THE SAFETY OF PRIVATE E-SCOOTERS IN THE UK

FINAL REPORT

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PACTS
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Forewords

There is no doubt that e-scooters are a growing presence within our towns, cities and wider public spaces. Currently the only lawful way to use an e-scooter on a public road is by renting one from an approved scheme but we can all see for ourselves that the use of private e-scooters on our roads and pavements is widespread. From a law enforcement perspective, this is presenting us with new challenges, both in terms of preventing harm and using our enforcement powers fairly and proportionately.

Of course this form of transport is an attractive, relatively low cost and sustainable way of getting around our shared spaces. But we do need to have the debate on what sort of controls and regulations might be necessary and proportionate to make sure we are all safe whatever type of travel mode we use. I therefore welcome this report by PACTS which I am sure will further add to the debate and which will be of interest to law enforcement, policy makers and the public.

Chief Constable Jo Shiner

National Police Chiefs Council Lead for Roads Policing

Over the forty years since PACTS was first established, we have seen many advances in road transport policy and its associated laws and regulations. More recently, the advent of new technologies has brought about a rapid rise in the promotion of innovative vehicle developments that seem set to transform the road transport system. The one constant in these developments over the lifetime of PACTS has been the axiom that **road safety is paramount** for all who use the road network, especially vulnerable road users.

PACTS and its membership has a proud record of upholding this underlying philosophy through the provision of independent, evidenced-based, advice gleaned from our own research and the robust analysis of the work of others. The recommendations of this report carries on that long tradition of impartial and thorough investigation.

This report on e-scooters could not have been achieved without funding by The Road Safety Trust, strong collaborative working and the support of our key partners. We have drawn upon the data and advice of a wide range of partners from both the public and private sectors, including the police, trauma specialists, insurance companies, legal organisations, and lead industry players. We all remain concerned that any introduction of e-scooters must be accompanied by regulations for construction and use and standards that prioritise the safety not just of riders, but of all other road users as well.

If the UK Government decides to legalise e-scooters, PACTS and its partners will strive to ensure their introduction is as safe as possible and help the UK to assert itself once again as a world leader on road safety.

Tony Ciaburro
MSc. BSc. CEng. MICE. FCIHT. FCILT
Chair of PACTS

Executive Summary

Hundreds of thousands of private e-scooters are being used illegally on public roads in the UK. The number of casualties has been rising with 15 deaths to date, 11 in 2021. The Government seems uncertain on how to proceed, and public opinion is divided. PACTS has recommended a way forward.

Background

Electric scooters (e-scooters) have been in widespread use in cities in Europe, North America and elsewhere since around 2017. Some people have found them to be a convenient mobility option and they have been heralded as a means of reducing car trips and carbon emissions. However as understanding of the risks of injury to riders of e-scooters and pedestrians has grown European legislation has evolved, with increasing regulation on their use.

Under UK law, e-scooters are classified as motor vehicles. Although it is legal to sell them, it is almost impossible to use private e-scooters legally on roads or in other public places.

Spurred on by the COVID-19 pandemic, the UK Government decided, in July 2020, to permit e-scooter trial rental schemes in England (eight were in place by the end of September 2020 and, to date, none have been permitted in the other nations of the UK). These schemes, which now involve 23,000 e-scooters in 31 areas, are being monitored by the Department for Transport (DfT) which has stated that it wants to introduce legalisation to permit wider use of e-scooters, using the trials as the evidence base. However, the trials have now been extended to November 2022 and no report or legislative proposals have been published.

Meanwhile, despite the illegality of their use, a far greater growth has occurred in ownership and use of private e-scooters. 750,000 may now be in use. These private e-scooters differ from rental e-scooters in that their construction and use is not managed as in rental schemes. As no official assessment of the nature or safety of private use was being undertaken, PACTS

proposed this study which The Road Safety Trust agreed to fund. Its purpose has been to provide contemporary data and recommendations to inform the ongoing debate and legislation, should the UK Government decide to proceed.

Scope of the project

PACTS, working with project partners, has gathered qualitative and quantitative information on the safety of private e-scooter use. PACTS has independently obtained accounts of casualties from the internet and social media for the year 2021, including records of eleven fatalities. This has been enhanced with data from police forces. We have published the data monthly, throughout the year.

PACTS has reviewed academic studies examining the stability of e-scooters through controlled crash-testing and computational modelling. Results show that instabilities caused by an e-scooter's design pose a risk to riders. This supplements evidence from injury reports into the nature of e-scooter riders' falls and the large numbers of single vehicle collisions which are recorded.

e-scooters differ greatly from pedal cycles. They are propelled entirely by electric power; they have much smaller wheels and the rider's centre of gravity is located further forward; and the severity of head injuries is greater. e-scooters and pedal cycles should not be classified in the same way.

The PACTS research is not intended to address rental e-scooters which are subject to monitoring by the DfT. Casualties involving use of rental e-scooters are, however, included in our data for 2021 and in the hospital studies cited. Our research may have implications for rental e-scooters but no specific recommendations are made.

Conclusions and recommendations

There is general agreement that the existing situation is unsatisfactory. The unsafe nature of some private e-scooters, and irresponsible use by some, is leading to serious injuries and risks harming efforts by rental operators and local authorities seeking to provide a safe, low-carbon mobility option.

Headlines Figures

Number of rental e-scooters in use in England in 31 different trial areas
23,000

Number of private e-scooters imported into the UK over the last three years
1,000,000

Number of deaths involving private e-scooters in 2021
11 (15 since 2019)

Number of casualties from collisions involving e-scooters in 2021
nearly 900[i]

Percentage of other road users injured in a collision with an e-scooter
20%[i]

Percentage of trial:private e-scooters involved in casualty collision
18% trial:82% private[i, ii]

Percentage of casualties with serious injures
38%[i, iii]

Percentage of male:female casualties
71% male: 29% female[i, iv]

Percentage of casualties aged 0-24 years
50%[i, v]

[i] as recorded by PACTS from online media, social media, insurance and police records for 2021
[ii] based on 740 collisions where data is available
[iii] based on 800 collisions where data is available
[iv] based on 700 collisions where data is available
[v] based on 600 collisions where data is available

PACTS recommends that the DfT

- **takes immediate action to address dangerous and illegal private e-scooter use;**
- **undertakes a thorough public consultation before making any decision on the legalisation of e-scooters;**
- **commissions further research; and,**
- **if the Government decides to legalise use of private e-scooters, it should adopt regulations for their construction and use as set out below:**
  - Maximum possible speed of 12.5mph (20km/h)
  - Maximum continuous rated motor power of 250 W
  - Anti-tampering mechanisms should be included in construction. Tampering should be prohibited by law
  - Minimum front wheel size of 12 inches (30.5cm) and minimum rear wheel size of 10 inches (25.5cm)
  - Two independently controlled braking devices, one acting on the front wheel and one acting on the rear wheel
  - Lighting to be mandatory at all times
  - Maximum unladen weight of 20kg
  - An audible warning device to be mandatory
  - Helmet wearing to be mandatory
  - Riding on the footway (pavement) or footpath to be prohibited
  - Rider age limit of at least 16 years
  - Carrying of a passenger to be prohibited
  - Drink driving, dangerous or careless riding, and handheld mobile phone use to be prohibited
  - In-person rider training and third-party insurance are recommended.

Whatever legislation is proposed, it is important that the police retain their current road traffic policing powers, provisions, and offences in respect of e-scooters.

Contents

1 Introduction

e-scooters – a Marmite issue

The title of the UK Transport Select Committee's September 2020 report 'E-scooters: pavement nuisance or transport innovation?' is comparable with newspaper headlines of the time.[1] The use of electric scooters (e-scooters) is still splitting opinion between those concerned with safety, including that of pedestrians, and advocates for a shift to a smaller, less polluting form of transport. It has featured regularly in the media and in Parliamentary questions and debates.[2] This report contributes to the assessment of the safety of e-scooters, particularly private e-scooters, while providing some contextual information on other aspects of their use.

Since launching in Santa Monica, USA, in 2017 and having been in use across mainland Europe since 2019, regulated trial e-scooter rental-schemes opened in England in the summer of 2020. Simultaneously, the prevalence of private e-scooters has grown with imports to the end of 2021 exceeding 1 million.[3] Private e-scooters are defined as motor vehicles and, as they do not meet necessary performance criteria, are effectively illegal to use on public roads. In July 2019 the first death of a private e-scooter rider was recorded in the UK, pre-dating the boom in popularity. In the twelve months to 30 June 2021, 931 casualties involving e-scooters were recorded by the DfT.[4] Over 20% were other road users, mostly pedestrians, who had been hurt.

The Department for Transport intends to publish an evaluation report on the trials sometime in 2022. UK Transport Ministers made clear that they wanted to legislate to enable the legal use of e-scooters, presumably for both rental and private use, and that the evaluation report would provide the basis for regulation. It soon became apparent to PACTS that private e-scooter use was growing but was not being evaluated in any way. PACTS therefore proposed this project to The Road Safety Trust which kindly agreed to fund it. Its purpose is to provide information and recommendations on safety regulations if the Government decides to make private use legal.

1 Third Report from the Transport Select Committee, Session 2019-21, 's 20 September 2020 report, *E-scooters: pavement nuisance or transport innovation?*, HC 255'
2 HC Deb,20 January 2022, Volume 817 [Lords Chamber]
3 As advised by the Bicycle Association and obtained from HMRC import figures for 2019, 2020 and 2021
4 Reported road casualties Great Britain: e-Scooter factsheet 2020 - GOV.UK (www.gov.uk)

This project

While there are supporters for legalising the use of e-scooters, there are also those who wish the rental schemes to be terminated and the prohibition on private use to be rigorously enforced. In this report PACTS does not take a position on whether or not e-scooters should be legalised. Our role is to contribute evidence to the debate and provide recommendations if the government introduces such legislation. We are clear that legislation should not be rushed before sufficient evidence is available to support decisions on regulations.

Through this project PACTS has gathered information on the safety of private e-scooter use in the UK. As it seemed possible that the Government might bring forward legislation at any time, in the absence of information about private e-scooters, our approach was one of action research – to collect and publish information monthly and to engage with DfT officials and other stakeholders throughout the project. PACTS also wrote to DfT ministers when publishing our interim report in October 2021, in November 2021 to ask for increased awareness to be made of the legal status of private e-scooters and in December 2021 with our interim recommendations for safe construction and use of private e-scooters.

We have not looked directly at the (legal) rental e-scooter trials although casualties involving rental e-scooters are included in the casualty data we collected for 2021. The trials are being evaluated as part of the Government's scheme. We have spoken regularly with the DfT, local authorities and operators to ensure that we are aware of what the trials are evaluating and where we can add value. The objective has been to support an informed debate and to compile information and recommendations for construction and use regulations should private e-scooter use in the UK be legalised. It seems most likely that the Government would do this in a Future of Transport Bill, probably later in 2022.

Our methodology has been to draw on the information and expertise which project partners can provide, as well as literature and information available through digital media. Casualty data for 2021 has been collected from online media reporting, police and insurance records and published monthly on the PACTS website. This has preceded the DfT's e-scooter factsheets and will do so until they publish their data for 2021 in September 2022.

Hospital audits and surveys, from the UK and Europe, have provided insights into the extent and nature of injuries. There are clear concerns from the medical profession over the safety of e-scooters, for riders and other road users. As academic research has been published this has been used to inform a wider understanding of how e-scooter design impacts their stability.

Interim report

In October 2021 PACTS published an interim report highlighting the differences between rental and private e-scooters. This has shown how private use differs greatly from rental schemes and some safety features of the rental schemes are not feasible for private e-scooters. It also included reports and statements from various NHS trauma surgeons. The clear message was that the Government should not rush to legislate until more information on safety had been gathered and published.

PACTS interim recommendations were subsequently sent to the DfT Minister.[5] This final report on the project is consistent with those interim findings but provides considerably more detail.

[5] 2021-12-06-PACTS-to-Minister-e-scooter-regulations (www.pacts.org.uk)

2 The development of e-scooters

Baron Karl von Drais de Sauerbrun is recorded as the inventor, in 1817, of the first human-powered two wheeled 'velocipede'.[6] Bicycles, tricycles and kick scooters resulted from this first 'running' device and in 1915 the 'Autoped' started manufacture in the US. Its design, a scooter with an engine mounted on the front wheel, became popular with long-skirted suffragettes, gang members and police alike.[7] Although the machine could reach 35mph (56.3km/h), it was reliant on a heavy motor and liquid fuel to power it. Fast forward to the late 1990s and the development of lithium-ion batteries brought the prospect of a lighter means of propulsion. Electric powered kick scooters began to be developed and, enthused by the opportunities they could bring for ease and speed of travel, entrepreneurs developed the idea into mass-manufactured products.

What is an e-scooter?

With the technology of light electric micromobility advancing quickly the vehicle form is, to a degree, fluid. Indeed, private e-scooters are constructed in a range of dimensions and power outputs, reflecting the breadth of machines available to purchase through the physical and online retail markets in the UK. There are some elements which are common to most e-scooters: a deck on two wheels (set one behind the other), a motor powered by an electric battery, a steering column, and a set of handlebars.

e-scooters are propelled with a 'twist and go' throttle and do not need any other physical input to power them. Under UK law they are therefore defined as a motor vehicle. To safeguard users, motor vehicles must conform to specified performance standards. This is demonstrated by achieving Vehicle Type Approval through testing. However, there is currently no category for e-scooters within those defined by the Vehicle Certification Agency, the UK's designated Type Approval Authority for automotive products.[8]

However, private e-scooters are legal to sell. Manufacturers need to self-certify that their e-scooter meets specific standards of product safety before they can be sold for use on

[6] The Motorized Scooter Boom That Hit a Century Before Dockless Scooters | History| Smithsonian Magazine, www.smithsonianmag.com
[7] 1918 Eveready Autoped Scooter – The Online Bicycle Museum, onlinebicyclemuseum.co.uk
[8] All e-scooters are defined as motor vehicles. e-scooters which are fitted with seats are subject to type approval, those without, are exempt.

Features of an e-scooter

Speed - Many private e-scooters are set to a limit up to 18.7mph (30km/h), however 30mph (48.2km/h) is not uncommon.

Wheels – 10inch (25.4cm) diameter wheels are promoted as being safer than the common 8.5inch (21.6cm)

Tyres can be pneumatic or solid.

Suspension - The highest quality options combine spring and piston suspension.[i]

Battery - Often 500 watt hour (Wh), larger batteries offer a greater range.[ii]

Motor - Brushless DC (BLDC) or Brushed. Brushed motors have mechanical brushes whilst a BLDC motor does this digitally.

250-watt motors are common, more powerful options can have motors over 6,000 watts.

Manufacturers often quote peak or sustained power. A high peak power will mean the scooter can get off to a quick start - but sustained power refers to how it will perform over a longer duration.

[i] Best electric scooters: a buying guide | Cycling Weekly.
[ii] Electric Scooter Database + Performance Testing Electric Scooter Guide (electric-scooter.guide)

private land. These are the General Product Safety Directive (GPS), the Machinery Directive (MD) , and the Electromagnetic Compatibility Directive (EMC). The vast majority of manufacturers use BS EN 17128: 2020, the type c (product) standard for personal light electric vehicles, as the method for demonstrating compliance.[9, 10, 11] However, these product safety requirements do not include factors such as speed, braking, power etc. that would be fundamental in vehicle safety regulations.

To be used legally in public spaces e-scooters would need to meet the regulations required of a motor vehicle including registration and insurance.[12] These requirements are difficult to meet for an e-scooter and for trial rental e-scooters to comply some regulatory changes were made. It is almost impossible for users of private e-scooters (and other personal light electric vehicles) to meet the regulations and, as a result, these are effectively illegal to use on public roads, pavements or in parks.

Micromobility

e-scooters are just one of an increasing selection of small, light, low-speed electric powered vehicles which are appearing on streets around the world. These are sometimes referred to as micromobility, but there is no firm definition. The International Transport Forum defines micromobility as "the use of micro-vehicles: vehicles with a mass of no more than 350 kilograms (771 pounds) and a design speed no higher than 45 km/h (28mph)".[13] Others say micromobility's "taxonomy includes three key criteria: fully or partially powered; kerb weight up to and including 500 lb (227kg) and, top speed up to and including 30 mph (48km/hour)".[14]

Micromobility is often part of shared mobility schemes and features in the gig economy. In the absence of a nationally agreed definition, it may be that legislation is brought in to regulate for a range of micromobility, including e-scooters. The DfT term "powered

[9] Consumer product safety | European Commission, europa.eu
[10] Directive 2006/42/EC - new machinery directive - Safety and health at work - EU-OSHA, europa.eu
[11] Electromagnetic Compatibility (EMC) Directive | Internal Market, Industry, Entrepreneurship and SMEs, europa.eu
[12] Powered transporters - GOV.UK, www.gov.uk
[13] OECD/ITF, Safe Micromobility, International Transport Forum, Corporate Partnership Board Report, 17 Feb 2020, www.itf-oecd.org/safe-micromobility,
[14] SAE International from SAE J3194TM Standard – Taxonomy & Classification of Powered Micromobility Vehicles, https//www.sae.org/standards

transporters" includes e-scooters and segways. Lower-powered electric mopeds are being developed which are similar in form to traditional liquid-fuelled mopeds and travel at speeds up to 45km/h (28 mph). Cargo bikes are being used which range up to 350kg in weight.

Some proponents of micromobility have claimed that light, electric and (relatively) low speed vehicles are intrinsically safe and pose little risk to other road users. Given the vagueness of the definition and variety of vehicle types, that is hard to assess. The newness of many of these vehicles means there is a lack of empirical evidence. As e-scooters are so prevalent in UK this report focusses on them but, hopefully, contributes to the wider understanding of micromobility.

3 European experience

e-scooter legislation in Europe

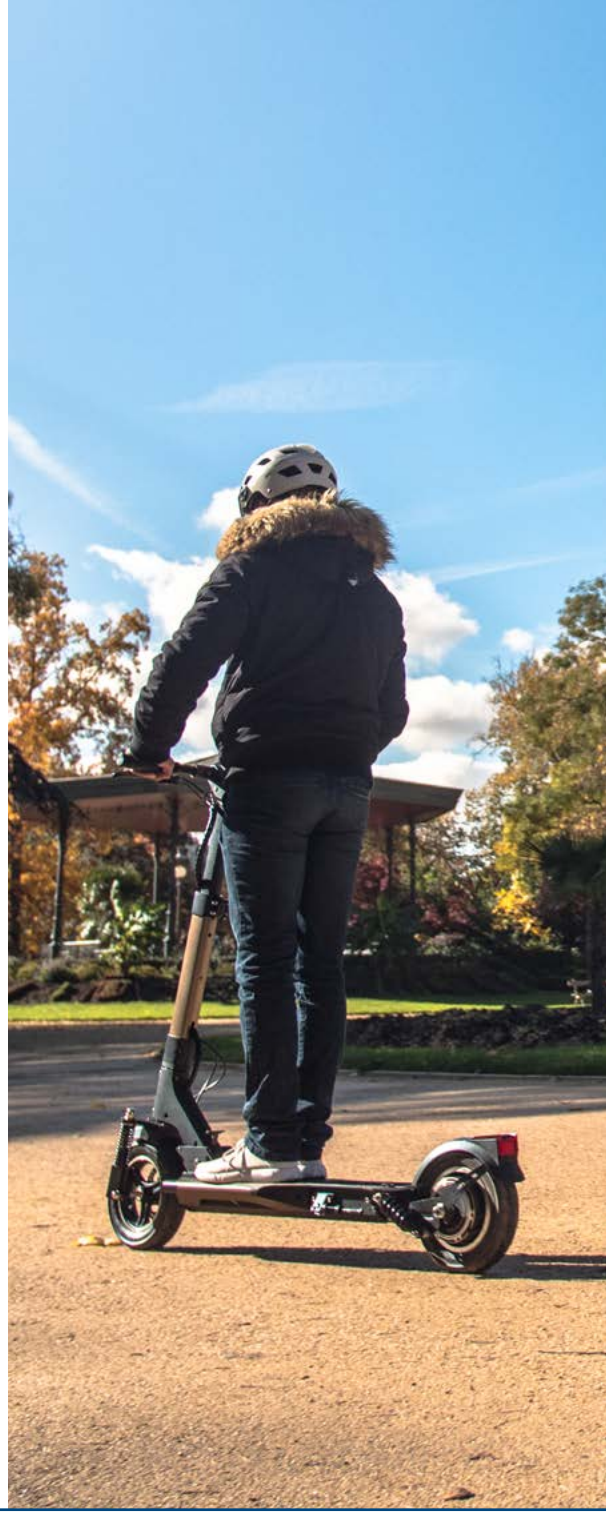
It is sometimes said that other European countries have developed ways to accommodate e-scooters and that the UK needs to "catch up". This is a simplification. Other European countries are still modifying their laws and looking for ways to safely manage e-scooters.

