Road Safety Factsheet

October 2018

Electric bikes

What is an electric bike?

An electric bike, sometimes known as an e-bike, is a motor assisted pedal bike. They often look just like a conventional pedal cycle, but include a rechargeable battery and a motor, alleviating some of the pressure of pedalling[1]. The cyclist can choose to engage the battery, meaning that when the cyclist pedals, the motor begins to run to take some of the strain of cycling. Once it reaches a top speed of 15.5mph, the motor cuts out and leaves the rest to the cyclist. This means that the cyclist is able to cycle faster than 15.5mph, but not with the help of the motor[2].

The law

In England, Scotland and Wales, cyclists aged 14 and over may ride an electric bike, as long as it meets certain requirements. A licence is not required to ride one and the electric bike does not need to be registered, taxed or insured. However, there are different rules in Northern Ireland, where a cyclist wishing to ride an electric bike must have a moped licence and register, tax and insure their bike[3].

Recently, the European Union have proposed an amendment to the Motor Insurance Directive so that anyone with an electric bike could eventually be cycling illegally unless they have third party insurance or live in a country where the government will pay out if the rider is involved in a collision. RoSPA's main concern about these changes, often referred to as the Vnuk judgement, is that this might mean that people who greatly benefit from the independence and mobility they gain from electric bikes would no longer be able to afford to use them as they could be seen as not such a desirable option. This could cause significant harm to their wellbeing and quality of life.

For more information on electric bikes and the law, visit the government website.

Popularity of electric bikes

While the first electric bike was invented in the 1980s in Japan, they have only truly gained popularity in Mainland Europe in the last 20 years[4]. Technology and the cost of electric bikes limited their attractiveness until the early 2000s. However, improved battery and motor technology means that electric bikes can travel much longer distances, are faster and are more affordable than ever[5].

Electric bikes now represent one of the fastest growing segments of the transport market, with over 31 million electric bikes sold globally in 2012. Since then, in China, 36 million e-bikes are manufactured per year[6]. Germany and The Netherlands are the two leading e-bike markets in Europe, accounting for 44% and 21% respectively of all European sales[7].

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In the UK, electric bikes have taken longer to be seen as a major mode of transport, although the number of bikes now being sold has risen to around 50,000 per year and is expected to increase further[8]. One study found that 5% of all UK adults say that they are 'likely' to buy an electric bike in the next 12 months, equating to around 2.5 million people[9].

There are a number of reasons that a cyclist may wish to have assistance while pedalling, such as carrying equipment and travelling routes with lots of hills or they can be a solution for those who are recovering from an injury or illness or who wish to cycle to work[1]. Many buyers of electric bikes have tended to be people who would not otherwise cycle at all or on longer journeys. Electric bikes are also becoming popular with the older road user. For example, Halfords reported that it sells 65% of its electric bikes to those aged over 55[10]. However, a growing number of existing cyclists are also beginning to buy electric bikes, with 11% planning to buy one within the next 12 months, according to a survey[9].

Types of electric bike[11]

There are a number of different types of electric bikes:

- Electric mountain bike
- Electric road bikes
- Electric hybrid bikes
- Electric folding bikes and;
- Electric utility bikes.

Figure 1: An example of an electric folding bike

How do electric bikes work?

In Europe, electric bikes provide electrical assistance only when the rider is pedalling, meaning that it is partly human powered[12]. Most electric bikes come in the form of pedelec or pedal assist, which monitors the input of the rider and assists them as much as possible, up to 15.5mph. Some bikes also allow the cyclist to operate the input of the motor from a switch or throttle[1].

Figure 2: Example of switch and assistance controls on an electric bike

Like conventional bikes, electric bikes can be either geared or single speed. However, they do differ from conventional bikes in many ways. The electric bike includes a motor, which can be placed on the front wheel (hub mounted) or on the frame of the bicycle. Although hub mounted motors are often quieter, they may not perform as well as a frame-mounted motor on hills. Frame mounted motors also have better weight distribution, as the motor is centred around the bottom bracket of the frame and are more efficient as it powers the chain rather than moving the wheel forward [4].

The electric bike also includes a rechargeable battery. Some of these batteries are integrated and some are detachable, meaning that the cyclist is able to charge the bicycle wherever they like. When considering an electric bike with an integrated battery, it is important to ensure that there is enough space to charge the bike [4].

An electric bike is likely to feature hydraulic disk brakes, as the higher speed and the weight of the battery and motor warrant extra stopping power. The tyres are also chunkier than on a conventional road bike. This is because the extra rubber helps to absorb the impact of a heavier frame, providing more grip and stopping power to balance the extra weight and speed[1].

