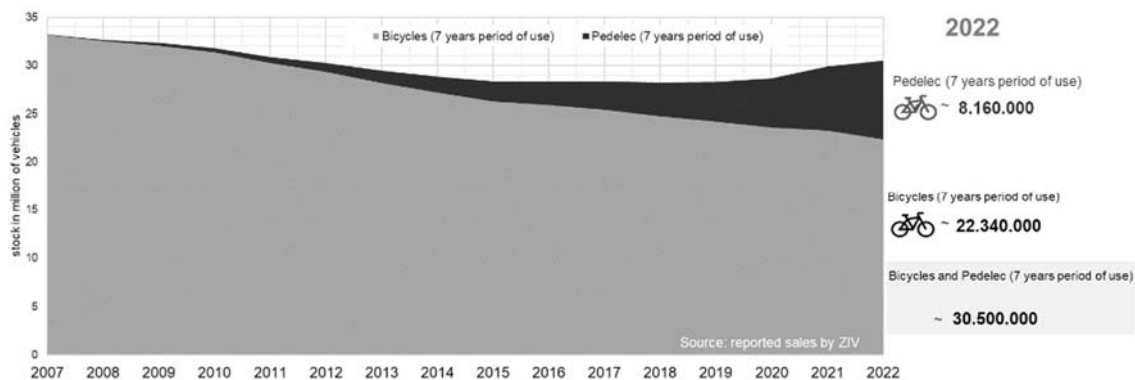


Figure 2: Vehicle stock according to pedelec/bicycle sales figures for 7 years of use

However, when looking at accidents in relation to 100 000 vehicles in the field, a different picture emerges. There are significantly fewer accidents with personal injury per 100 000 vehicles for Pedelecs than for conventional bicycles. This is remarkable, because the average mileage is not included in this analysis (significantly higher for Pedelecs). The increase in Pedelecs in recent years can be explained, among other things, by changing usage behavior (e.g., more frequent use as a commuter vehicle, etc.). The regular rate of use is determined at 7 years according to the depreciation table for fixed assets [6] of the Federal Ministry of Finance. This value is also assumed for Pedelecs. This results in the following parameters:

Table 1: Accidents regarding stock. [3,7]

Road user type	Accidents with casualties 2020	Vehicle stock	Accidents per 100 000 vehicles	Source stock
pedelec	15 415	6 640 000	232	sales (7years)
conv. bicycles	77 537	23 260 000	333	sales (7years)
motorcycle	25 120	4 570 318	550	registered
car	195 099	47 017 269	415	registered

The distance travelled also plays a very important role when considering the frequency of accidents, as a vehicle that travels significantly longer distances can also have more accidents as a result. Observations show that Pedelecs are used for significantly longer distances due to the electric assistance. There are now various data from studies on average mileage. The Federal Ministry for Transport and digital infrastructure gives an annual average value of 439 km/year for conventional bicycles [8]. Various studies show significantly higher mileages for Pedelecs. Mileages between 1 000 km/year and over 2 000 km/year are given. Considering the average mileage, the expected number of accidents with personal injury per billion kilometers travelled is higher by a factor of about 3 for cyclists than for Pedelec users (Pedelec: 2 322 vs. conv. bicycles: 6 667 accidents per billion km).

4 LIMITATIONS AND DISCUSSION

The use of official crash statistics provides a representative and meaningful insight to the accident situation in Germany, as the data contain every accident with personal injuries recorded by the police. Limitations in the coverage are only to be expected for single bicycle or Pedelec crashes, as well as collisions with slight and minor injuries or property damage crashes only, as these are not notified and reported to the police.

5 CONCLUSIONS

The present study shows that the accident situation of Pedelecs is rather similar compared to the accident figures involving bicycles. Age of users and single vehicle crashes are the main differences observed in national data which is often mentioned in the media. However, still some increasing trend is expected as a change in the mobility sector currently in ongoing and cycling becomes more popular also for commuting. As some of the cyclists will replace their bicycle with a Pedelec some compensation will occur and in long-term some decreasing trend for bicycle crashes is estimated. This again must be observed using national crash data.

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