Legislation for e-scooters started being drawn up, in Europe, through 2018 and 2019. e-scooters were legalised in Belgium and Germany in June 2019 and in France regulations came into force in September of that year. Private e-scooter use is now permitted across most countries with the UK and the Netherlands notable exceptions. However, the proportion of private e-scooter use elsewhere is less than that in the UK, and renting an e-scooter, instead of buying one, is more popular in many European cities.

As new technologies are developed, and e-scooters are introduced in an ad hoc manner, European institutions and standardisation bodies have not agreed unified safety standards for micromobility. The European Commission acknowledges that the 'micromobility revolution' requires more effort in terms of sharing best practice and providing guidance, especially as these vehicles pose significant safety challenges.[15]

Standards for the construction of e-scooters are set in EN 17128: 2020, the type c (product) standard for Personal Light Electric Vehicles (PLEV). This voluntary standard has been developed by the European Committee for Standardization.[16] This includes e-scooters but it comes with a number of caveats. Vehicles excluded are 'those considered as toys; vehicles without a self-balancing system with a seat; electrically powered assisted cycles (EPAC), electric vehicles having a maximum design speed above 25 Km/h (15.5mph) and those not subject to type-approval for on-road use'.

These standards are being take into law by some Governments. For example, from January 2022, Spain's General Directorate of Traffic approved a 'Manual of characteristics of the



[15] Questions and Answers: European Urban Mobility Framework, europa.eu, 14 December 2021,
[16] CEN - CEN/TC 354, Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-approval for on-road use, cencenelec.eu

vehicles of personal mobility'. This subsumed standards from EN 17128:2020 with lighting and electrical requirements as well as minimum 203.2mm (8 inch) wheels and the inclusion of anti-tampering measures.[17]

There are no common standards for use. However, by following EN 17128: 2020, capping the speed of e-scooters to 25km/h (15.5mph) or below is one regulation on which most European countries agree. In Finland, rental scheme operators limit e-scooter speeds to 20 km/h (12.5mph), and 15 km/h (9mph) at night, and in Paris the speed of rented e-scooters is limited to 10 km/h (6mph) within certain central areas.

While regulations in some countries were initially like those for pedal cycles, amendments are being made to align e-scooters more closely with motor vehicles. Limits on power, use on pavements, age restrictions and the need for insurance vary. Helmets are compulsory in Finland, Greece, and Denmark and, from March 2022, all e-scooter riders in Spain must also wear a helmet. The creation of a new category of motor vehicle has been mooted.[18] As such e-scooters would need to obtain type approval (they would need to meet specified performance standards) and their riders would need to comply with specific regulations. In Germany e-scooters are already considered as a new category of motor vehicle. For example, riders are required to have insurance but, unlike mopeds, they can be used on cycle paths. It should be noted that the estimated number of private e-scooters in Germany is just 20% of the number of rental e-scooters in use.[19] Regulations mean that all e-scooters should have a maximum speed of 20km/h (12.5mph) and power of 500W.

Recommendations from transport safety organisations in Europe

Alongside the existing legislation, safety bodies are calling for more stringent regulations. The VIAS institute (Belgian Road Safety Research Institute) proposed five recommendations

[17] General Directorate of Traffic, *Manual of characteristics of the vehicles of personal mobility*, Resolution No. 18, of 21 January 2022, pages 6882 to 6915 (34 pp.), Spanish Government

[18] New moped category in traffic code created in France - Bike Europe, bike-eu.com

[19] As advised by GDV, German Insurance Association

Learning from experience

"In the last three years, we have seen unacceptably high injury rates and an ever-increasing level of conflict between e-scooters and other road users…That is why we are tightening the rules for the use of e-scooters from spring 2022,"

Jon-Ivar Nygård

Minister of Transport and Communications, Norway

Norway's extended e-scooter regulations

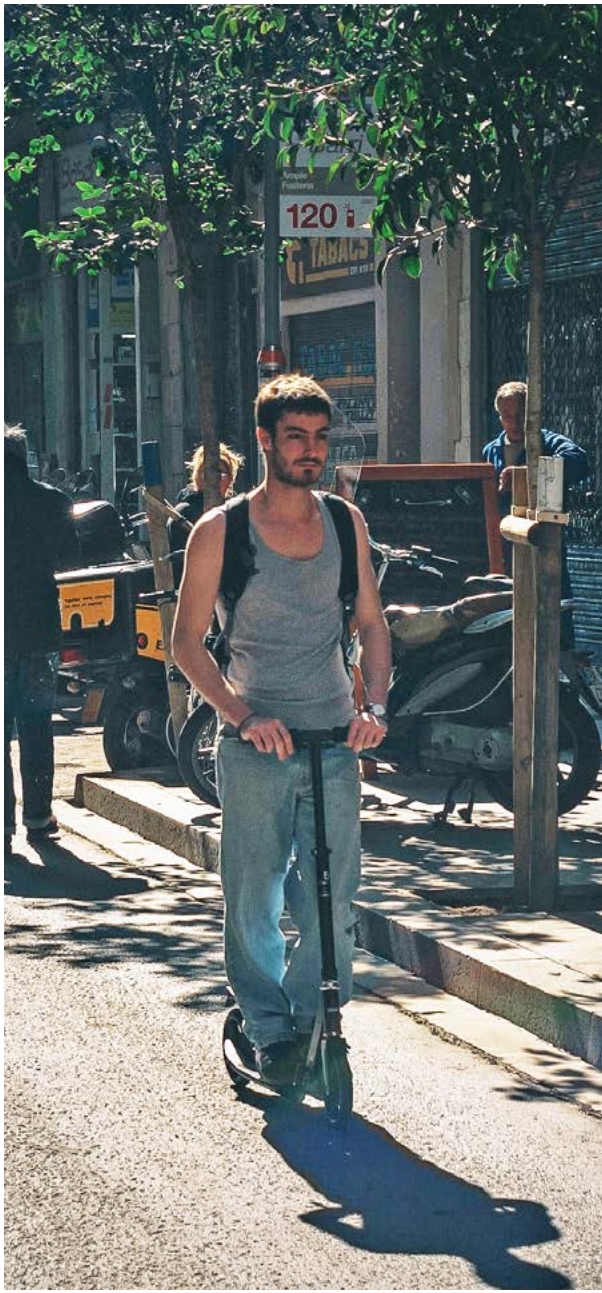
1. The general legal limit of 0.2g/l shall also apply to intoxicated driving with small electric vehicles.
2. Small electric vehicles are reclassified from "bicycle" to "motor vehicle".
3. Age limit of at least 12 years.
4. Mandatory wearing of a helmet for children under the age of 15.[i]

[i] Now the Government is tightening the rules for electric scooters - regjeringen.no, 22 January 2022

which they say would fill the gap around current legislation. These include a minimum age limit of 16 years for e-scooter riders and prohibited pavement riding.[20] The result has been a proposed change to amend the law in a favour of both recommendations.[21]

The DVR (German Road Safety Council) has listed eleven recommendations. Visibility should be increased with indicators and reflective materials. Riders should be 15 years old and, if they have had no other road awareness training, should pass a test before they can ride. The use and design of infrastructure is covered with two recommendations: regulations for the use of cycle paths by e-scooters and improvements to the quality of segregated paths by local authorities.[22]

In the Netherlands, only operator owned rental e-scooters are permitted. SWOV, the Institute for Road Safety Research, presents two safety criteria: that innovative light electric vehicles (LEVs) can be admitted to road traffic if, on balance, the social benefits of admittance exceed the costs, if road traffic becomes safer and that only vehicles that are similar to regular bicycles in size, weight, speed and function can safely be used on bicycle tracks.[23] They are clear that choices will have to be made about which new vehicles can be admitted where and under what conditions and which urban mobility the Dutch Government want to facilitate in the future.



[20] https://www.vias.be/fr/newsroom/trottinettes-electriques-vias-plaide-pour-un-changement-de-la-legislation/
[21] Belgian House of Representatives, Proposed Law, Amendment to Article 74 of the Constitution, 1 December 2021, DOC 55 2354/001
[22] E-scooters, dvr.de
[23] Boy, P. van der, Safe innovation: approval of LEVs and the future of cycle paths, SWOV, The Hague, R-2021-11

Figure 1: European e-scooter legislation

Country	e-scooters permitted?	Min. age	Max speed	Max power	Ride on pavements?	Passengers forbidden	Helmet required
Austria	Yes	12	25 km/h	600w	No	Yes	<12 years
Belgium	Yes	Legal proposal for minimum 16	25 km/h		Up to 6 km/h	No	No
Bulgaria	Yes	14 (cycle paths) 16 (roads)	25 km/h		Yes, if no cycle lane	Yes	<18
Czechia	Yes	unclear	25 km/h	250w	Yes, up to 10 years old	Yes	<18
Croatia							
Cyprus	No, information reflects forthcoming law	16	15 km/h		No	Yes	Yes
Denmark	Trial	15 (<15 must be accompanied by an adult)	20 km/h		No	Yes	Yes
Finland	Yes	No	25 km/h	1000w	No	Yes	Yes
France	Yes	12	25 km/h		When permitted, up to 6 km/h	Yes	
Germany	Yes	14	20 km/h	500w	No	Yes	No
Greece	Yes	15 (for e-scooters with design speed up to 25 km/h)	25 km/h		Up to 6 km/h	Yes	Yes
Ireland	No, legislation in progress						-
Italy	Yes	14	20 km/h	500w	No	Yes	<18
Netherlands	No, unless vehicle type-approved as a moped	16	25 km/h				No
Norway	Yes	12	20 km/h		No TBC	Yes	<15
Poland	Yes	10 (under 10 under supervision by an adult)	20 km/h limit on cycle paths		Yes, if the road speed limit is >30km/h and there is no cycling path/road	Yes	No
Portugal	Yes	No	25 km/h	1000w	Children up to 10	Yes	No
Spain	Yes	14-16 years (set at city level)	25 km/h	1000w	No	Yes	Yes
Sweden	Yes		20 km/h	250w		Yes	<15 - as bikes
Switzerland	Yes	14	20 km/h	250w			
United Kingdom	No, only trial rental schemes	16 (moped)	25 km/h	500w (trials)	No	Yes	No

Information provided by member organisations of the European Transport Safety Council - ETSC, current to end February 2022

e-scooter casualties in Europe

There are a number of ways in which the safety of a mode of transport might be assessed and each is based on a record of casualties. However, as e-scooters are such a new mode of transport in most countries they have not yet, or have only recently, been included as a distinct vehicle category in road traffic casualty records.[24] Data has instead been collected from hospital records, which does not capture details of the collision itself, or from small research studies where police data is scrutinised for relevant information.

Studies have found that in most e-scooter crashes no other vehicle is involved. Poor road surface conditions, e-scooter speed, riders intoxicated by alcohol or drugs, inexperienced users and lack of helmet use combined with the instability of an e-scooter contribute to the cause and severity of the injuries. Head injuries are prevalent, followed by injuries to the upper limbs. Other road users are injured and these are most often pedestrians and cyclists.

Casualties involving e-scooters are by no means the major type of casualty in these countries. Casualties involving cars, motorcycles, pedestrians etc. will account for far greater numbers. Comprehensive data on casualties and vehicle usage across the modes and including e-scooters is not available. The data and studies below are provided to give an indication of the scale and nature of casualties involving e-scooters. While it is not possible from these sources to provide a full context, we believe these records show the safety issues are not trivial and need to be addressed.

Germany

The Federal Statistical Office (Destatis) has included reports of e-scooter casualties from January 2020. Over the whole of 2020 a total of 2,155 collisions involving e-scooters resulting in personal injury were documented.[25] In 2020, just over 40% of the injuries were from a single-vehicle collision and 18% of the casualties were intoxicated.[26] Where a pedestrian

[24] Study on market development and related road safety risks for L-category vehicles and new personal mobility devices, TRL, Guy I, Appleby J, Ball P, But B, Chowdhury S, Jenkins D, Kent J, Obazele I, Radcliffe J, Sharp R, Wardle A, March 2021

[25] 2,155 e-scooter accidents with personal injury in 2020 - Federal Statistical Office, destatis.de

[26] Road safety of e-scooters, Unfallforschung der Versicherer, GDV, Research report No. 75, M Ringhand, J Anke, T Petzoldt, T Gehlert, April 2021

was involved in a collision with an e-scooter (in 162 incidents), far more pedestrians were hurt than e-scooter riders (74% of the casualties were the pedestrian).[27] From January to November 2021, 5,105 collisions involving e-scooters were recorded in Germany.[28]

Overall in Germany in 2020, e-scooter injuries accounted for only 0.8% of collisions where someone was injured. However, there is concern that police data misses many collisions involving e-scooters which result in injury. An epidemiological study in one trauma centre in Essen recorded 68 patients between June 2019 and October 2020.[29] Of these, only eight (11.8%) were also included in police records.

Data records from hospital patients informed two studies in Berlin and Munich during 2019 and 2020. In four emergency departments in Berlin, 248 patients presented with injuries incurred in collisions involving e-scooters between July and December 2019. Notably the primary cause of injury was from falling off the e-scooter and nine patients were pedestrians who had been hit by an e-scooter. A positive breath test was associated with a fivefold increase in the odds of traumatic brain injury and a doubling in the odds of hospital admission, even if the drivers were experienced in handling e-scooters.[30]

From July 2019 to April 2020 60 patients were prospectively recorded in one hospital in Munich. 59 patients had rented their e-scooters and the one patient riding a private e-scooter was the only one wearing a helmet. Nearly 40% of patients were intoxicated and 52% suffered head or facial injuries.[31]

Denmark

In 2019, the year e-scooter rentals were launched in five cities in Denmark, two-thirds of the e-scooters were rented and one-third in private ownership, although there were differences across the five cities. Evaluations were set up assessing e-scooter rider behaviour, casualty

[27] Traffic Accidents in Germany, Federal Statistical Office (Destatis), published August 2021 for the year 2020
[28] Accidents of e-scooters - A comparison - German Federal Statistical Office, January to November 2021, destatis.de
[29] Meyer, HL., Kauther, M.D., Polan, C. et al. *E-scooter, e-bike and bicycle injuries in the same period – a prospective comparative study of a Level 1 trauma center.* Trauma surgeon (2022)
[30] Uluk D, Lindner T, Dahne M, et al, E-scooter incidents in Berlin: an evaluation of risk factors and injury patterns Emergency Medicine Journal Published Online First: 07 June 2021.
[31] Mair, O., Wurm, M., Müller, M. et al. *E-scooter accidents and their consequences.* Trauma surgeon 124, 382–390 (2021)

rates for anyone involved in a collision with an e-scooter and the carbon footprint of the schemes.

A study of injuries resulting from e-scooter collisions was carried out retrospectively looking at data from emergency departments in Copenhagen from January 2016 to July 2019.[32] The vast majority presented between August 2018 and July 2019 and were most likely to be riders aged 18–25 years. The most common injury was from falling off the scooter (97 (86.6%)). e-scooters resulted in high energy impacts with 20.5% of riders sustaining head injuries and 43 (38.4%) suffered facial injuries.

Finland

In the first six months of 2021 the emergency department at Helsinki's Töölö hospital recorded 74 e-scooter related casualties, the same number as for the whole of 2020. Riders were treated for head and limb injuries, 50% of them were intoxicated.[33]

Sweden

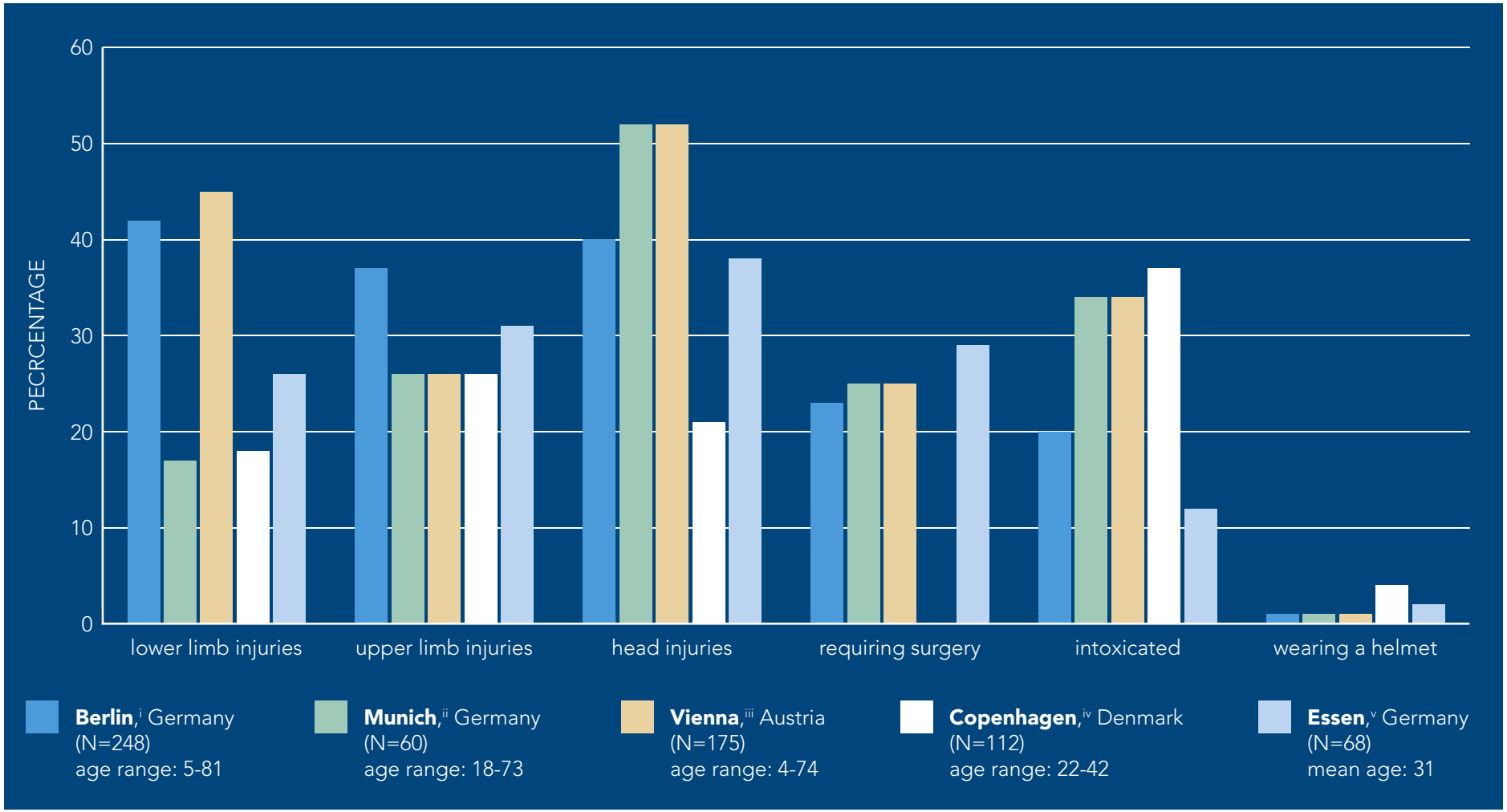
Using data collected from both the police and hospitals, the Swedish National Road and Transport Research Institute gathered casualty numbers amongst e-scooter riders. From 2014 to 2018 there were no more than fifteen e-scooter rider casualties in a year. In 2019 there were 490 casualties.[34] 50% of riders suffered head injuries and 87% were injured in single vehicle collisions. 10% of the casualties were other road users.