Benefits

There are a number of benefits of electric bikes. In a review of the research published on electric bikes, one study found that the barriers to cycling include concerns about safety, the weather, inconvenience, a lack of fitness, a lack of time or cycling being perceived as too much effort. These barriers can be more or less significant based on an individual's age, fitness or physical ability. Although improving the infrastructure, destinations and destination facilities for cyclists can address some concerns about cycling related to safety and distance; these improvements fail to address other barriers related to the rider such as fitness, how hilly the route is and the amount of effort required.

However, electric bikes could allow people with physical limitations, older adults and people living in hilly areas to participate in cycling[13]. Electric bike users have reported benefits such as being able to achieve a higher speed while cycling with less effort, reduced journey times and finding it less challenging to ride up hills with their electric bike compared to a conventional bike [12].

Where electric bikes are used as a replacement for motor vehicle trips, potential benefits may also arise through reductions in congestion, emissions, improvements to health through physical activity and by lowering air pollution. However, the environmental impact of electric bikes depends on the mode of travel they replace [7]. The results of a North American survey[14] of 553 electric bike users suggested that the electric bike allowed users to cycle more often, to locations that are more distant and to carry more luggage and equipment with them. The results also showed the demographics of electric bike users, which included populations of people who tend to cycle less, such as women, older adults, people with physical limitations and people with longer distances to travel.

The study also found that replacing car trips was cited by almost 65% of respondent as one of the primary reasons for beginning to use an electric bike. Similarly, Australian research found that 60% of respondents to an online survey said that replacing some car trips was a main motivation for buying an electric bike, followed by 49% who said that they were motivated by being able to ride with less effort[15]. A Norwegian study also found that those provided with an electric bike increased the proportion of trips completed by bike from 28% to 48% of all trips[16].

Riding an electric bike can also have a number of health benefits. One study aimed to establish whether an electric bike could be health enhancing in the same way as a conventional bike, which depends on the duration of the journey and the intensity of physical activity[12]. The study found that completing a journey on an electric bike was 21% faster than on a conventional bike on average. The difference between electric bikes and conventional bikes was larger on hillier routes (electric bike 29% faster) than on flat routes (electric bikes 16% faster). Exercise intensity was also measured, showing a 51% intensity for the electric bike and 58% for the conventional bike. Although exercise on an electric bike was less intense, 95% of time on both types of bike was spent in moderate or vigorous intensity physical activity. Therefore, changing commuting mode from car to electric bike will significantly increase levels of physical activity.

Another study[16] involved randomly selecting 66 individuals and giving them an electric bike and comparing their cycling levels to a control group of 160 individuals. The research found that cycling trips increased from 0.9 to 1.4 per day and distances increased from 4.8km to 10.5km following the provision of an electric bike. The increase in the electric bike group was greatest for women. The control group showed no increase in cycling trips or increased distance travelled by bike.

Similarly, Simons, Van Es and Hendriksen[17] conducted a study in the Netherlands on 12 healthy, physically active subjects who rode a 4.3km route three times on an electric bike while being measured for physiological performance. The first route was completed without power assistance, the second while the electric bike was set to 'eco mode' and the final circuit was completed using the most electrical assistance. The researchers measured physiological variables such as heart rate, oxygen consumption and power applied through the pedals. The results showed that all three power settings provided a useful contribution to meeting minimum physical activity requirements. Even with pedal assist, riders achieved the necessary physical activity intensity to help reduce the chance of sedentary lifestyle diseases. Unsurprisingly, riders under the most powerful assistance setting achieved a higher speed, reducing their overall riding time. However, while this does have the effect of reducing the duration of physical activity, there is some evidence to suggest that those riding electric bikes tend to spend more time on their bikes than if they did not have an electric bike available[14].

Another study explored whether cycling on an electric bike was acceptable to and could potentially improve the health of people with Type 2 Diabetes. There was evidence that cycling on an electric bike was acceptable, could increase fitness, and elicited a heart rate that could lead to improvements in cardio metabolic risk factors in this population. Therefore, electric bicycles did have potential to improve health in those with Type 2 Diabetes[18].

Finally, a North American survey of electric bike owners found that 60% felt safer riding an electric bike than a conventional bike and 42% said that the electric bike had assisted in avoiding collisions. The reasons used to explain this effect ranged from increased acceleration to clear a junction, being able to keep up with traffic and improved balance at higher speeds[14]. Research is also underway to understand how the popularity of electric bikes and the increasing speed differences between electric and conventional bikes will affect road safety. It is expected that these developments could lead to more conflicts, especially at junctions. These conflicts could occur not only with motorised traffic but also on bike paths before and immediately after junctions[19].