[32] Blomberg SNF, Rosenkrantz OCM, Lippert F, et al. Injury from electric scooters in Copenhagen: a retrospective cohort study. BMJ Open 2019;9:e033988.

[33] E-scooters speeding towards uncertain future | News | Yle Uutiset

[34] Per Henriksson, Åsa Forsman and Jenny Eriksson, *Accidents involving cyclists, electric cyclists and electric scooter riders: Analysis of Stradadata*, VTI (Swedish National Road and Transport Research Institute), December 2019

Figure 2: Casualty Characteristics: results from hospital studies in mainland Europe



[i] Uluk D, Lindner T, Dahne M, et al, *E-scooter incidents in Berlin: an evaluation of risk factors and injury patterns.* Emergency Medicine Journal Published Online First: 07 June 2021.
[ii] Mair, O., Wurm, M., Müller, M. et al. *E-scooter accidents and their consequences.* Trauma surgeon 124, 382–390, 2021
[iii] Moftakhar, T., Wanzel, M., Vojcsik, A. et al. *Incidence and severity of electric scooter related injuries after introduction of an urban rental programme in Vienna: a retrospective multicentre study.* Arch Orthop Trauma Surg 141, 1207–1213, 2021.
[iv] Blomberg SNF, Rosenkrantz OCM, Lippert F, et al. *Injury from electric scooters in Copenhagen: a retrospective cohort study,* 2019
[v] Meyer, HL., Kauther, M.D., Polan, C. et al. *E-scooter, e-bike and bicycle injuries in the same period – a prospective comparative study of a Level 1 trauma center.* Trauma surgeon, 2022.

Austria

A retrospective study was carried out of patients presenting at three major trauma departments in Vienna between May 2018 and September 2019.[35] Of the 175 patients who had sustained an injury from a collision involving an e-scooter 40.6% sustained major injury (including fracture or concussion). For those who suffered head injuries the proportion of serious injuries was greater than the proportion of those who suffered serious injuries to the extremities.

Belgium

A study in Belgium found that casualties were predominantly beginners and occasional users of an e-scooter, with more incidents recorded in fine weather when there is more e-scooter use. Head injuries and jaw fractures were the most common injuries to the riders (few wore a helmet). Fractures of the upper limbs, especially the wrists, were also common injuries. While most of the injuries were minor, their impact could be significant, for example a broken wrist leading to an absence from work of up to eight weeks.[36]

Norway

In the summer of 2020 865 people, 374 e-scooter riders and 491 non-users, were surveyed in Norway.[37] Of the riders, 14% had had a collision while riding an e-scooter and 37% had had at least one near miss. Of the non-users 72% had had a near miss, 38% as a pedestrian. This data is important as the experiences of pedestrians, especially near misses, are generally under reported.

Maybe unsurprisingly more people who owned their own e-scooter wore a helmet when riding than those riding rental e-scooters. However nearly half (47%) of the 101 private e-scooter riders still never wore a helmet, and 70% of rental e-scooter riders never wore a helmet.

[35] Incidence and severity of electric scooter related injuries after introduction of an urban rental programme in Vienna: a retrospective multicentre study Timon Moftakhar · Michael Wanzel · Alexander Vojcsik · Franz Kralinger · Mehdi Mousavi · Stefan Hajdu · Silke Aldrian · Julia Starlinger. Published online: 27 August 2020

[36] Electric scooters: helmets are of vital importance, press release from VIAS institute (Belgian Road Safety Research Institute), 28 May 2020

[37] Elsparkesykler til glede og besvær, Katrine Karlsen, Aslak Fyhir, TØI 1828/2021, Elsparkesykler til glede og besvær - Transportøkonomisk institutt (toi.no)

More experiences from Europe

"We probably do not have a single activity at the moment that is the cause of as many injuries as e-scooters."

Henrik Siverts

Senior Doctor at Oslo University Hospital (OUS), Norway, July 2021

"These injuries are very much more severe than bicycle injuries. When people crash down from the e-scooter they hit their head. The brain injuries can be very severe."

Arja Kobylin

Emergency care doctor, Helsinki and Uusimaa Hospital District (HUS), Finland, Sept 2021

Belgium road safety institute Vias recorded 1,000 accidents involving electric scooters across Belgium in 2021, about 400 in the Brussels region.

"This is only the tip of the iceberg since all the people who, for example, fall off an electric scooter do not call the police. It's a worrying trend that we must keep an eye on."

Spokesperson from the VIAS institute (Belgian Road Safety Research Institute)

France

A study in Rhône found a 478% increase in e-scooter casualties from 2018-2019. This led to e-scooter riders becoming the fourth most injured road users, above pedestrians. Head injuries were common. Within inner Paris during the first nine months of 2021, two women were killed and 329 people were injured in accidents involving e-scooters.[38]

Summary

Legislation for e-scooter use has been in place in mainland Europe since 2019. Since then legislation has been developed to improve safety for riders and other road users. Sources for data recording e-scooter collisions are still maturing, but currently underreport casualty numbers. Findings from studies into the numbers and natures of injuries indicate:

- 20-50% of casualties attending hospital suffer head injuries
- More riders fall in single vehicle collisions than by colliding with another road user
- Intoxication is a problem

[38] Road safety in France Summary of the accident rate of the year 2020, ONISR 2021

The implications of a modal shift to e-scooters

e-scooter trials were launched in England to evaluate, amongst other criteria, the nature of modal shift that e-scooters could achieve, particularly to transfer trips from car, thereby reducing emissions. The results of the evaluation of the trial schemes are not yet available. Data from other surveys give an indication of the modal shift that generally occurs.

Figure 3: Modal shift in Europe

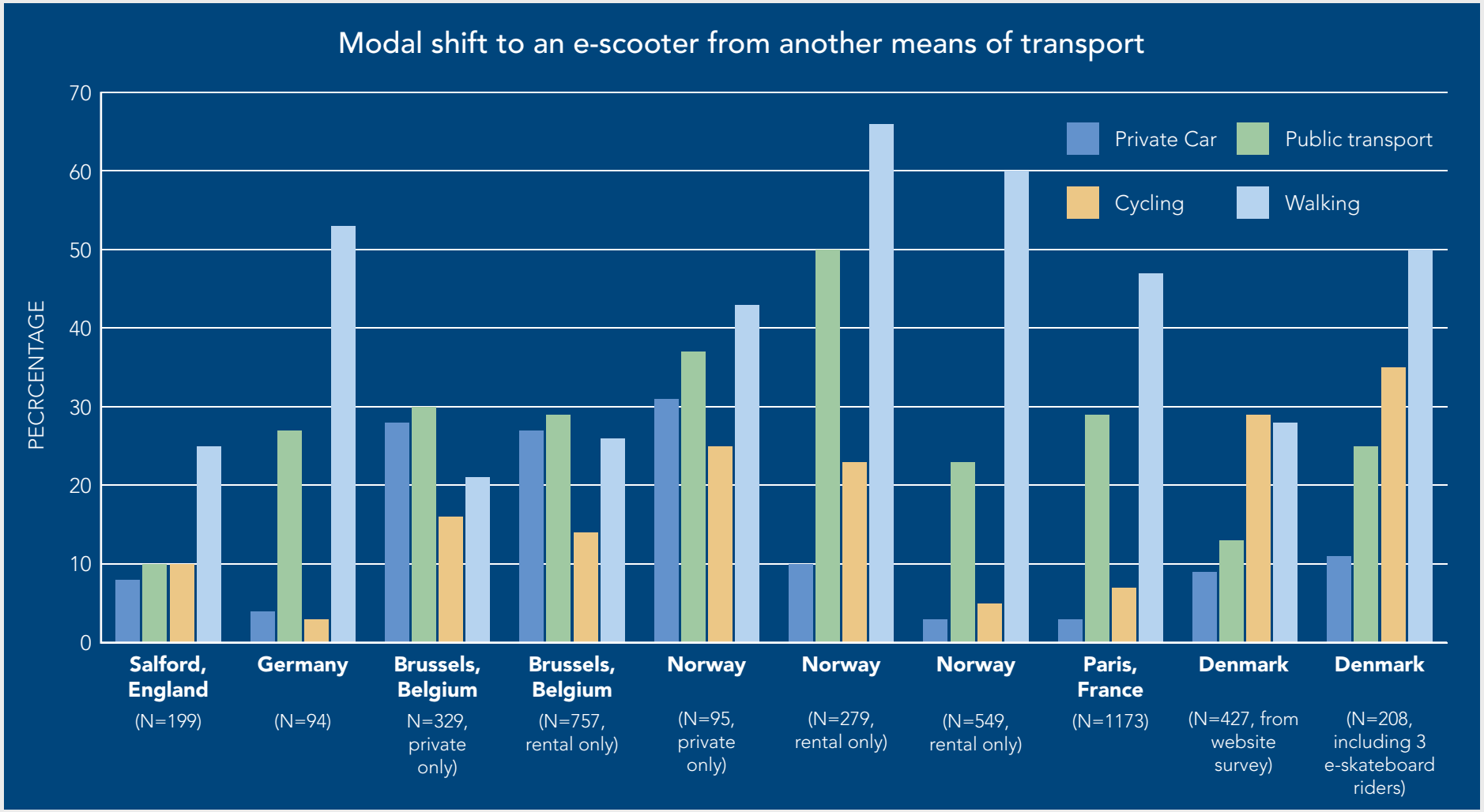


FIGURE 3 REFERENCES

Salford, England, 2022 Sherriff, G, Blazejewski, L, Lomas, M and Larrington-Spencer, *E-scooters in Greater Manchester : second interim report*, University of Salford, 2022, URL link - http://usir.salford.ac.uk/id/eprint/62888/

Germany, 2021 Madlen R, Anke J, Petzoldt T, Gehlert T, , *Road Safety of e-scooters*, Gesamtverband der Deutschen Versicherungswirtschaft e. V, Research report No. 75, 2021

Brussel, Belgium, 2020 Moreau, H., Jamblinne de Meux, L. de, Zeller, V., D'Ans, P., Ruwet, C. & Achten, W.M.J., Dockless E-Scooter: A Green Solution for Mobility? Comparative Case Study between Dockless E-Scooters, Displaced Transport, and Personal E-Scooters. Sustainability 12 (1803), 2020

Norway, 2021 Karlsen, K, Fyhri A, *The joy and trouble with e-scooters*, Institute of Transport Economics, Norwegian Centre for Transport Research, TOI report 1828/2021, 2021

Norway, 2020 Fearnley N, Berge S H & Johnsson E., *Shared electric scooters in Oslo, An early survey*, TOI report 1748/2020, 2020

France, 2019 6t-bureau de recherche, *Uses and Users of free-floating electric scooters in France*, 158 p, 2019

Denmark, 2020 Evaluation of the pilot schemes for small motorised vehicles, Faerdselsstyrelsen Denmark,

The implications of a modal shift to e-scooters

In the view of the Transport Select Committee, "it would be counter-productive if an uptake in e-scooters, whether rental or private, primarily replaced people undertaking more active and healthy forms of travel, such as walking, cycling, and even using kick-scooters. Promoting active travel must remain a key policy aim for the Department for Transport."[i]

These studies show a range in the proportion of e-scooter trips which were reported to replace a car trip from 3% to 31%. A global study found that figures up to 50% have been observed in the United States.[ii] It is likely that in locations where car use is more extensive a greater shift is seen. However, in Europe it is clear that e-scooters mainly attract trips from walking (21-66%) and public transport (10-50%). The distance within an e-scooter area which is travelled by rental e-scooter is also small relative to the distance travelled by car within that area each year at no more than 0.5%.[iii]

There is little evidence that the use of an e-scooter meets the definition of 'active travel' (or active transportation or mobility). In comparison to walking or cycling, no direct human exertion is needed to power an e-scooter. However, e-scooters could provide social inclusion benefits by enabling people to make journeys they could not already make and give riders an experience of the outdoors.

When assessing the benefits of trips transferred to e-scooters, eg. reduced carbon emissions and time-savings, the health and casualty disbenefits of the transfers from safer, active travel and public transport modes will also need to be assessed.

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i Third Report from the Transport Select Committee, Session 2019-21, 's 20 September 2020 report, *E-scooters: pavement nuisance or transport innovation?*, HC 255'

ii OECD/ITF, *Safe Micromobility*, International Transport Forum, Corporate Partnership Board Report, 17 Feb 2020,

iii PACTS analysis comparing Road traffic statistics (TRA) - GOV.UK, www.gov.uk for the year 2019 with data from London e-scooter rental trial headline metrics - Trial period 9, tfl.gov.uk and Voi Liverpool service data. e-scooters have been estimated to have travelled 4.16Mkm in a year in LiverpoolCars have been estimated to have travelled 1,084MKm in 2019 in Liverpool

4 e-scooters in the UK

Although invented, in their current form, in the late 1990s and having been in use across Europe and the US for several years, it was not until summer 2020 that e-scooters became extensively used in the UK. Here all e-scooters are deemed motor vehicles and all motor vehicles – from mopeds through to HGVs – need type approval. e-scooters do not conform to any of the type approval categories; as such, therefore, they are illegal. However, the DfT used powers to allow, for a limited period, regulated trial e-scooter rental schemes to operate in England. Commencing in July 2020, these schemes present a legal means by which hired e-scooters can be ridden. Simultaneously, the prevalence of private but illegal e-scooters has grown with ownership up to an estimated 750,000 in mid-2021.[39]

Rental e-scooter trials

The Queen Elizabeth Park, a publicly accessible private estate in east London, was the first place to host an e-scooter rental scheme which started in November 2018.[40] The COVID-19 pandemic then accelerated the launch of the DfT's regulated e-scooter trial rental schemes in July 2020. The changes to legislation came into force on 4 July.[41] Middlesbrough and Hartlepool were some of the first locations in England to join the pilot as Tees Valley Combined Authority partnered with UK based e-scooter operator Ginger delivering 50 e-scooters to the area.[42, 43]

The Government said that e-scooters would be an alternative to public transport and offer a 'greener' mode of transport to the private car. Schemes now operate in over 30 areas, with around 23,000 e-scooters in circulation provided by over ten different global e-scooter operators.[44] The purpose of the trials includes improving the "speed to market of new products and services that could deliver significant benefits" as well as assessing "the safety benefits of new transport modes".[45]

[39] Baroness Vere of Norbiton, 14 Dec 2021 in answer to written question UIN HL4630, tabled on 2 December 2021 by Lord Blencathra
[40] Electric scooter trial quietly extended in London | The Independent | The Independent, www.independent.co.uk
[41] The Electric Scooter Trials and Traffic Signs (Coronavirus) Regulations and General Directions 2020 (legislation.gov.uk)
[42] Tees Valley E-Scooter Trial - Tees Valley Combined Authority, teesvalley-ca.gov.uk
[43] Decarbonising Transport, A Better, Greener Britain, July 2021
[44] As advised by DfT
[45] DfT, Future of Transport Programme, November 2020

e-scooters used in the DfT trial rental schemes

All 23,000 rental e-scooters must meet a list of criteria including:

- no motor other than an electric motor with a maximum continuous power rating of 500W
- not fitted with pedals
- be designed to carry no more than one person
- have a maximum speed not exceeding 15.5 mph
- have a mass including the battery, but excluding the rider, not exceeding 55kg
- have a means of directional control via the use of handlebars that are mechanically linked to the steered wheel
- have a means of controlling the speed via hand controls and a power control that defaults to the 'off' position

In addition to stipulations around construction, the use of e-scooters is regulated with riders needing to hold at least a provisional driving licence. Insurance is provided by the operator.

The power and weight limit are greater than those included in the DfT June 2020 consultation.[i]

[i] E-scooter trials: guidance for local areas and rental operators - www.gov.uk as of February 2022

Each local authority works with the DfT but sets its own trial requirements and objectives before procuring services from operators. When schemes were launched guidance encouraged swift implementation with suggestions to local authorities to "rapidly develop and agree local high-level requirements and objectives" and that "light-touch contractual arrangements [are] better able to rapidly deliver e-scooter trials in response to COVID-19".[46] However, some areas, including London, chose to take a longer look at the process before contracting with rental e-scooter operators. Five boroughs opened to rentals on 7 June 2021, expanding to ten boroughs three months later.[47]

Through the trials, registered individuals with a provisional driving licence can hire an insured e-scooter, with a capped speed of 15.5mph or less, which can be ridden on roads and cycle lanes. (As with bicycles and other motor vehicles, it is illegal to ride them on pavements.) e-scooters must meet a number of requirements including conformity with technical standards, licensing, and registration. Riders are expected to abide by the operator's terms of use, based on DfT guidelines, and are recommended to wear appropriate safety equipment. From the operator-owned and maintained e-scooters, data covering demographics, location and extent of use, rider experience, including collisions, and helmet wearing is collected. (These last three points depend on the frankness and cooperation of the rider.) Riders have an obligation to report any injuries they sustain to the operator, although this cannot be enforced.

Private e-scooters

Private e-scooters are unlike rental e-scooters in both their construction and use. They are legal to buy, at a wide range of prices, with minimal certification to demonstrate their safe construction. However, they can be used only (with permission) on private land where speeds are unrestricted. 15-20mph is typical although some devices can exceed 50mph. There are no standards to be met for their safety or performance and a wide range of models are available. These include e-scooters with seats which classify them as mopeds.

[46] E-scooter trials: guidance for local authorities and rental operators - GOV.UK (www.gov.uk), updated with additional requirements for operators and local authorities from 1 April 2022

[47] London e-scooter rental trial headline metrics - Trial period 2, tfl.gov.uk

Selling private e-scooters

Private e-scooters are illegal to use on public roads and in public spaces. However, due to a lack of public knowledge about the law and to a perception that it is not enforced, sales and use of private e-scooters have increased rapidly. Retailers do not appear to be helping with irresponsible promotion readily accessible in online advertisements.

"It is not illegal to sell an e-scooter, however under the Consumer Protection from Unfair Trading Regulations 2008 (CPRs) there is a general obligation for traders to give consumers sufficient information about goods and services at the point of sale, so consumers are not misled. The CPRs carry criminal penalties and are enforced by local authority trading standards officers."

Baroness Vere of Norbiton
30 June 2021 in answer to written question UIN HL1208, tabled on 17 June 2021 by Lord Shinkin

"At least 66 suppliers from outside the UK and 21 within the UK have been found to have omitted to display the required restrictions on use… Several companies have changed the information on their pages to reflect the rules. Online retailers are included to address sales from non-UK providers."

Trading Standards officer
January 2022

It is illegal to ride a private e-scooter in public places including roads, pavements, parks or cycleways. However, they are being used more and more in these spaces. The speed of a private e-scooter can be increased with modifications to their batteries and motors. They are not fitted with the geofencing control of no-go or go-slow areas or onboard diagnostics afforded by the rental e-scooters. They do not need to be fitted with bells or lights. There is no traceability of users and limited ability for enforcement authorities to penalise riders for irresponsible behaviour. A list of differences between private and rental e-scooters is included in Appendix A.

Assessing the actual numbers of private e-scooters in use is very difficult. Although it is known that over 1,000,000 units have been imported since 2018, the life span of an e-scooter is estimated at three years, indicating that a percentage are no longer in use.[48, 49] The extent of use far exceeds that of the rental schemes (which are limited to England) with private e-scooters sighted across the UK. In two nationwide YouGov surveys conducted by Guide Dogs UK most of the people interviewed reported seeing e-scooters in locations without an e-scooter trial.[50] Vehicle detection systems, such as those used to measure congestion, are still being developed to distinguish e-scooters. These, however, would not provide information on the age or riders, nor the length of or purpose for their journeys.

Evaluation of the rental e-scooter trials

Trial rental e-scooter schemes opened in England in July 2020 and, following an extension of a year, are due to operate until November 2022. These schemes give members of the public access to an operator owned e-scooter for use on public roads. "The main objective of the trials will continue to be an assessment of the safety and wider impacts of e-scooters and development of best practice for shared micromobility service". Each rental trial has been set in place with extensive requirements on evaluation "to build robust evidence about the

[48] As provided by the Bicycle Association
[49] ITF, "Good to Go? Assessing the Environmental Performance of New Mobility", International Transport Forum Policy Papers, No. 86, OECD Publishing, Paris, 2020
[50] As advised by Guide Dogs UK

E-scooter fires and subsequent bans

e-scooters are fitted with lithium-ion batteries. If these catch fire, which they are prone to do if damaged or charged incorrectly, they pose a serious fire hazard.

e-scooter battery fires have been reported on public transport, in domestic properties and operators' warehouses.[i, ii, iii] e-scooters should be sold with a warning of the possible risk of fire or explosion when an e-scooter is charging. However, while private e-scooters are not regulated and tampering is prevalent, batteries are at greater risk of water ingress and damage resulting in fires and explosions.

The risks from lithium-ion batteries have been apparent in the aviation sector for some time and the International Air Transport Association has imposed safety regulations which, due to the nature of air travel, are relatively straight forward to enforce.[iv]

Since e-scooter fires in 2021 in homes, on the London Underground, and elsewhere, e-scooters have been banned from a number of public transport services, university campuses and other places.[v]

[i] E-scooters: Fire on Tube prompts call for London transport ban - BBC New, www.bbc.co.uks9
[ii] Serious house fire in Shefford caused by newly-purchased e-scooter, www.bedfordshirelive.co.uk Bedfordshire Live, www.bbc.co.uk
[iii] Bristol: More than 200 e-scooters damaged in 'significant' fire on New Year's Day | ITV News West Country, www.itv.com
[iv] 2022 Lithium Battery Guidance Document, IAIA, revised 19 Nov 2021
[v] London Fire Brigade backs TfL ban on dangerous private e-scooters on London's transport network | London Fire Brigade, london-fire.gov.uk)

safety, benefits, public perceptions and wider impacts of e-scooters in order to inform legal changes that may be necessary after the trial period ends".[51] The trials have been made possible due to the implementation of emergency powers. If rental e-scooters are to remain on English roads beyond the extended trial period, legislation to allow that will be necessary.

Safety is due to be assessed for both users and non-users. Riders will be asked about their perception of safety, which mode of transport they would otherwise have used, and the purpose for the journey.[52] Details of the journey (duration and distance) and demographics will also be recorded.[53]

Despite being initially set to run for a year, trials are expected to continue to November 2022. The Government says that this will provide more evidence to support recommendations for changes to legislation that might be needed in the longer term to manage e-scooter use. Interim reports had been anticipated in September and December 2021 but have since been cancelled. The publication of the full report is expected sometime in 2022 and before the extension of the trials ends.

Some data on rental e-scooter use is available in a piecemeal fashion. Transport for London (TfL) are publishing their summary reports monthly on their website. By 13 February 2022, 15 serious injuries had been reported since June 2021, out of just over 1.7million km travelled.[54] This equates to approximately 9 serious injuries per million km travelled. In Liverpool, by the end of January 2022 there had been 45 serious injuries over 16 months.[55] In comparison there were 0.74 serious injuries per million km travelled by pedal cycle in the whole of Great Britain in 2019 and 3.5 serious injuries per million km travelled by motorcycle in Great Britain in 2019.[56, 57]

Future regulation of rental e-scooters

The Urban Transport Group, the UK's network of city region transport authorities, proposes five recommendations for regulating the rental market and construction and use of private e-scooters. If the report's recommendations are not implemented the wide-ranging risks include:

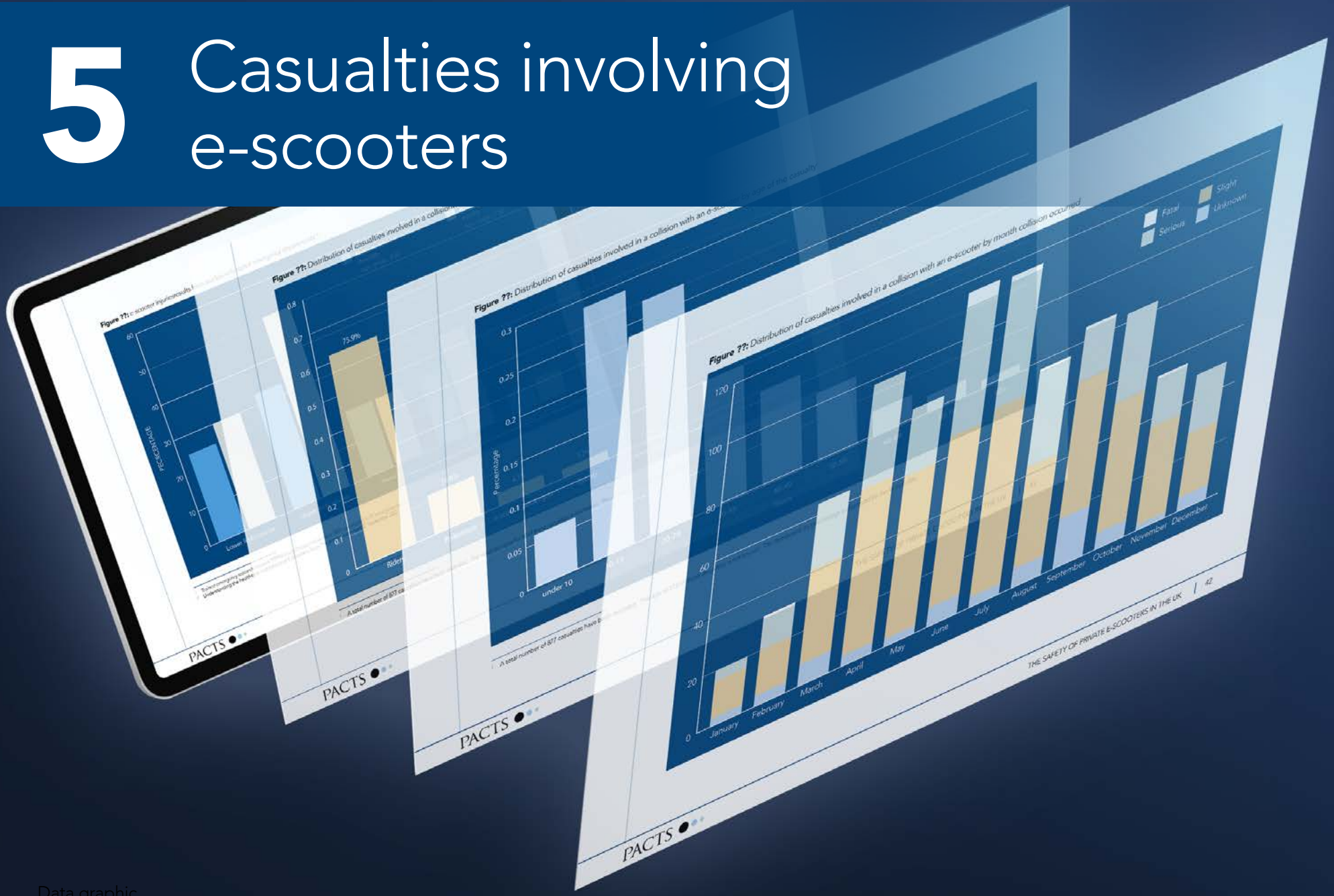
- Danger to users, pedestrians and other road users from falls, collisions and other incidents;
- Micromobility services not complementing existing journey patterns and transport provision, limiting the capacity for modal shift;
- Pedestrians being unable to safely use obstructed streets and footways;
- Lack of data to inform transport planning;
- Lack of traceability of riders; and
- The potential for e-scooters to be used in criminal activity.[i]

51 E-scooter trials: guidance for local authorities and rental operators - GOV.UK (www.gov.uk)
52 E-scooter trials privacy statement - GOV.UK (www.gov.uk)
53 Presentation by DfT e-scooters: introducing a new transport mode, Road Safety Delivery Group, 13th October (dated February 2021)
54 Electric scooter rental trial - Transport for London (tfl.gov.uk)
55 Voi Liverpool service overview 24-30 January 2022
56 Reported road casualties in Great Britain: pedal cycle factsheet, 2020 (www.gov.uk)
57 Reported road casualties in Great Britain: motorcycle factsheet, 2020 - GOV.UK (www.gov.uk)

i The future of e-scooters, Urban Transport Group, March 2022

Safety incident data is being gained from a number of sources, including the users themselves, but the authorities acknowledge that despite collecting information about injuries from operators and casualty statistics (STATS19) as reported to the police, it will not be a complete picture. In line with the data being reported through the trials, PACTS data of rental and private e-scooter casualties is presented in STATS19 format recording fatal, serious and slight injuries.

5 Casualties involving e-scooters



Data graphic

It is difficult to know how many casualties involving private e-scooters occur in the UK. Currently, incidents involving private e-scooters are suspected to be substantially under reported for a number of reasons:

- vulnerable road users are less likely to report single vehicle collisions (police records of single vehicle collisions involving pedal cycles are estimated to be only one third of those treated in hospital);
- there are limited means of identifying recorded incidents involving e-scooters on police records;
- it is likely that many incidents occur away from the road, on pavements and elsewhere, where there is no obligation for the public to report or for the police to record, even if aware, and
- the illegal nature of a private e-scooter means there is little reason to want to report a collision when the rider is then liable for a fine and points on their licence for admitting to riding without insurance.

Official statistics

Some official data is now available for Great Britain as the DfT have published factsheets for the year 2020 and the year ending June 2021.[58, 59] These were prepared using police reports where free text data against a STATS 19 reportable accident led to the identification of involvement of an e-scooter. This method of identification is less robust than if a designated vehicle type were available. With adjustments made to account for police injury-based reporting, 484 casualties were recorded in incidents involving e-scooters in 2020, 20% were other road users. In the first six months of 2021, 502 casualties were recorded in incidents involving e-scooters, two were fatalities and 17% were pedestrians. Numbers fell to just over 40 incidents a month in the COVID-19-lockdown in January to March then rose to nearly 120 per month in April, May, and June. 20% of reported e-scooter incidents were single vehicle collisions which is lower than the percentage measured from hospital records.

[58] Reported road casualties Great Britain: e-Scooter factsheet 2020, www.gov.uk
[59] Reported road casualties Great Britain: e-Scooter factsheet year ending June 2021 - GOV.UK (www.gov.uk)

Coroner's report of an e-scooter fatality

Joanne Lees, Area Coroner for the Black Country, recorded a conclusion of road traffic collision. "The medical cause for Shaky's death was severe head trauma caused by a road traffic collision."

A police officer giving evidence said Shakur Pinnock was on the right-hand footpath travelling in the opposite direction of the car. [CCTV] showed the scooter travelling towards where the van is then it makes a left turn into the carriageway where it carries on at an almost 90 degree angle. "Shaky on his scooter would not have been visible until he and his scooter appeared from behind the van, he would have been visible for less than 1.5 seconds"

The Coroner considered commissioning a Prevention of Future Deaths Report. She deemed however that as legislation (that made use of e-scooters illegal) was already in place a report was not necessary in this case.[i]

[i] Driver had 'just seconds' to avoid Shakur Pinnock killed in Wolverhampton electric scooter crash - Birmingham Live, birminghammail.co.uk

This suggests incidents involving larger motor vehicles are more likely to be reported than single e-scooter collisions. In 2022, STATS19 will include a vehicle category entitled 'powered personal transporter device'. However, it will take until 2024 for changes on all IT systems to take effect. When it is implemented, pedal cycles, electric motorcycles and mobility scooters will have their own categories, but all other new electric powered technology will fall under the 'powered personal transporter device' category.[60]

Data collection by PACTS

Because of the lack of e-scooter casualty data, the time lags in publishing official data, and the rapid increase in e-scooter sales and use, PACTS proposed this project. For the year 2021, collision data relating to e-scooters, private or rental, has been collected and made publicly available through the PACTS web page.[61] This data is gathered from media sources accessible online, supplemented by data from insurance firms, the police, social media, a major trauma unit and other organisations which have shared it with PACTS. Where possible, the nearly 900 records which PACTS has collected have been tabulated to identify the incident by geographic region, type of collision, casualty age and sex, severity of injury, and the type of e-scooter, as well as a record of the source for the data.[62] Records can be accessed through the PACTS website.[63]

PACTS acknowledges that the data is incomplete. For example, we have obtained data for 34 out of 48 police forces. On the other hand, we have collected data from other sources and obtained cases that do not appear in the police reports. Moreover, we have updated and published our data monthly throughout the project. Having discussed it with DfT statistics officials, we are confident that the 900 records provide a constructive contribution.

The quality of each source varies. The media are only likely to have reported incidents which were exceptional in their rarity or severity. Insurance claims are made only when one, or both, parties deem it worthwhile. Police records only include collisions on public land which they have identified through review of their free-text records.

[60] STATS19 review - final report, publishing.service.gov.uk
[61] Assessing the safety of private e-scooter use in the UK - PACTS research - PACTS
[62] Where a casualty has been recorded by multiple sources reference is to each source and the casualty is counted once in the dataset
[63] Assessing the safety of private e-scooter use in the UK - PACTS research - PACTS

Enforcing the law

"Enforcement of road traffic law and how available resources are deployed to tackle illegal riding of e-scooters is an operational matter for Chief officers according to local policing plans."

Trudy Harrison MP

21 February 2022 in answer to question UIN 12694, tabled on 9 February 2022 by Sir Greg Knight.

"[In the year] since July 2020, there have been more than 420 offences reported by people riding e-scooters, ranging from robbery, drug offences and youth violence. Private e-scooters have also been caught doing more than 40 mph. Reckless behaviour by e-scooter riders is commonly reported."

Commissioner's report 28 July 2021, TfL[i]

From January to November 2021, 3,637 private e-scooters were seized by the Metropolitan Police.[i] 417 private e-scooters were seized by Merseyside Police in 2021, and 71 in the first six weeks of 2022. As valid insurance is near impossible to prove, most seized e-scooters are destroyed.

[i] https://content.tfl.gov.uk/commissioners-report-july-2021.pdf

Media reports

Searches of the internet have provided over 180 records of casualties involving an e-scooter recorded by media outlets as well as on personal social media posts in the year 2021. These are generally available within a matter of days following a collision. Social media posts supply additional insights to the nature of the injuries and extent of near misses as well as incidents which are not recorded by the police. Some of these are very graphic and distressing. Some social media posts have included tweets from police forces referring to collisions which fall outside STATS19 parameters.

Analysis of the data collected by PACTS is included in Figure 4. PACTS have allocated casualties recorded in media accounts using the three injury categories in STATS19: fatal, serious or slight. Where necessary a judgement has been made based on the information available. The official data is due to published by the DfT in September 2022 and PACTS is making its records available for them.

Eleven deaths have been reported in the media for 2021. Notably, one of these deaths was reported over six months after the rider passed away. At least two fatalities fall outside STATS19 criteria and therefore have not been recorded by the police. Five of the eleven e-scooter rider fatalities in the Great Britain in 2021 were the result of falls from e-scooters rather than collisions with other motor vehicles and five had suffered severe head injuries.

Police records

As noted above, there is no designated vehicle type for e-scooters within STATS 19 recording. Instead, where police forces can make searches of their free text data, an indication of the number of e-scooter incidents is available. In some cases, PACTS records from the media have drawn attention to incidents which the police had not initially identified.

34 police forces have shared their 2021 data with PACTS, providing over 650 records of casualties. Each casualty entry is categorised against three injury criteria: fatal, serious and slight. One force has also used the injury-based report system (CRASH and COPA) where injuries are defined using 21 descriptions which are translated into severity level. Several

forces have also used these criteria for some, but not all, of the casualty records they have submitted.

In London, for the first ten months of 2021, 440 e-scooter casualties were recorded by the Metropolitan Police Service. 18% (79) were pedestrians. e-scooter casualties are primarily young people aged around 14-36 years old (77%) and male (79%). Of those casualties who suffered a serious injury, 12% had been involved in a single vehicle collision.[64]

In Liverpool, the local police force receives weekly casualty data from the trial rental e-scooter operator. From October 2020 to the end of January 2022 45 serious and 338 slight injuries had been reported by the operator.[65] However, the police are aware that the majority of these are not referred to them. Their records, for the year 2021, included only 17 serious injuries involving rental e-scooters. Over 60% of the collisions recorded involved rental e-scooters.