Risks

The increasing share of cyclists who become victims of collisions on electric bikes internationally has become a concern and raises the question of how safe electric bikes are compared to conventional bikes[20], with some suggesting that the accident risk, particularly for elderly cyclists, is higher when riding an electric bike than on a conventional bike.

In the Netherlands, an indication of the casualty risk on electric bikes in relation to age can be derived from casualty and exposure data on the 'Spartamet'. The Spartamet was a bicycle with a very small combustion engine that was popular among middle-aged and elderly cyclists in the 1990s. It was approximately as heavy and as powerful as an electric bike, reaching a maximum speed of 25km/h. For 25-49 year old riders, the casualty risk was approximately the same as those of a similar age riding a conventional bike. However, for Spartamet riders over 50, the casualty risk was about twice that of cyclists of that age riding conventional bikes[21]. Dutch news outlets also reported people on e-bikes were involved in 341 accidents in the first part of 2018, a 26% rise on 2017, with 102 electric bike users killed between 2014 and 2018[22].

Recently, the injury risk of electric bikes have been calculated based on hospital data and estimated mileage from a sample of electric bike data recorders. According to one study, until the age of 75, injury risk did not differ between cyclists riding an electric bike and cyclists on a conventional bike. For cyclists over 75 years of age, the injury risk on electric bikes was twice the injury risk on conventional bikes[21].

There are a number of factors that could contribute to the presumed higher casualty risk of elderly cyclists riding electric bikes. First, electric bikes are on average 10kg heavier than conventional bikes. This can make dismounting problematic, especially for elderly cyclists who may experience age-related stiffness. This is because the extra weight has to be handled while mounting and dismounting when speed is low and active steering is needed to stabilise the bike[23].

In a survey amongst injured cyclists who rode electric bikes, a large proportion had fallen while mounting or dismounting their electric bike[24]. Similarly, another study found that crashes with electric bikes are often single bicycle crashes while mounting or dismounting and occur more often on bends and while overtaking. However, numbers were too low to report true statistical significance[25].

Secondly, elderly people who ride on an electric bike could be in poorer physical health than those who ride a conventional bike. For instance, those who have stopped riding a conventional bike may start to cycle again on an electric bike because it is less physically demanding. Therefore, comorbidity between diminishing physical strength and cognitive functions cannot be excluded. McGough et al. (2011) for instance found that for elderly (over 69 years of age), mild cognitive impairment was associated with reduced physical performance. [26].

Finally, elderly cyclists may be able to ride faster on an electric bike than on a conventional bike. As bicycles offer little protection to cyclists as unlike a car, they do not have a crash cage, it is likely that the faster a cyclist rides, the more serious the injuries will be in the case of a fall or collision.[27].

The average cruising speeds of electric bikes have been estimated at only 1 to 3km/h above the average cruising speed of those on conventional bicycles in a study conducted in the Netherlands[28]. However, this does vary in other countries. For instance, in China, cruising speeds were found to be 40-50% higher[29]. For those who ride electric bikes but lack experience, even a small increase in speed could be problematic relative to their skill level[25]. In this instance, a refresher cyclist training course might be beneficial.

Hu et al (2014) found that electric bike collisions were more severe than crashes on conventional bikes. However, when controlling for demographic factors such as age, no differences between electric bike and conventional bike crash severity were found in the Netherlands, Germany or Switzerland[30]. Similarly, another study found that the odds of being treated at an emergency department were greater for those riding electric bikes than those on conventional bikes. Higher age and higher cycling frequency was correlated with the likelihood of a cyclist being involved in a collision. However, this difference disappeared when adding annual distance cycled as a control variable[20].

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RoSPA's position

Cycling in Great Britain is increasing because it is an excellent way to get about and provides a wide range of health and environmental benefits. RoSPA encourages cycling, whether on a conventional or electric bike.

However, cyclists must remain aware of the different handling characteristics of electric bikes in comparison to conventional bikes. Electric bikes have the added weight of the motor and battery, meaning that they are likely to come fitted with hydraulic brakes as they warrant extra stopping power.

Cyclists must also follow all normal road rules and laws- these laws apply no matter what kind of bicycle they are riding. RoSPA recommend that all road users regularly read the Highway Code to refresh their knowledge of the rules of the road. All cyclists should also be looking out for other road users such as pedestrians and giving them time and room. As riders are able to accelerate quicker when riding an electric bike, pedestrians may miscalculate their speed.

RoSPA recommend that any cyclist who is returning to riding after a long people of not riding or cyclists switching from a conventional bike to an electric bike should consider taking a cycle training course. For more information about cycle training, visit the Bikeability website.

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