Insurance claims

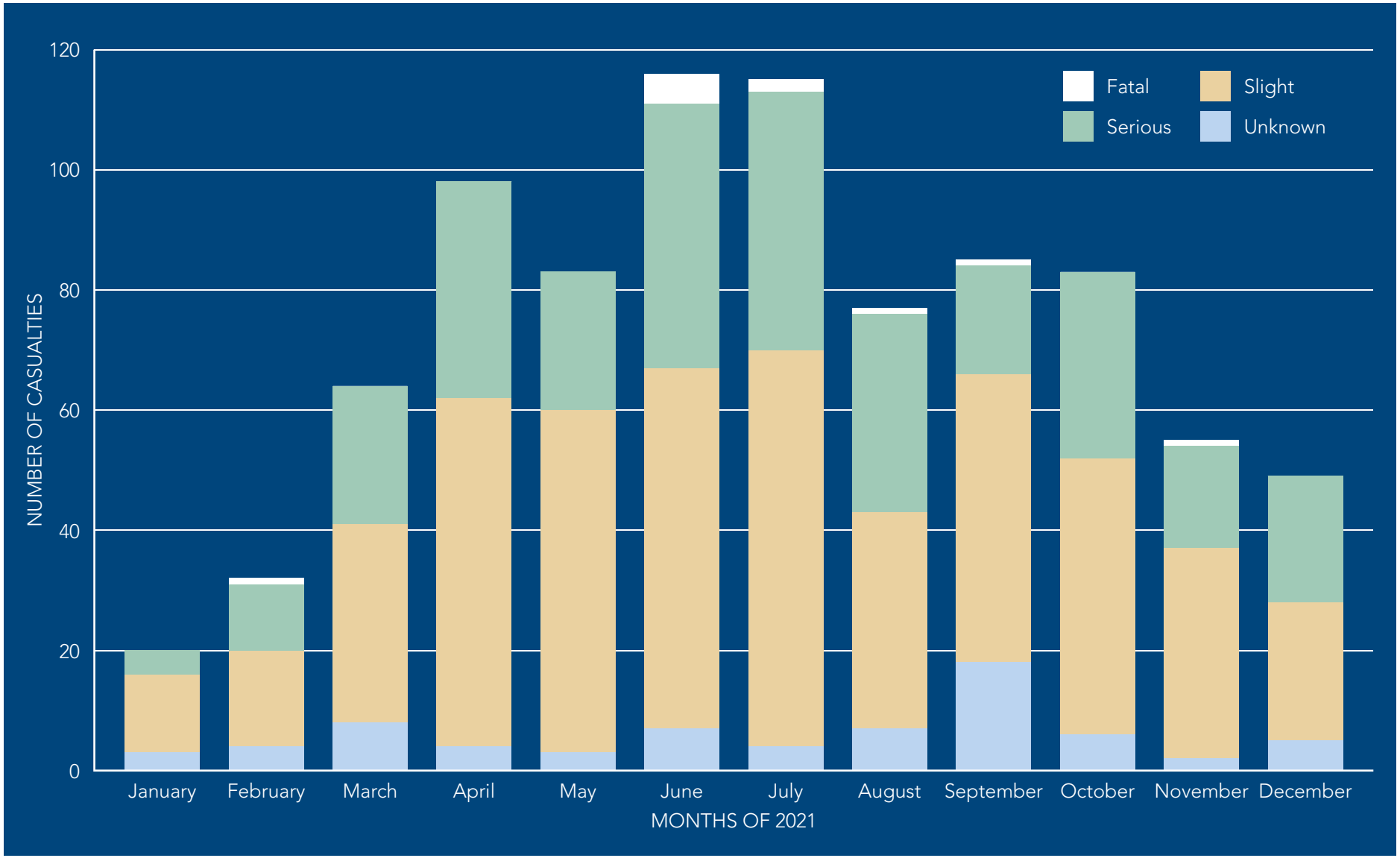
Two insurance firm have provided data from 2021. For one this is limited to serious injuries on their more serious claims, in excess of £100k. From the other details of 30 incidents have been provided where an injury was recorded. There are limited records of the types of injuries suffered. As of February 2022, The Motor Insurers' Bureau (MIB) had received 64 claims with the potential cost of £1,684,820. One serious injury case accounted for £628,000.[66, 67]

Presentation of PACTS casualty data

Graphical representation of the data collected by PACTS draws out the seasonal nature of e-scooter use, the extent of young people being injured (50% were 0-24 years of age) and the extent of serious injury (38% of casualties suffer serious injury).[68]

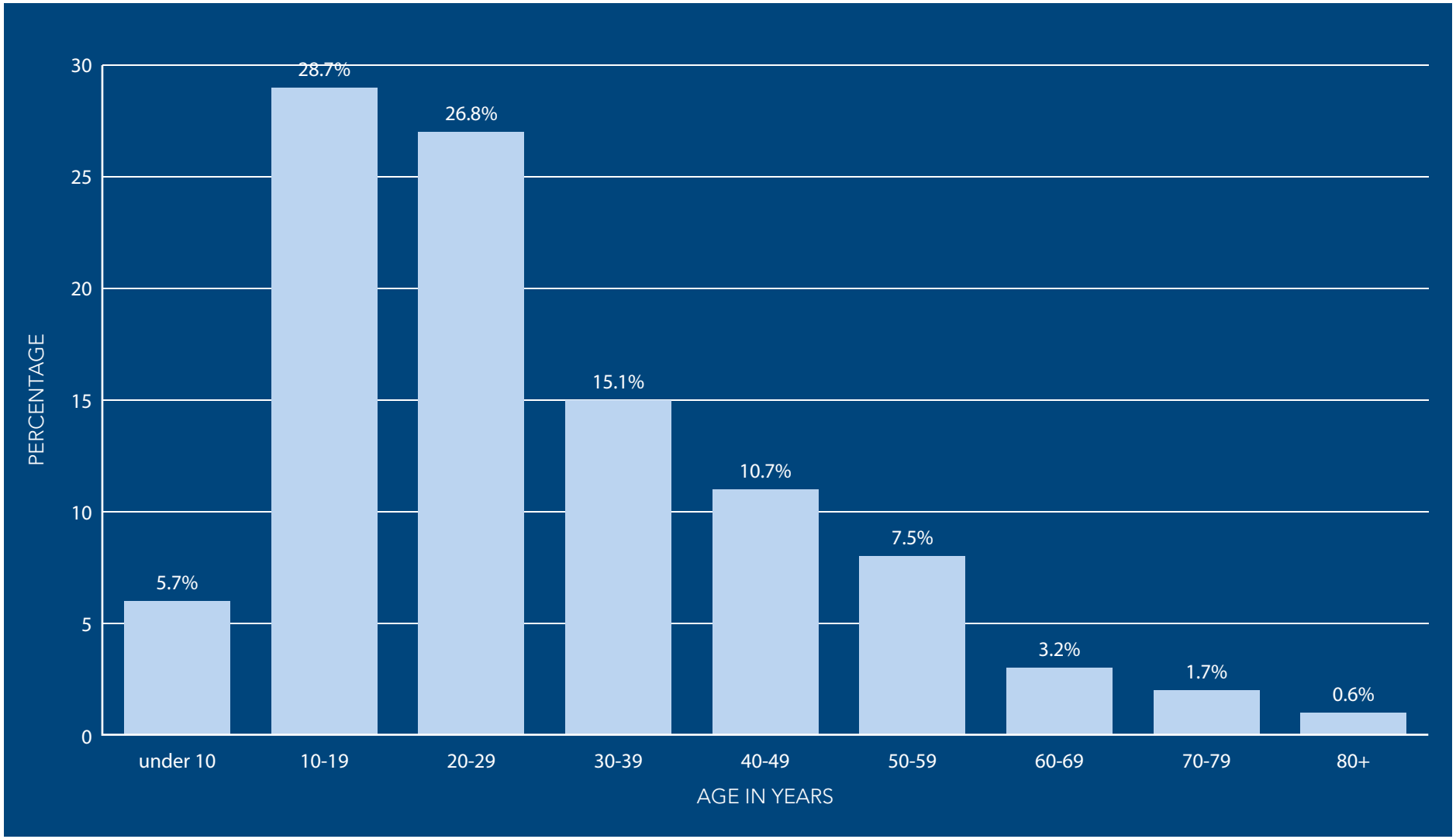
[64] As advised by TfL
[65] Voi Liverpool Service Overview (24 Jan-30 Jan)
[66] Due of their illegality, it is virtually impossible to obtain third party insurance for private e-scooters use on UK roads. They are however a motor vehicle and claims by third parties therefore fall to the Motor Insurers' Bureau (MIB).
[67] As advised by the MIB in February 2022
[68] For the year 2020, in Great Britain, 29% of all road traffic casualties were aged 0-24 years. For the year 2019, less than 20% of all road traffic casualties suffered serious injuries, and 30% of casualties who were riding a pedal cycle suffered serious injuries.

Figure 4a: Distribution of casualties involving an e-scooter, data collated by PACTS, GB, 2021[i]



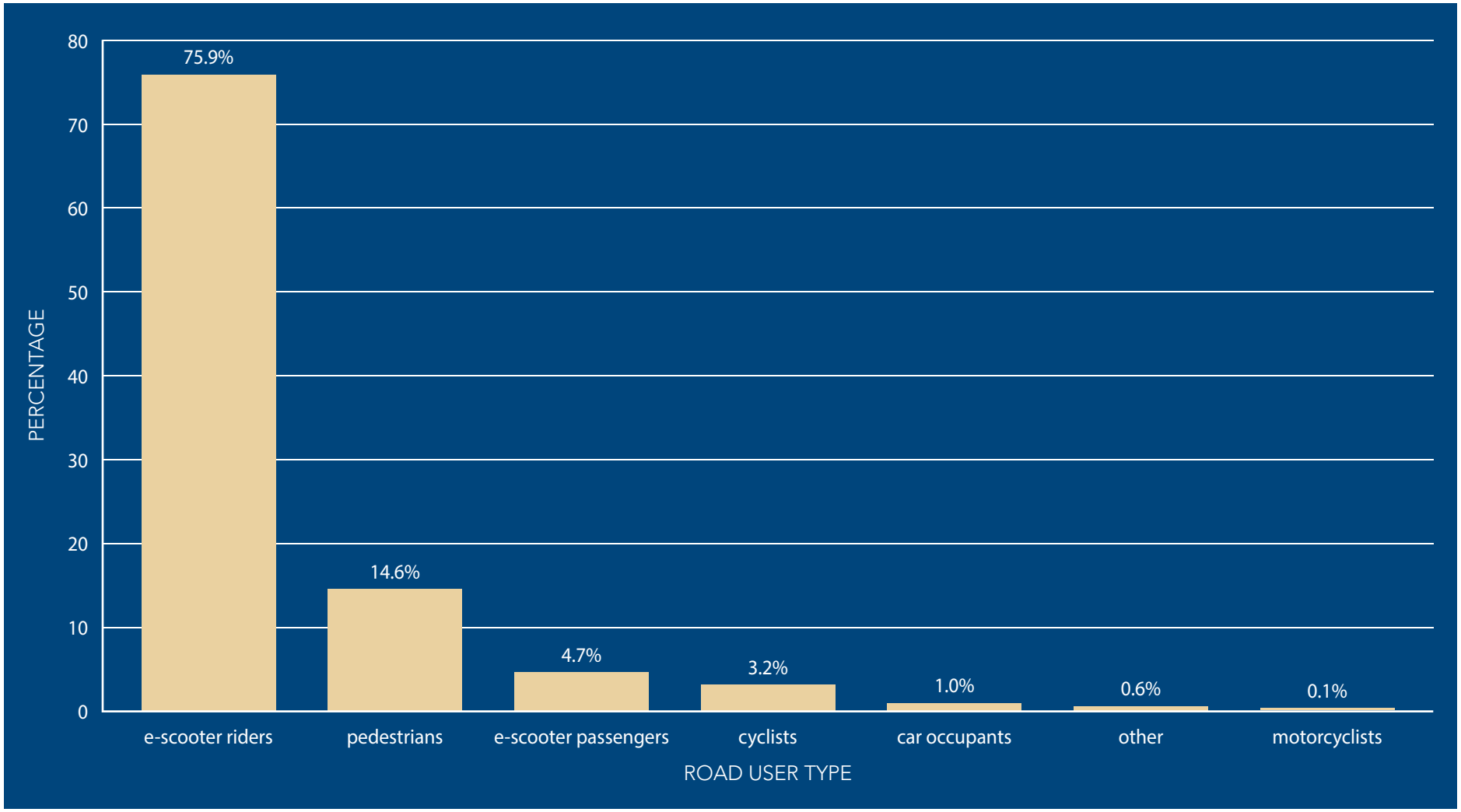
[i] No casualty data has been provided for Northern Ireland

Figure 4b: Distribution of casualties involving an e-scooter by age of the casualty, data collated by PACTS, GB, 2021[i]



[i] At the end of February 2022, a total number of 877 casualties had been recorded for the year 2021. This figure represents the 664 casualties where their age is known.

Figure 4c: Distribution of casualties involving an e-scooter by road user type, data collated by PACTS, GB, 2021[i]



[i] At the end of February 2022, a total number of 877 casualties had been recorded for the year 2021. This figure represents the 817 casualties where road user type is known.

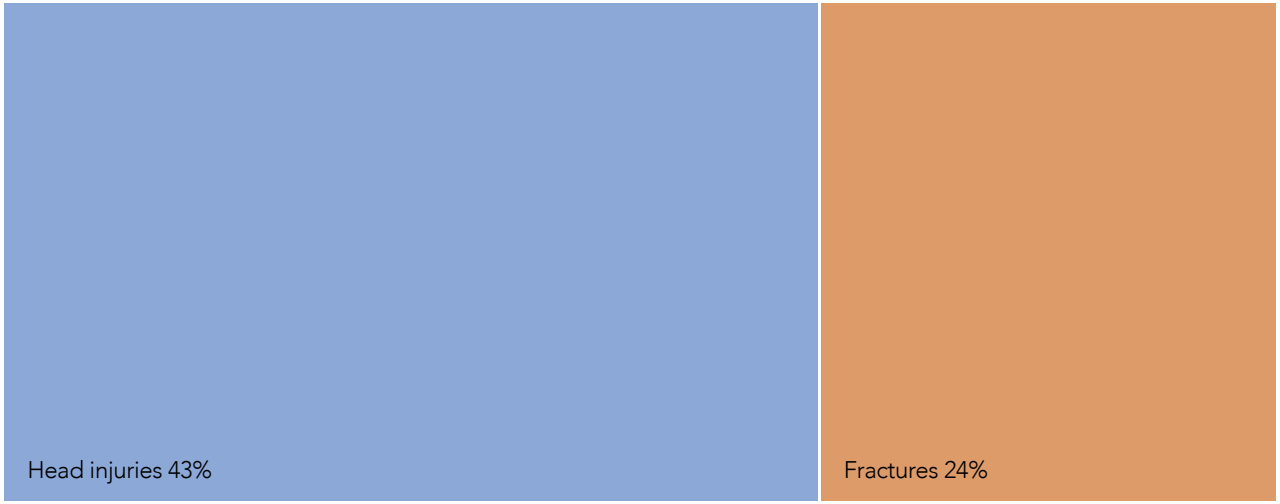
Figure 4d: Distribution of casualties involving an e-scooter by record source, data collated by PACTS, GB, 2021

Figure 4e: Distribution of casualties involving an e-scooter by e-scooter type, data collated by PACTS, GB, 2021

Figure 4f: Distribution of casualties involving an e-scooter by severity of injury, data collated by PACTS, GB, 2021[i,ii]

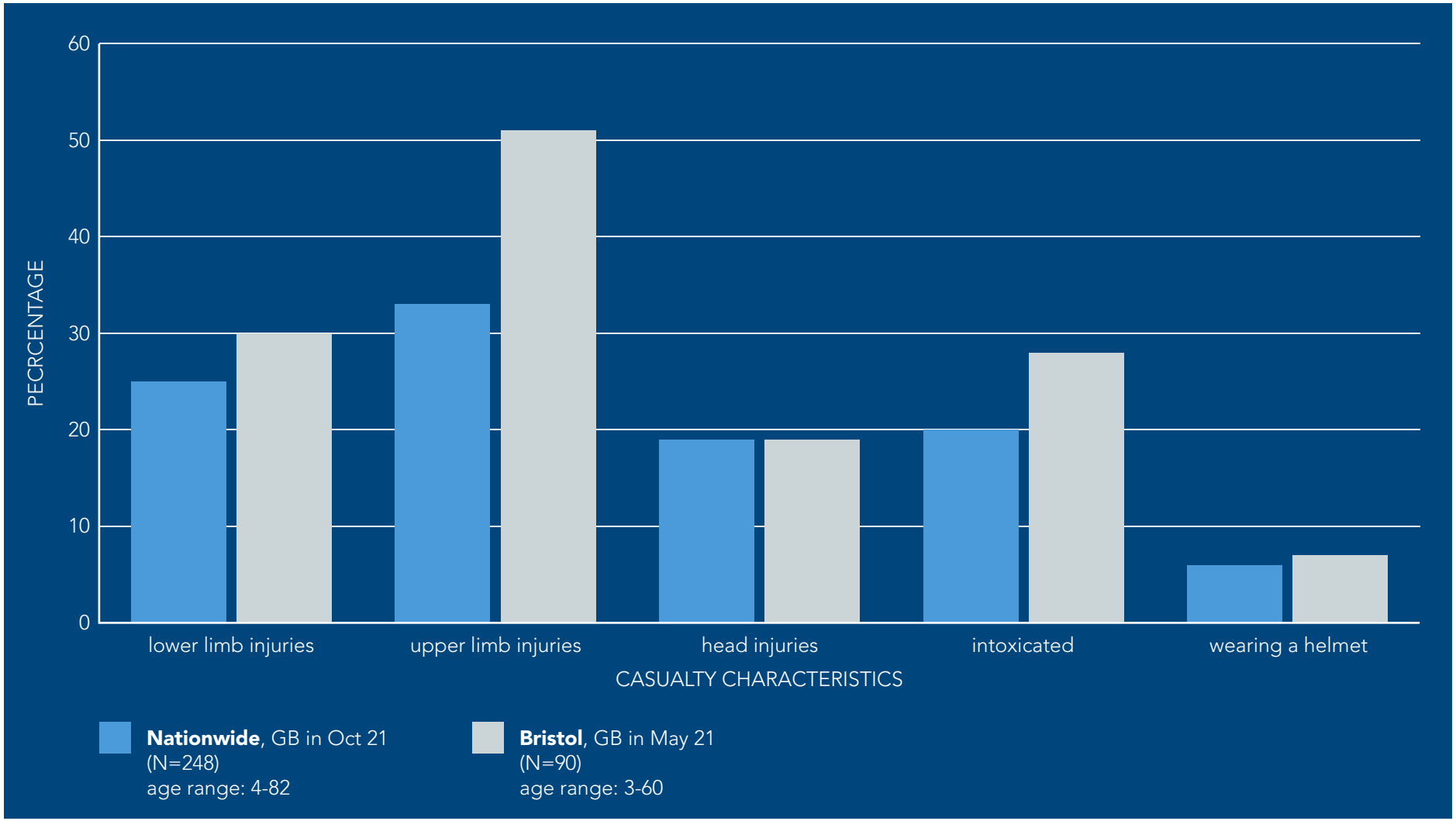
[i] At the end of February 2022, a total number of 877 casualties had been recorded for the year 2021. This figure represents the 806 casualties where severity of injury is known.
[ii] It is assumed that none of the 71 casualties for which the severity of their injury is unknown suffered a fatal injury.

Figure 4g: Distribution of injury type for casualties involving an e-scooter who suffered a serious injury, data collated by PACTS, GB, 2021[i]



[i] This figure shows the type of injury for the 304 casualties who suffered a serious injury.

Figure 5: Casualty Characteristics: results from hospital studies in Great Britain, 2021 [i] [ii]



[i] Trainee emergency research network (TERN) study October-November 2021, conducted in 20 emergency departments, nationwide
[ii] Understanding the healthcare implications of E-Scooters, Injury Prevention, submitted 27 September 2021

Evidence from around the NHS

NHS emergency departments, major trauma centres and surgical teams are treating increasing numbers of casualties involving e-scooters with head injuries and limb fractures presenting as the most common types.

Emergency Departments

Following the success of a service evaluation conducted over a four-week period in Bristol, the Royal College of Emergency Medicine (RCEM) launched a nationwide survey. During four weeks across October and November 2021, 250 patients presented at the 20 hospitals which took part in the study.[69] Casualties with e-scooter related injuries were recorded. Just under 5% were other road users (pedestrians or cyclists). 68% (161) fell from their e-scooter and 14% (33) hit a stationary object. 12 of the 20 hospitals had an active rental trial during the time of recruitment. There the mean number of patients presenting was 19.4. In hospitals without a rental trial scheme in their area, the mean number of patients presenting was 5.3. Casualty characteristics for both emergency department studies are included in Figure 5.

A children's hospital

Alder Hey Children's hospital, in Liverpool, have conducted an audit of records of scooter injuries.[70] 39 e-scooter casualties have been identified prospectively through a review of records back to January 2020. Seven suffered major trauma and only one wore a helmet. Almost half of the e-scooter patients required admission to hospital, staying on average three days.

The children were aged from 5 to 15 years and two were bystanders, rather than e-scooter riders. 17% (7) were involved in a road traffic accident involving another motor vehicle. 56% (22) were estimated to have been travelling at over 15mph at the time of their collision and 62% (24) were riding on public roads, footpaths or in a public park.

[69] As advised by Rob Hirst, TERN Fellow, Royal College of Emergency Medicine

[70] McGalliard R (ST3), Hallam K (ST5), Durand C (PEM consultant), Messahel S (PEM consultant), *Electric scooter injuries, Jan 20-Dec 21, Emergency Department Audit,* Alder Hey Children's Hospital, NHS Foundation Trust, 2022

Case study supplied by Headway

In July 2019, Wendy Joss hired an e-scooter while visiting friends in Belgium. Like many people, she didn't realise the dangers of riding one without a helmet. Wendy hit a pothole and was thrown over the handlebars of the e-scooter. She hit her head on the pavement and was left unconscious.

More than two years on, Wendy is still affected by her brain injury, experiencing severe fatigue, memory loss, sensitivity to light and noise and cognitive difficulties.

She said: *"At first, I was super confused and the pain in my head was unbelievably strange. It felt like someone was stroking my brain with ice cold hands and then squeezing areas so tightly I thought I would pass out. When I tried to speak, I couldn't find the words I wanted to say. I forgot the dog's name, I forgot my dad had died and I even forgot that I had a daughter.*

I don't know if I ever will be the old me again."

Wendy is hoping that she can turn her negative experience into a positive by advocating for safer e-scooter measures. Alongside the introduction of e-scooter training and ensuring they are speed-limited, she is passionate about making helmets compulsory.

A London hospital

During 2020 at King's College Hospital, 196 patients presented to the emergency department with injuries incurred in an incident involving an e-scooter. 30% had suffered limb fractures while less than 20% suffered head injuries. Those with the most serious injuries required, on average, 6.1 days of hospital admission and over 1,000 minutes of anaesthetic time. The medical teams have recorded patients presenting in greater numbers between 3pm and 7pm. [71]

A London-based neurosurgery centre

Patients suffering serious head injuries are treated at the Major Trauma Centre at Royal London Hospital. Between January and August 2021, the patients presenting included over 70 road traffic casualties. Of these, eight were e-scooter riders, 11 motorcyclists and 17 pedal cyclists. Each e-scooter casualty was brought in by ambulance and two stayed in the Intensive Care Unit for over a week, both following urgent neurosurgery. [72]

A major trauma centre

At the University Hospitals Coventry and Warwickshire NHS Trust the pattern of one e-scooter injury per month admitted to hospital with severe injuries has been maintained through 2021.[73] The majority of these have been male e-scooter riders who have fallen in single vehicle collisions. Fractures to their limbs are common and, for half of them, fractures to their skulls.

Orthopaedic trauma

A retrospective review of all orthopaedic referrals at three trauma centres in London found 83 patients presented with e-scooter related orthopaedic trauma between March and November 2020.[74] 79 (95%) were riders of private e-scooters, the rest were pedestrians. 58 riders (73%) fell from their e-scooter, 27 (34%) were wearing a helmet and 35 (42%) were

"e-scooters can cause serious musculoskeletal injury, and the long-term implication of this is currently unknown. As the UK considers legislation for private e-scooters, the drafting of safety regulations should ensure appropriate injury prevention mechanisms are in place to protect both the riders and the public."

Nina Jyne Minette dela Cruz
SMD MRCSEd
Post Core Fellow, Chelsea and Westminster Hospital

[71] As advised by Raju Ahluwalia, Consultant Orthopaedic Surgeon, King's College Hospital
[72] As advised by Chris Uff Consultant Neurosurgeon Clinical Lead for Neurosurgery and Molly Hilling, Clinical Nurse Specialist for Neurotrauma at Royal London Hospital
[73] As advised by Caroline Leech, lead for Major Trauma across the West Midlands
[74] NJM Dela Cruz, C Morgan, RV Morgan, S Tanna, C Talwar, R Dattani, KM Sarraf, CER Gibbons, *Injury patterns of e-scooter-related orthopaedic trauma in central London: a multicentre study* Ann R Coll Surg Engl 2022

reported to be travelling over 15.5mph. 93 (89%) of the injuries were fractures and 29 patients (35%) required admission to the ward.

A citywide audit

An audit of e-scooter casualties has been undertaken at the Liverpool University Hospitals NHS Foundation Trust.[75] Records from October 2020 to the end of 2021 report 132 people presenting to the four hospitals in the Liverpool University Hospitals NHS Foundation Trust; Aintree University Hospital, Broadgreen Hospital, Liverpool University Dental Hospital and Royal Liverpool University Hospital. Of the people presenting at hospital, and who declared which type of e-scooter they were riding, two thirds were using rental scheme e-scooters. This corresponds with the proportion recorded in police records for the city of Liverpool. A full report of the audit is due to be published sometime in March 2022.

TARN

When a patient is recorded on the Trauma Audit and Research Network (TARN) database it means they have sustained injuries resulting in hospital admission of over three days, critical care admission, death and/or a transfer to a tertiary/specialist centre. PACTS is aware that TARN data relating to e-scooter incidents has been collected since November 2020. Although this data has not been made available to PACTS it will present the DfT with further evidence to better understand the safety of e-scooters.

Summary

Data collected about e-scooter casualties in Great Britain from media reports, police records and hospital admissions indicate the following:

- There is significant under reporting to the police by road users, including pedestrians, of collisions which involve an e-scooter, especially single-vehicle collisions.
- Private e-scooters have resulted in a greater number of casualties, nationwide. However, in trial areas where data has been made available, rental e-scooter injuries exceed those recorded for private e-scooter riders.

[75] Response to a Freedom of Information request to the Liverpool University Hospitals NHS Foundation Trust

- There have been 15 recorded deaths involving e-scooters in Great Britain from July 2019 to February 2022. All were riders of private e-scooters.
- 38% of casualties recorded by PACTS for 2021 suffered a serious injury. The severity and number of recorded head injuries is a concern. Where records of casualties are available, few e-scooter riders wore a helmet.
- 50% of e-scooter casualties recorded by PACTS for the year 2021 were aged 0-24 years.
- Single vehicle collisions are the most common form of collision. Of those injured in a collision involving an e-scooter up to 20% are other road users, mainly pedestrians.

6 Risks to pedestrians

Although e-scooter riders are themselves vulnerable road users, data shows that around 20% of the casualties in collisions involving e-scooters are other road users, mainly pedestrians and cyclists.[76] Where and how e-scooters are used has an impact on what risks are posed to their riders and other road users. In addition to casualties, there is considerable concern among pedestrians about e-scooters being ridden on pavements, particularly from those who are more vulnerable (older, visually impaired, with young children etc). Obstruction caused by some rental e-scooters is also a concern.

The impact of pavement riding

The Transport Select Committee recommended that "should privately-owned e-scooters be legalised, the Government should ensure that the law clearly prohibits the pavement use of e-scooters, that there are robust enforcement measures in place and that such measures are effective in eliminating this behaviour."[77] Rental e-scooters, along with other motor vehicles, are banned from using pavements. However, despite geofencing technology being able to limit e-scooter access to specific zones in a rental area, it is not accurate enough on a granular level to prevent pavement riding. Private e-scooters have no such location tracking and, due to the number of riders, enforcement is proving difficult. With an electric motor e-scooters are near silent and even a rental e-scooter travelling at the regulated speed of 15mph (25km/h) is still many times the speed of someone walking. Pedestrians, especially the elderly and those who are visually impaired, are at risk of serious injury in the event of a collision. In Germany, data shows that in the event of a collision between an e-scooter and a pedestrian, the pedestrian is three times more likely to be injured than the e-scooter rider.

Pedestrians are reporting that their fear of harm from e-scooters is preventing them from leaving their homes and, therefore, is impacting their quality of life.[78] Creating and maintaining an accessible public realm is crucial for ensuring that disabled people are not

[76] Including PACTS data, Reported road casualties Great Britain: e-Scooter factsheet year ending June 2021, www.gov.uk
[77] Third Report from the Transport Select Committee, Session 2019-21, 20 September 2020 report, E-scooters: pavement nuisance or transport innovation?, HC 255, Paragraph 101
[78] Christina Young, Liverpool - E-scooters: casualty stats and the strive for accuracy, roadsafetygb.org.uk,

excluded from playing a full role in society.[79] Indirect discrimination is discrimination which puts rules or arrangements in place (through legislation or lack of enforcement) that apply to everyone, but that put someone with a protected characteristic at an unfair disadvantage.

People with sight loss and other groups rely on safe and unobstructed pavements and e-scooters are having a tangible impact on their lives.

Limiting risks to pedestrians

The virtually silent nature of e-scooters is a concern too for pedestrians crossing roads. Acoustic Vehicle Alert Systems (AVAS) have been required, since 1 July 2019, for new electric vehicles when travelling at less than 15.5mph (25km/h).[80] UCL's Person-Environment-Activity Research Laboratory are working with rental e-scooter operators to create a new and distinctive sound.[81] This should enable people with a range of different capabilities to know when an e-scooter is nearby and how it is moving, increasing their sense of safety. The cost for installing such a system on a private e-scooter may be disproportionate.

Measures which are effective in eliminating dangerous behaviour are needed. Some local councils have chosen to emphasis the illegality of e-scooters by putting in place public space protection orders for a local area or park.

Some have suggested that private e-scooters be fitted with a registration plate, as rental e-scooters are, and riders be registered. However, the benefits of this would need to be weighed against the significant administrative burden.[82] If registration were to be in place, it may be possible to extend the existing Civil Enforcement powers of local authorities outside London through Part 6 of the Traffic Management Act 2004. This could increase the resources available to enforce regulations, beyond those provided from the police.

[79] Inclusive Mobility. A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure, publishing.service.gov.uk, Dec 2021
[80] Regulation (EU) No 540/2014 of the European Parliament and of the Council Annex VIII
[81] Developing a universal sound to alert road users to e-scooters | UCL News - UCL – University College London
[82] Adam Norris, founder of Pure Electric, as quoted in the Sunday Times 21 November 2021

7 Not “just like bikes”

One yardstick of e-scooter safety used quite widely is comparison with bicycles. This is useful but needs to be undertaken with care to details.

How e-scooters and bikes are not the same

Pedal cycles, including electrically assisted pedal cycles (EAPCs), and e-scooters operate in different ways.[83] A table listing these differences is included in Figure 6. While pedal cycles and EAPCs require the rider to pedal to move forward, e-scooter riders can accelerate to their maximum speed within only a few seconds.[84] They also travel at a faster constant speed than a pedal cyclist. The rental e-scooter speed limit of 15.5mph is higher than the average speed of many pedal cycles in urban areas which has been measured as 11.3mph (18.2km/h) for men and 10.5mph (17.0km/h) for women in a range of 18-29 year old pedal cyclists.[85]

They are also constructed very differently, with different safety consequences. The wheel size and the location of the centre of mass has implications on the stability of a pedal cycle or e-scooter. The larger wheels of a pedal cycle and more centrally located centre of mass make it more stable than an e-scooter especially when navigating changes in the road surface. There are also implications on self-stability when accelerating and decelerating as presented in Chapter 8 of this report

Comparing the safety of e-scooters with bikes

Cycling is a well-established means of transport and, although not measured to the same extent as motor vehicles, there is a large dataset of usage by both number of trips and distance travelled. In comparison, private e-scooters are both new to the UK's roads and are illegal to use in public spaces. Telemetry systems used for transport management, for example to assess levels of congestion, are not yet reliable at detecting e-scooters. Riders are also reluctant to declare their usage due to the possibility of incurring a fine. It is therefore not yet possible to know how many trips are being taken by private e-scooter and how long each journey is.

[83] Electric bikes: licensing, tax and insurance - GOV.UK, www.gov.uk

[84] Billstein L, Svernlöv C, *Evaluating the Safety and Performance of Electric Micro-Mobility Vehicles Comparing E-bike, E-scooter and Segway*, Department of Mechanics and Maritime Sciences Chalmers University of Technology Gothenburg, Sweden 2021, www.chalmers.se

[85] Aldred R, Elliott B, Woodcock J, Goodman *A, Cycling provision separated from motor traffic: a systematic review exploring whether stated preferences vary by gender and age*, Published online. 14 Jul 2016

Instead, casualty figures and the nature of injuries incurred by casualties can be compared. Casualties involved in a collision with a bike are already being recorded by police and are included in STATS 19 data. e-scooter casualty figures, although not formally recorded as a category in STATS 19 records, are being identified. Some European locations have used data, both from police and hospital data, to present comparisons between the safety of e-scooters and pedal cyclists. It should be noted that more rental e-scooters than private e-scooters are in use in most European cities.

Global study

The report Safe Micromobility, by the International Transport Forum Corporate Partnership Board, is a comprehensive source of references about e-scooters. It cites a wide range of studies and findings from around the world, some of which are inevitably more robust and relevant to the UK than others. It found that a road fatality was not significantly more likely when using a rental e-scooter rather than a bicycle and that the risk of an emergency department visit for an e-scooter rider was like that for cyclists.[86] The more recent, detailed studies, summarised below, suggest however that this broad conclusion may not apply in European countries.

Germany

During the first quarter of 2020, 251 people were known to be involved in a collision with an e-scooter. That figure is small in comparison to the 12,700 collisions throughout Germany in which cyclists were injured. However, DLR Institute of Transport Research estimate, based on usage, that for any given journey the risk of being seriously injured when using an e-scooter is more than twice as likely as if a bicycle has been used. The risk of serious injury per kilometre travelled when using an e-scooter is five times that when riding a bicycle.[87, 88]

[86] OECD/ITF, *Safe Micromobility*, International Transport Forum, Corporate Partnership Board Report, 17 Feb 2020, www.itf-oecd.org/safe-micromobility

[87] First accident record for e-scooters - What do the figures say about their safety? DLR Portal, www.dlr.de

[88] Accident risk for e-scooters is higher than for bicycles, springerprofessional.de

Injury patterns for e-scooter, e-bike and pedal cyclists were analysed at a trauma centre in Germany across 2019 and 2020.[89] In all three groups, the most injuries were to the head (38% of e-scooter riders, 35% of e-bike riders and 25% of pedal cyclists). The number of seriously injured e-scooter riders was significantly higher than that of cyclists and the number of seriously injured e-bike riders was also significantly higher than that of cyclists.

Denmark

Preliminary accident figures from the Danish Road Directorate for 2019 showed that the police recorded 24 e-scooter casualties. From this small sample set, an estimate of the accident rate per kilometre travelled put the risk of a collision on an e-scooter at seven times that of a bicycle. The authors of the report noted the limited available data and statistical uncertainty.[90] Nonetheless, Denmark has introduced mandatory helmet wearing for all e-scooter riders from January 2022.

Norway

An assessment of e-scooter collisions in 2019, published in Norway and based on preliminary figures from Oslo, Denmark and the US, found that the rate per kilometre travelled of collisions resulting in an injury was 10 times higher for e-scooters than for bicycles.[91] In Oslo, 89 injuries resulting from e-scooter collisions were recorded per million kilometres travelled. In contrast, there were around 8 injuries resulting from cycle collisions per million kilometres cycled.

London

In London, TfL have obtained collision data for the first six months of 2021. They found that for the casualties attributed to privately owned e-scooters in London 0.8% were fatal, 25.4%were serious injuries and 73.8% were slight injuries. For casualties attributed to cycling in London, 0.2% were fatal, 16.7% were serious injuries and 83.1% were slight injuries. [92]

[89] Meyer, HL., Kauther, M.D., Polan, C. et al. *E-scooter, e-bike and bicycle injuries in the same period – a prospective comparative study of a Level 1 trauma center.* Trauma surgeon, 2022.
[90] Minister for Transport, Denmark, *Evaluation of the pilot schemes for small motorised vehicles*, Faerdselsstyrelsen Denmark, 2020
[91] Fearnley N, Berge S H & Johnsson E., *Shared electric scooters in Oslo, An early survey*, TOI report 1748/2020, 2020
[92] TfL, Safety, Health and Environment Quarterly report, Quarter 2 2021/22, Appendix 1 p18

The UK

PACTS has not attempted to calculate casualty or collision rates for private e-scooters. Others, however, have been prepared to. They have also estimated casualty rates for e-scooter riders to be much higher than those for pedal cyclists. For example, Thatcham Research has estimated that for the year 2019, car to e-scooter collision frequency was nine times higher than car to cyclist collision frequency.[93] If these rates are broadly correct, they indicate that casualty rates for e-scooter riders are closer to those for motorcyclists than pedal cyclists.

[93] Holmes A and di Cugno D, Reviewed by: Grover C, Young A and Brookes D, *Assessing e-scooter risk to motor insurers*, Thatcham Report July 2021

Figure 6: e-bikes and e-scooters compared

Item	Electrically-assisted pedal cycle (EAPC)	Electric scooter	Issues
Wheel size:	16" to 28"	6 " to 12"	Stability over obstacles/potholes
Ground clearance	6-10" (pedal clearance is also specified in standards)	2-4"	Grounding on obstacles/potholes
Riding position	Seated	Standing	Stability
Speed/control	Pedalling required; motor assist up to 15.5 mph	Throttle only. Private e-scooters can be >20 mph, some 30 mph+. Rental e-scooters capped to 15.5 mph	Speed differential: actual average speed of EAPCs 11 mph
Power	250 W	250 - 6000 W (private). Limited to 500 W (rentals e-scooters)	Acceleration
Weight	Typically 22 kg	Typically 15-30 kg (private) Limited to 55 kg (rental)	Accident impact
Brakes	Detailed requirements in law, performance set in standards[i,ii]	No clear legal requirements. Standard specifies minimum deceleration	Stopping distance, 'over the front' risk, instability
Lighting	Front and rear lighting at similar levels above road to most road vehicles by law.[iii] Pedal, wheel reflectors give extra visibility.	Rear light can only be very low down. Wheels small so side reflectors show little movement	Visibility to other road users
Signalling	Stable enough for riders to use clear hand signals	Using hand signals increases instability. Most have no turn indicators. If fitted, indicators often hidden by rider, small.	Signalling intentions clearly to other road users while maintaining control.
Construction regulations	CE marking, well proven designated standard (BS EN 15194) in place	CE marking. Recent standard available (for models up to 25 km/h only) but not designated (BS EN 17128)	Consumer safety
Age limit	14+	Currently none for private e-scooters as illegal on public roads16 years, to use a rental e-scooter	
Training	Bikeability available widely in schools, national training standards.	Only operator-supplied training or in-app instructions (for rental e-scooters)	Road skills/safety
Third party insurance	Not required but many riders insured anyway	Unclear – unclear if even possible while used illegally	
Environmental impact	Long lifespan – ca. 10 years Removeable battery	Short lifespan (1-3 years) Usually non-removable battery (or only removable with tools)	CO_2 impact and recyclability
Health impact	Studies confirm significant benefits	Minimal active travel benefits	Public health
Estimated current UK ownership (early 2022)	350,000	750,000[iv]	

Credit: Bicycle Association, http://www.bicycleassociation.org.uk

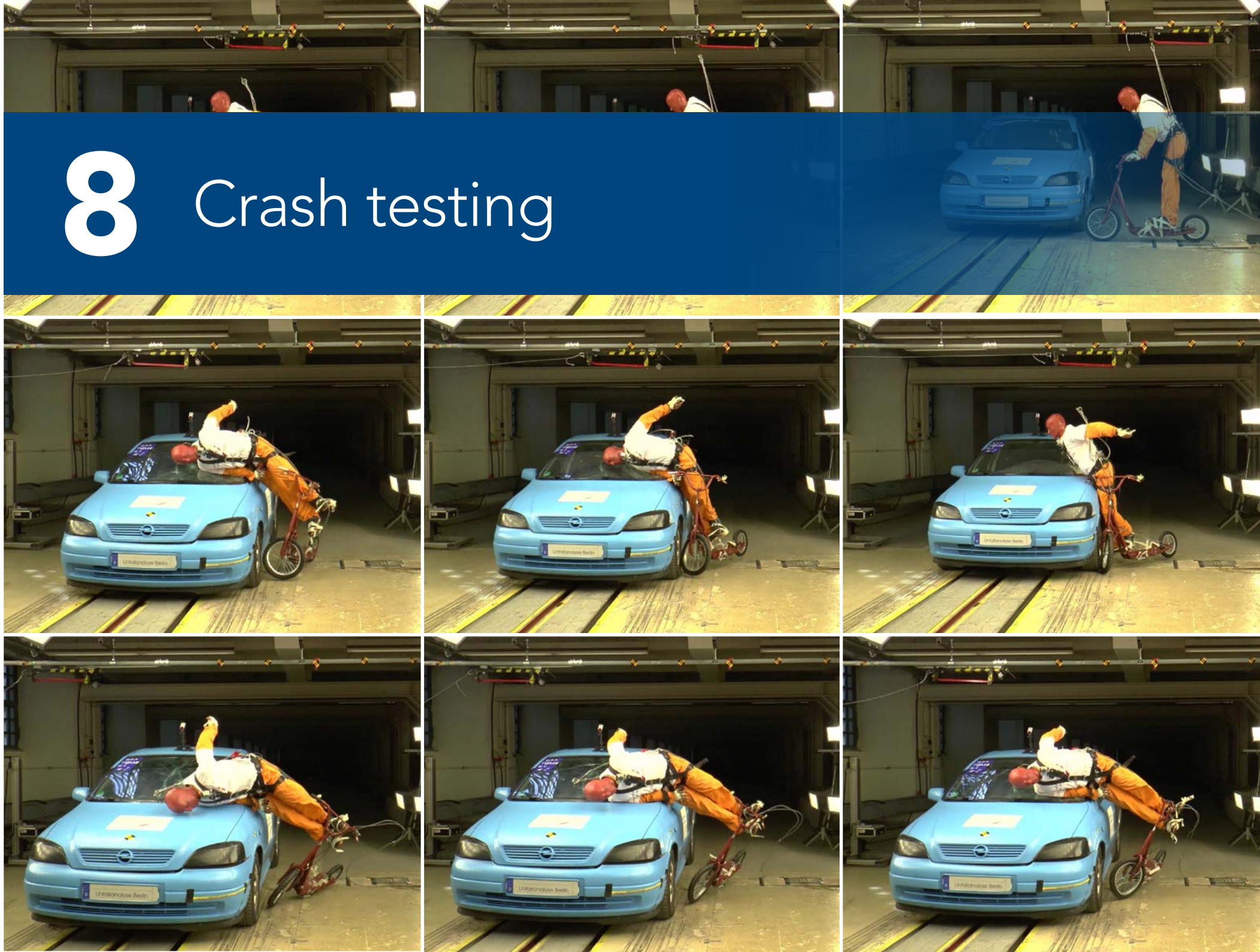
(i) The Pedal Cycle (Construction and Use) Regulations and Electrically Assisted Pedal Cycle Regulations

(ii) BS EN 15194:2017

(iii) Road Vehicle Lighting Regulations

(iv) Baroness Vere of Norbiton, 14 Dec 2021 in answer to written question UIN HL4630, tabled on 2 December 2021 by Lord Blencathra

8 Crash testing



Rental e-scooter operators have to demonstrate their compliance with regulations and standards by testing their e-scooter models. However, there has been little calibrated crash testing or computational modelling of private e-scooters. That which has been carried out gives an insight into the stability of an e-scooter and the likelihood and severity of injury to both the rider and a pedestrian.

e-scooter ride testing

Vehicle testing is essential for determining safety and validating the suitability and appropriateness of e-scooters as a means of transport. Commercial companies have an incentive to demonstrate the road worthiness of their products when in use, rather than necessarily testing the e-scooter to destruction. Stability during braking and the effectiveness of brakes is important. The stability over road imperfections is important for e-scooter riders as local authorities do not have to rectify defects while potholes are less than 50mm deep.[94]

Testing of e-scooters with different wheel sizes over a 50mm pothole shows increased stability with increased wheel size. In one example two different sized front wheels were compared: one front wheel was 8" (203mm), representing the most common size on the commercial market, and the other 16"(406mm), the same diameter as a folding pedal cycle wheel.[95] The results show increased stability with a larger wheel and some tests even showed that the small-wheeled e-scooter was not only unstable but also incurred damage when traversing surface defects.[96]

e-scooter crash testing

Video evidence from e-scooter testing in Europe and the US indicates that when an e-scooter collides with an object or a defect in the road surface, the e-scooter riders fall

[94] What_is_a_pothole_final_Makwana_December_2018.pdf, racfoundation.org
[95] Adult Scooter Safety – Pothole Test Results! | Swifty Scooters, swiftyscooters.com and as advised by S.H.A.D.O Works Partnership
[96] Testing by Dipl.-Ing. Roy Strzeletz, Unfallanalyse Berlin for Dr.-Ing. Matthias Kühn, Unfallforschung der Versicherer, Berlin (Accident Research for Insurers, Germany)

forwards, over the handlebars.[97, 98, 99, 100]. Analysis of this testing is limited, in part due to the challenge of eliminating the impact of test-rigs on the rider's position on the e-scooter. The tests are predominantly a means of demonstrating the way casualties fall. A doctor, commenting on the nature of injuries likely to be inflicted when colliding with a stationary vehicle, describe them as 'body wide' including serious head injuries.[101]

Another test, using crash test dummies, investigated collisions between pedestrians and an e-scooter travelling at 15km/h (9mph) and 25km/h (15.5mph). At 15km/h the adult pedestrian is first struck at their upper body. Both rider and pedestrian then fall likely sustaining further injuries when hitting the ground. When testing at 25km/h the adult pedestrian is first struck at the upper body then both rider and pedestrian strike foreheads. The pedestrian is thrown 3.45m and the rider falls. Measurement of the damage to the dummies, using the Head Injury Criterion, shows a 25% probability of fatal injury to the rider when striking the ground and a 90% probability of fatal injury to the pedestrian when striking the ground.[102]

This research indicates that in the event of a collision between an e-scooter and a pedestrian, the pedestrian is likely to be more seriously injured than an e-scooter rider. This has also been recorded in German casualty data. More research is needed to understand the relative injuries between e-scooter riders and pedestrians when collisions occur.

Computational modelling: demonstrating falls

Researchers at the Dyson School of Design Engineering, Imperial College London have created computational models of e-scooters ridden over potholes of different sizes. The aim was to understand how falls are influenced by speed and surface conditions and measure the resulting head-ground impact velocity and force.[103]

97 Fisher, J, Exponent, (2) Post | Feed | LinkedIn,
98 Baloise crash test highlights consequences of accidents involving electric scooters and bikes, www.baloise.com
99 RCAR - Scooter testing, www.rcar.org
100 Sicher unterwegs mit dem E-Scooter - Unfälle mit Fußgängern - YouTube, German Insurance Association (GDV) YouTube channel
101 E-Scooter Crashtest! Wie gefährlich sind Unfälle? - YouTube, Deutscher Verkehrssicherheitsrat (DVR), German Road Safety Council in collaboration with Techtastisch YouTube channel
102 Testing by UTAC Millbrook for Tin Man Communications on behalf of Guide Dogs UK
103 Posirisuk P, Baker C, Ghajari M, *Computational prediction of head-ground impact kinematics in e-scooter falls*, Accident Analysis & Prevention, Volume 167, 2022, 106567, ISSN 0001-4575

The results of the modelling showed that when using 10" (254mm) wheels the number of falls increased with pothole size. No falls where recorded when the computational model tested e-scooters traversing 30mm depth potholes. 41 out of 60 e-scooter riders fell when traversing potholes with a depth of 60mm. When falls occurred, at any speed, the measured head-ground impact force was larger than skull fracture thresholds.

Further modelling showed that decreasing the e-scooter speed reduced the head impact speed. For instance, reducing the e-scooter speed from 30 km/h(20mph) to 20km/h (12mph) led to a 14% reduction in the mean impact speed and 12% reduction in the mean impact force, as predicted by the models. The speed of impact between the riders' heads and the ground was comparable to the speed measured for pedal cyclists. However, the nature of the injuries were different to those suffered by pedal cyclists. 44% of impacts were to the face, which would not be protected by a traditional bicycle helmet.

The implications of a rider hitting their head when falling from an e-scooter have been found to be severe. Further research is needed into the optimal design of helmets to limit the severity and extent of injury.

Computational modelling of e-scooters: assessing stability

Self-stability is the property which makes it easier for a two-wheeler (pedal or motor powered) to ride hands-free, navigate obstacles or sideways winds. e-scooter riders appear to be susceptible to instabilities as injuries due to falling from an e-scooter are more common than collisions with other motor vehicles. To assess self-stability, validated mathematical models were used to analyse the dynamic performance of e-scooters with 8" (203mm) diameter wheels. Self-stability, braking effect and steady-state turning were assessed against that of a 26" (674mm) diameter pedal cycle.[104]

[104] Paudel, M & Yap, F F, Front steering design guidelines formulation for e-scooters considering the influence of sitting and standing riders on self-stability and safety performance. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 235. 2021

Big wheel bicycles were found to be self-stable at speeds of 17.0km/h-27.5km/h (10.6-17mph). However, e-scooters were found to be unstable until travelling at 22.4km/h (13.9mph). This means that e-scooters were more stable the faster they were travelling. This impacted on stability both during deceleration and acceleration on a flat surface.

Slowing-down from a higher, more stable speed, meant transitioning to a slower, less stable speed, making the e-scooter more challenging to control. Deceleration increased any existing oscillation (weave motion). While applying a sudden brake to avoid obstacles, the oscillation amplitude increased much faster, and the chance of losing control became greater. The self-stability of e-scooters was found to be more sensitive to decelerations compared to bicycles.

The effect of acceleration was found to be opposite to that of the deceleration. Acceleration reduced the amount of 'wobble'. However, the self-stability range was found to shrink drastically with the acceleration. The analysis found an acceleration greater than $3m/s^2$ could make the self-stable region disappear completely therefore losing its self-stability property. For example, a hefty acceleration on an e-scooter could cause a sudden loss of the intrinsic self-stability property, making the rider put more effort into balancing.

The results confirmed that e-scooters are easy to manoeuvre as they require much less steering torque than bicycles. However, the steering of e-scooters is more sensitive to external forces and is affected more compared to bicycles when encountering obstacles on the road.

By testing the impact of changing the steering stem angle (sometimes known as the head angle or rake angle) relative to the headtube angle improvements to the e-scooter's stability were achieved, as shown in Figure 7. These modifications improve self-stability of the e-scooter relative to a bicycle and improve handling and braking performance.[105] Rider training can also improve stability by teaching the rider how to reallocate their weight on the e-scooter. Instabilities of the e-scooter are still exacerbated by surface irregularities and potholes.

[105] Analysis was carried out on seated e-scooters and these were assessed as being more stable than standing e-scooters. In the UK seated e-scooters are subject to type approval and would need to registered as a moped and ridden subject to the requirements for a moped.

Figure 7: Improving the stability of an e-scooter by modifying its design

Changing the angles for the lower part and upper part of front steering assembly alters the location of the centre of mass. Shifting the centre of mass of the front steering assembly backwards shifts the self-stability range of the e-scooter towards the lower velocity range and vice versa.[i] This modification results in a self-stability range more similar to a big wheeled bicycle.

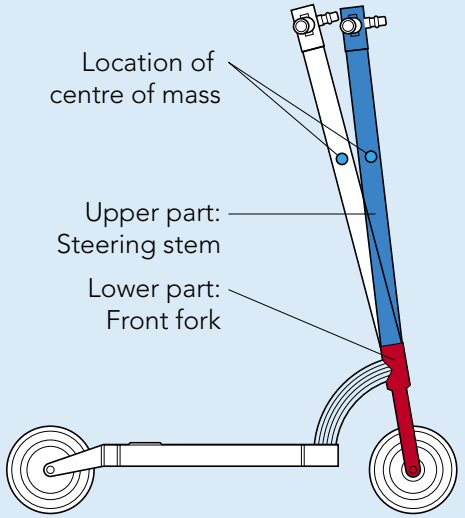


Illustration of scooter showing the benefit of design changes

[i] Paudel, M. An investigation into the design for rideability of small wheel single-track bicycles and e-scooters. Doctoral thesis, Nanyang Technological University, Singapore, 2019

Further experiments and computer-simulation models are being carried out to assess e-scooters in terms of stability, handling, braking performance, and obstacle interaction. Results are yet to be published.

Summary

e-scooters have been tested for ride stability and, in the event of a collision, on the impact on the rider and other road users

- e-scooter stability over surface irregularities and potholes is improved with a larger wheel size;
- in a collision with a pedestrian when travelling at 15.5mph (20km/h), both the e-scooter rider and pedestrian are likely to suffer severe injuries, and the pedestrian injuries are more likely to be fatal;
- e-scooter riders impact their heads with a similar force to pedal cyclists but there is a higher likelihood of facial injury compared to pedal cyclists, and
- acceleration and deceleration reduce the stability of an e-scooter. Increased awareness by a rider of their need to manually stabilise an e-scooter may reduce the likelihood of falling. Modifications to the steering assembly could improve self-stability. However, for these test and modelling conditions, e-scooters are inherently less stable than bicycles in many circumstances: when accelerating, braking and negotiating uneven road surfaces.

9 Conclusions

e-scooters present a new means of mobility. In the UK, private e-scooters are selling in large numbers despite being illegal to use in public places. Riders of both private and rental e-scooters are vulnerable road users. There are also concerns over the risks to pedestrians from inappropriate use of e-scooters.

In many European countries e-scooter use has been widespread for longer than the UK. With a growing maturity in the recording of and understanding of casualties, both of numbers and types of injury, Governments are now tightening e-scooter regulations. Lower speed limits, minimum age for riders and mandatory helmet wearing are increasingly common.

PACTS is clear that rental e-scooters and their use are different in a number of significant respects from private e-scooters and private use. This will remain so. It will not be feasible to impose the sophisticated safety devices and management systems, employed in the better rental schemes, on private e-scooters and users.

Casualties involving e-scooters are rising, with 15 deaths since 2019, 11 in 2021. All were riders of private e-scooters. Despite limited means for recording casualties, PACTS has collated data for 2021. Almost 900 casualties involving an e-scooter have been recorded. Hospital emergency departments and major trauma centres are treating seriously injured patients, many with head injuries. More research and data will be needed to understand the numbers, types and mechanisms of injuries occurring and improve understanding of head and face injury mechanisms. There is significant underreporting of collisions, in particular off-road incidents and those involving pedestrians. Organisations representing pedestrians, visually impaired people and other vulnerable groups are particularly concerned for their safety on pavements. The pedestrian experience needs to be monitored and increased opportunities given for reporting of collisions. Education and enforcement is also needed.

Research into the stability of e-scooters using crash-testing and computational modelling confirms that riders are prone to fall and impact their heads. These falls are likely due to the design of the e-scooter which influences its stability especially when negotiating changes in the road surface and when braking. From test and modelling conditions, e-scooters have been

found to be inherently less stable than bicycles in many circumstances: when accelerating, braking and negotiating uneven road surfaces.

In comparison with casualties involving cars, the numbers of those injured in collisions involving an e-scooter, are far fewer. Comparison with another similarly sized mode of transport is more appropriate, and the pedal cycle is the most used example. It is not possible, across the UK, to accurately estimate rates of injuries for private e-scooter riders per kilometre travelled as their extent of use is currently unclear. Where data is available, the rate of collisions resulting in injury has been found to be up to ten times higher for e-scooter riders than for cyclists. If these collision rates prove accurate in the UK, they will be more akin to those for motorcyclists. e-scooter journeys are more likely to replace those previously made on foot or by public transport. Both these modes are established safe modes of transport.[106] This suggests that the casualties are additional, rather than replacing casualties on other modes.

If use of private e-scooters is to be legalised, appropriate regulations for construction and use are essential. PACTS have applied a collected body of evidence to make recommendations, based on safety principles, for such regulations. Our recommendations consider the wholistic use of private e-scooters, for example, safe vehicle design enforces safe speeds and, as such, enables the rider to wear more readily accessible safety equipment.

The successful implementation of these recommendations as regulations depends on successful education (both to the commercial sector and the public) and enforcement (before point of sale and while in use). Where national and local regulations and traffic codes already exist, there can be an assumption that road users are already familiar with them.

The Government appears to have three basic options:

- To maintain the existing laws and to enforce the ban on illegal e-scooter use;
- To legalise only rental e-scooters;
- To legalise use of rental and private e-scooter use, with appropriate regulations.

[106] Webster E and Davies D, *What kills most of the roads*, PACTS report 2020

Despite previous statements about their intention to legislate, the Government seems currently undecided about how to proceed, or when. It will need to take into account a wide range of factors when considering future legislation. One factor is the significant number of private e-scooters which are already in use in the UK. Assessments of safety and social cost-benefit analysis should be included.

Should e-scooters be legalised, PACTS seek to ensure that safety matters are adequately understood and considered as part of that process.

10 Recommendations

Based on the evidence gathered for this report, PACTS makes the following recommendations to address the safety of private e-scooters. Many of the recommendations might also be appropriate for rental e-scooters, but that should be considered in light of the trial rental scheme evaluation report to be published by the DfT later in 2022.

PACTS recommends the DfT should:

1. **Take immediate action to address dangerous and illegal private e-scooter use and**
   - issue clear information to the public that it is illegal to use a private e-scooter on public roads and in almost all public places in the UK, and that they could incur substantial fines and penalties if caught;
   - take action against retailers which fail to properly inform customers of the risks and illegality involved in the use of private e-scooters, and
   - support the police in taking enforcement action against illegal and unsafe use.

2. **Undertake a thorough public consultation before making any decision on the legalisation of e-scooters. This should include**
   - publishing the data from the evaluation report as soon as possible and before reaching decisions on legalisation;
   - acknowledging that rental schemes and private e-scooter use are significantly different, and
   - holding a thorough public consultation.

3. **Commission further research, including**
   - a review of casualty estimates based on data obtained by PACTS, the NHS and insurance companies as well as the police;
   - an in-depth study of the causes of the fatal and most serious casualty collisions involving e-scooters to date;

- engagement with the Chief Coroner to commission one or more prevention of future deaths reports, and
- requiring the police to record information on helmet wearing by e-scooter riders in casualty reports (STATS19).

4. **If the Government decides to legalise use of private e-scooters, it should adopt regulations for their construction and use as set out below:**
   - Maximum possible speed of 12.5mph (20km/h)
   - Maximum continuous rated motor power of 250 W
   - Anti-tampering mechanisms should be included in construction. Tampering should be prohibited by law
   - Minimum front wheel size of 12 inches (30.5cm) and minimum rear wheel size of 10 inches (25.5cm)
   - Two independently controlled braking devices, one acting on the front wheel and one acting on the rear wheel
   - Lighting to be mandatory at all times
   - Maximum unladen weight of 20kg
   - An audible warning device to be mandatory
   - Helmet wearing to be mandatory
   - Riding on the footway (pavement) or footpath to be prohibited
   - Rider age limit of at least 16 years
   - Carrying of a passenger to be prohibited
   - Drink driving, dangerous or careless riding, and handheld mobile phone use to be prohibited
   - In-person rider training and third party insurance are recommended.

A complete list with technical data is included in Appendix B.

Acknowledgements

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- Essex Police
- Gloucestershire Constabulary
- Greater Manchester Police
- Hampshire Constabulary
- Hertfordshire Constabulary
- Kent Police
- Lancashire Constabulary
- Lincolnshire Police
- Merseyside Police
- Metropolitan Police Service
- Norfolk Constabulary
- Northamptonshire Police
- Northumbria Police
- North Yorkshire Police
- Police Scotland
- South Wales Police
- South Yorkshire Police
- Staffordshire Police
- Suffolk Constabulary
- Surrey Police
- Sussex Police
- Thames Valley Police
- Warwickshire Police
- West Mercia Police
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Appendix A – Rental and private e-scooters compared

	Rental e-scooter	Private e-scooter
Rules & Regulations	Subject to motor vehicle regulations, as modified to permit experimental trials for rental e-scooters only	Subject to motor vehicle regulations (but an e-scooter cannot meet the requirements for legal use of a motor vehicle on the public highway)
	Allowed on public roads	Illegal to use in any public space including roads, cycle lanes, pavements, pedestrianised areas, parks and off-road paths such as bridleways
	May be ridden on cycle lanes	
	Must not be ridden on pavements	
	Exempt from normal type approval, but the trial technical requirements are effectively a form of type approval	Excluded from the scope of whole vehicle type approval and cannot obtain UK single vehicle type approval either
	Exempt from vehicle registration	Vehicle registration is necessary for legal use but cannot be obtained without type approval
	Exempt from vehicle excise duty	Vehicle excise duty cannot be paid for a vehicle which cannot be registered
	Must be insured	Un-insurable without type approval and vehicle registration
	May be geofenced to trial area	No technical controls on place of use
	Owned by licensed operator, hired by rider meeting certain requirements	
Rider Requirements	Rider training recommended	Limited rider training available
	Rider must have a valid driving licence with category Q entitlement	Legal to sell to anyone and no rider requirements stipulated
	Helmet wearing recommended	
	Rider must report injuries incurred to the operator	
	Responsible riding encouraged (irresponsible use can result in penalties including a ban from use of the rental scheme)	If caught, penalties for illegal use include a Fixed Penalty Notice for no insurance, with a £300 fine and six penalty points as well as seizure of the e-scooter

	Rental e-scooter	Private e-scooter
Features	Capped speed at 15.5mph, or less	Some capable of speeds in excess of 50mph
	Robust construction to withstand wear and tear	Should meet General Product Safety, Machinery and EMC product regulations for CE marking (compliance can be self-certified by the manufacturer)
	Dual braking	No standard, some have single foot-operated or electric only brakes
	Must pass rider stability testing	No performance testing required
	Lighting, some have indicators	No requirement for lighting
	Audible warning, some make a continuous noise	No requirement for warning noise to be made
	May include geofencing which controls speed in no-go & go-slow areas	No technical controls on place of use
Monitoring	May have on-board diagnostics	No maintenance testing requirements
	Riders can report defects	
	Rider age recorded at a minimum	No records held at point of purchase,
	Distance and route of each journey recorded	Current traffic-survey devices struggle to detect e-scooters to monitor extent of use
	Helmet wearing may be noted through app	

Appendix B – Technical details supporting the recommendations for construction and use of private e-scooters

PACTS has prepared the following recommendations. These are based on the research into use of private e-scooters that PACTS has undertaken, funded by the Road Safety Trust, with assistance from our project partners.

These recommendations have been prepared to inform the regulations for private e-scooters. Although the DfT evaluations of their rental e-scooter trials may inform safety considerations for private e-scooters, the use and construction of the two types of e-scooter differ too greatly for regulations for rental e-scooters to be duplicated for private e-scooters. For example the systems for managing safety and use for rental scooters are far greater than for private ones.

Safe Speeds

Recommendation	Reasoning	Evidence, precedence and examples
1. Maximum possible speed of 12.5mph (20km/h)	Lower speeds mitigate the likelihood of severe injury to e-scooter riders, pedestrians and other vulnerable road users.	• Over half of the trial schemes rental e-scooters are controlled to operate at these speeds without any obvious lack of demand including 10mph in North Lincolnshire. [107] Other countries limit maximum speeds of e-scooters to 20km/h (12.5mph) and so to 15km/h (9.3mph).[108, 109] • Enforcement for private e-scooters that is reliant on police resources would be difficult to implement. e-scooters, both for rental and private, are not fitted with speedometers as standard. • Speed limits are most able to be enforced when controlled within the e-scooter construction. This means the limit is not reliant solely on driver compliance. • Where e-scooters share space with pedestrians local speed limits of 6mph (10km/h) should be implemented. Enforcement would be reliant on police resources and may be difficult to implement. [110]

[107] Scunthorpe hosts e-scooter trial as Government backs council's green transport revolution - North Lincolnshire Council (northlincs.gov.uk)
[108] Kraftfahrt-Bundesamt - ABE - Small electric vehicles (eKFV) (kba.de)
[109] Cómo circular en patinete eléctrico – How to ride an e-scooter (dgt.es)
[110] Paris e-scooter users face new speed limits (thelocal.fr)

Recommendation	Reasoning	Evidence, precedence and examples
	• The design of e-scooters places the rider at risk of falls and head injury.	• Loss of control when navigating defects or changes in surface level is more likely at higher speeds and results in more severe head injuries.[111] • Surface defects caused half of falls in a study of e-scooter casualties.[112] • Six of the eleven e-scooter rider fatalities in the UK in 2021 have been the result of falls from e-scooters rather than collisions with other motor vehicles.[113] • Tests of a vehicle and e-scooter colliding when each are travelling at 12.5mph (20km/h) or less resulted in the e-scooter rider dummy being thrown at least 3.7m.[114]
	• 12.5mph is higher than the average speed of many pedal cycles in urban areas.	• The average speed for 18-29 year old pedal cyclists has been measured as 11.3mph men and 10.5mph for women.[115]
2. Maximum continuous rated motor power 250W	The maximum motor power affects the e-scooter's possible maximum speed and rate of acceleration as well as the weight which can be carried on the e-scooter. • Limiting power restricts the maximum speed the e-scooter can travel at in normal use. The ability to increase speed through tampering is also limited. • Limited power reduces the likelihood of passengers being carried.	• This maximum continuous rated motor power has been applied in trial schemes and has not obviously impacted demand.[116] • Limiting the power of the e-scooter at construction limits the speed at which the e-scooter can travel.[117] • A power level of 250W aligns with e-bikes (EAPCs). • Findings show that comparing an e-scooter, Segway and a pedal cycle, the e-scooter was the vehicle that could accelerate the fastest.[118] • e-bikes (EAPCs) require rider input to accelerate and therefore the rate of acceleration, especially from a standing start, is restricted.

[111] Posirisuk P, Baker C, Ghajari M, Computational prediction of head-ground impact kinematics in e-scooter falls, Accident Analysis & Prevention, Volume 167, 2022, 106567, ISSN 0001-4575
[112] Coelho Leal A, Feito P, Corominas L, Sánchez-Soler J, Pérez-Prieto D, Martínez-Diaz S, Alier A, Monllau J, *Electric Scooter-Related Injuries: A New Epidemic in Orthopaedics*, 2021/07/25, , Journal of Clinical Medicine
[113] Assessing the safety of private e-scooter use in the UK - PACTS research – PACTS.org.uk
[114] Testing by Dipl.-Ing. Roy Strzeletz, Unfallanalyse Berlin for Dr.-Ing. Matthias Kühn, Unfallforschung der Versicherer, Berlin (Accident Research for Insurers, Germany)
[115] Aldred R, Elliott B, Woodcock J, Goodman A, Cycling provision separated from motor traffic: a systematic review exploring whether stated preferences vary by gender and age, Published online. 14 Jul 2016
[116] Lime rental e-scooters in Milton Keynes and Salford
[117] Bartlett W, Craig V, Electric scooter specifications and test results , American Accident Reconstruction Journal Vol 31, No 1, January/ February 2021
[118] Billstein L, Svernlöv C, Evaluating the Safety and Performance of Electric Micro-Mobility Vehicles Comparing E-bike, E-scooter and Segway, Department of Mechanics and Maritime Sciences Chalmers University of Technology Gothenburg, Sweden 2021, www.chalmers.se

Recommendation	Reasoning	Evidence, precedence and examples
3. Anti-tampering mechanisms should be included in construction **Tampering should be prohibited by law**	Anti-tampering measures and penalties for alterations limit the opportunity to increase the maximum speed and acceleration of the e-scooter • Limits on speed and power have been set to meet safety standards. A means to restrict those limits being exceeded should be implemented.	• Speed limiting using software control alone is not sufficient to prevent tampering. • From their experience enforcing pedal cycles, the DVSA Vehicle Market Surveillance Agency have asked for regulations in legislation to be clear and easy to enforce so that power and speed of e-scooters cannot readily be modified.[119] • Tackling tampering is included in the consultation on Future of Transport regulatory review: modernising vehicle standards.[120] • On road enforcement is made easier when there is a clear violation of regulations. For example, an e-scooter travelling faster than the construction-controlled speed would indicate the e-scooter had been tampered with and justify intervention from the authorities. On road testing of power is not straightforward.

Other considerations in relation to safe speeds

- e-scooters, both hire and private, are not fitted with speedometers as standard. By limiting an e-scooter's maximum speed at construction speed limit compliance is self-enforcing. Effective use of local speed limits, for example within pedestrianised areas, would require speedometers to be fitted as standard.
- It is recognised that limiting the power of an e-scooter will restrict its speed when moving up an inclined surface. However, a similar reduction in speed is experienced by pedal cyclists and mopeds which are also power limited. The benefit of enforcing regulations at point of purchase through capping the power in construction is considered greater value for the safety of the rider and other road users.

[119] As advised by Market Surveillance Unit, October 2021
[120] Future of transport regulatory review: modernising vehicle standards - GOV.UK (www.gov.uk)

Safe Vehicle Design

Recommendation	Reasoning	Evidence, precedence and examples
4 Minimum front wheel size of 12 inches (30.5cm) and minimum rear wheel size of 10 inches (25.5cm)	Larger wheels make e-scooters more able to withstand surface defects therefore increasing stability and control. • Riders are at risk of falling due to instability.	• Regulations should increase the inherent stability of the e-scooter to minimise falls, especially when e-scooters are used amidst other road traffic.[121] • Testing of e-scooters with different wheel sizes over a 50mm pothole shows increased stability with increased wheel size.[122] Excluding risk-based assessments.[123, 124] 50mm is the deepest actionable defect size for potholes in Great Britain.[125] • Tests have shown small-wheeled e-scooters are not only unstable but also incur damage when traversing surface defects.[126]
5. Two independently controlled braking devices, one acting on the front wheel and one acting on the rear wheel	More than one independent means of braking increases the effectiveness of stopping as well as stability when stopping. • Electric braking must be supplemented by a mechanically operated brake in case of electrical failure.	• Dual braking is comparable to the requirement for mopeds.[127] • e-scooters have found to be unstable when decelerating.[128] • Braking distance is impacted by a number of factors including weather conditions.[129] • Braking distance is impacted by rider weight and their position on the vehicle. Without establishing a nominal riding position, the potential braking distance of the scooter is a variable parameter.[130] • Minimum standards for rental e-scooters are such that each vehicle should be fitted with two independent braking systems, each of which is capable of bringing the vehicle safely to a halt.[131] • The stopping distance should be comparable to those set for e-scooters within the trial rental schemes.[132] • Speed control can be further improved with a motor brake for regulating downhill speed automatically. This has already been incorporated into some rental e-scooters.

[121] Routt A, AAE, MIMI, *Electric Scooters – A Technical Case Study of their Suitability on Roads*, Metropolitan Police Service, 2020
[122] Posirisuk P, Baker C, Ghajari M, *Computational prediction of head-ground impact kinematics in e-scooter falls*, Accident Analysis & Prevention, Volume 167, 2022, 106567, ISSN 0001-4575
[123] Confidential report by TRL for commercial client
[124] Adult Scooter Safety – Pothole Test Results! | Swifty Scooters, swiftyscooters.com and as advised by S.H.A.D.O Works Partnership
[125] What_is_a_pothole_final_Makwana_December_2018.pdf, racfoundation.org
[126] Testing by Dipl.-Ing. Roy Strzeletz, Unfallanalyse Berlin for Dr.-Ing. Matthias Kühn, Unfallforschung der Versicherer, Berlin (Accident Research for Insurers, Germany)
[127] Motorcycle Single Vehicle Approval (MSVA): inspection manual (publishing.service.gov.uk)
[128] Paudel, M & Yap, F F, *Front steering design guidelines formulation for e-scooters considering the influence of sitting and standing riders on self-stability and safety performance*. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 235. 2021
[129] Typical stopping distances (publishing.service.gov.uk)
[130] Wishard J, *Micro-Mobility Vehicle Dynamics and Rider Kinematics during Electric Scooter Riding, Arizona* State University, Conference Paper · April 2020
[131] E-scooter trials: guidance for local authorities and rental operators - GOV.UK (www.gov.uk)
[132] E-scooter trials: guidance for local authorities and rental operators - GOV.UK (www.gov.uk)

Recommendation	Reasoning	Evidence, precedence and examples
6. Lighting to be mandatory at all times	e-scooters are small vehicles that can travel and manoeuvre quickly in traffic. Front and rear lights increase the visibility of the rider in all conditions. • Both front and rear lights should be placed as high on the e-scooter as is practical.	• As e-scooters are electrically powered, illumination at all times through integrated lights is not problematic. Many models do so already. • An increased visual presence is needed for e-scooter riders as vehicle detection systems fail to reliably recognise e-scooter riders, especially at speeds over 6mph(10km/h).[133, 134] • Indicating, by removing one hand from the handlebars, is particularly difficult when using the hand which controls power to the e-scooter. Integrated indicator lights should therefore be considered. These have been constructed into some of the trial rental e-scooters.[135]
7. Maximum unladen weight of 20kg	The weight of the e-scooter is a fundamental part of the risk which it poses to pedestrians and other vulnerable road users. • Lower vehicle weight reduces the momentum and kinetic energy of the e-scooter when ridden.	• The mass of a vehicle has a direct effect on the amount of momentum and kinetic energy it carries and thus has to dissipate in a collision. A heavier machine will always inherently be more dangerous than a lighter one.[136] • The average weight of private e-scooters available to purchase in September 2021 was under 20kg. • Higher weight enables larger vehicles which means there is potential capacity for riders to carry passengers, thereby increasing the overall mass much further. • The Health and Safety Executive provides guidance for manual handling, which is applicable to portable private e-scooters. 20kg is within the lifting capacity for men such that the risk of injury is considered low.[137]
8. An audible warning device to be mandatory	The ability of an e-scooter rider to make their presence known increases awareness for other road users.	• As e-scooters are electrically powered a buzzer could be integrated into the e-scooter's construction. • Minimum standards for rental e-scooters require each vehicle to be fitted with a bell or horn suitable for giving audible warning of the approach or position of the vehicle.[138] • Blind and partially sighted people are particularly at risk of collisions with e-scooters which move at a faster speed than walking space, are almost silent and have low visibility. Acoustic Vehicle Alert Systems (AVAS) should be considered. This has been required, since 1 July 2019, for new electric vehicles when travelling at less than 15.5mph (25km/h).[139]

[133] Holmes A and di Cugno D, Reviewed by: Grover C, Young A and Brookes D, *Assessing e-scooter risk to motor insurers*, Thatcham Report July 2021
[134] Emergency brake assistants in the test: More protection for the unprotected? | KFV - Board of Trustees for Road Safety (www.kfv.at)
[135] Included in some operators' rental e-scooters.
[136] As advised by TRL 20210705
[137] Manual handling at work, A brief guide, 01/20 INDG143(rev4)
[138] E-scooter trials: guidance for local authorities and rental operators - GOV.UK (www.gov.uk), accessed February 2022
[139] Regulation (EU) No 540/2014 of the European Parliament and of the Council Annex VIII

Other considerations in relation to safe vehicle design

- The maximum front and rear wheel size is advisory and further research is needed to determine a safe wheel size. This research should also include the impact of grounding due to the small clearance below the e-scooter's running board/load platform.
- Further research is needed into the optimal location for lighting noting that the current regulations for pedal cycles require lights to be fitted at least 350mm above the ground. Projection lighting onto the back of the e-scooter rider could be used.
- Some research indicates that seated e-scooters are more stable that standing e-scooters.[140] Further research should be carried out.
- There is evidence that the width of the running board/load platform impacts manoeuvrability of the e-scooter as well as comfort for the rider. Wider running boards decrease manoeuvrability, therefore decreasing the likelihood the e-scooter is used to make unexpected moves at higher speeds around obstacles. Tests show that riders prefer to have sufficient space on the running board/load platform to place both feet adjacent to each other rather than placing one behind the other. This research supports a recommendation for a minimum board size. Further research is needed into optimal dimensions.[141]
- The texture of the running board/load platform should be considered to improve stability. A uniform rough texture across the surface of the running board/load platform increases grip, and therefore stability, especially when in conjunction with high-grip footwear.
- There have been reported cases of battery fires occurring in e-scooters. Testing of e-scooters to assess product safety has identified that e-scooter riders should be made aware of the possible risk of fire or explosion while their e-scooter is charging. Safety regulations should be considered for the transportation of e-scooters on public transport, such as those the International Air Transport Association has drawn up.[142, 143, 144]
- Indicating, by removing one hand from the handlebars, while riding an e-scooter increases instability. Integrated indicator lights should therefore be considered. These have been constructed into some of the trial rental e-scooters.[145]

[140] Paudel, M & Yap, F F, *Front steering design guidelines formulation for e-scooters considering the influence of sitting and standing riders on self-stability and safety performance*. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 235. 2021
[141] Wishard J, *Micro-Mobility Vehicle Dynamics and Rider Kinematics during Electric Scooter Riding, Arizona* State University, Conference Paper · April 2020
[142] E-scooters: Fire on Tube prompts call for London transport ban - BBC News, bbc.co.uk
[143] 2022 Lithium Battery Guidance Document, IAIA, revised 19 Nov 2021
[144] CASP 2019, Coordinated Activities on the Safety of Products, Final Report, Personal transporters, European Commission 2020.
[145] Included in latest versions of TIER and Voi rental e-scooters.

- The angle of the steering column relative to the running board/load platform has an impact on the mechanism by which e-scooter riders fall. Evidence suggests that the nearer the angle is to 90 degrees, the more likely the rider is to fall over the handlebars. Smaller angles reduce this likelihood.[146] More research is needed to determine the magnitude of this impact.
- Unlike hire e-scooters, the stem (holding the handlebars) on a private e-scooter can be folded. This brings an inherent weakness into the construction of the e-scooter. The potential for this point to fail in a collision should be investigated, especially when investigating e-scooter rider fatalities in the UK.
- Vehicle detection systems should be improved to detect all forms of micro-mobility, especially e-scooters.
- PACTS recommends that riders should wear light-coloured or fluorescent clothing in daylight and poor light, and reflective clothing and/or accessories in the dark. Light coloured and reflective clothing increases rider visibility especially when in the dark or when lighting levels are low. The Highway Code advises pedestrians, cyclists and motorcyclists to wear light-coloured or fluorescent clothing to help other road users to see them in daylight and poor light.[147]

[146] Paudel, M & Yap, F F, *Front steering design guidelines formulation for e-scooters considering the influence of sitting and standing riders on self-stability and safety performance*. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 235. 2021

[147] Rules for motorcyclists (83 to 88) - The Highway Code - Guidance - GOV.UK (www.gov.uk)

Safe Rider Behaviour

Recommendation	Reasoning	Evidence, precedence and examples
9. Helmet wearing to be mandatory	The nature of riders' falls from e-scooters is such that they are more likely to impact their head.	• The rate of serious head injury is higher than that for pedal cyclists.[148] • Studies have found that for riders suffering head injuries, many involved traumatic brain injuries. Many of these injuries could have been prevented or lessened had a suitable helmet been worn (the studies have found very few riders wore safety helmets)[149, 150, 151, 152, 153, 154] • Computational modelling has shown the mechanism of an e-scooter rider when falling and the prevalence of head injuries.[155] • The nature of head injuries are more similar to motorcycle injuries than cycle injuries.[156] • Crash tests with dummies indicate that e-scooter riders fall forwards, over the handlebars when involved in a collision, an impact with a surface defect or when becoming unstable while accelerating or braking.[157, 158, 159, 160] • Further research is needed of helmet design for e-scooter riderse-scooter riders suffer more facial injuries than pedal cyclists.[161] • Helmets which are compliant with BS EN 1078, the standard for pedal cyclists and for users of skateboards and roller skates, are tested to a maximum of 5.42 m/s, about 12.5mph (20 km/h).[162] These do not provide protection of the face.

[148] Meyer, HL., Kauther, M.D., Polan, C. et al. *E-scooter, e-bike and bicycle injuries in the same period – a prospective comparative study of a Level 1 trauma center*. Trauma surgeon (2022)
[149] Mair, O., Wurm, M., Müller, M. et al. *E-scooter accidents and their consequences*. Trauma surgeon 124, 382–390 (2021)
[150] Uluk D, Lindner T, Dahne M, et al, *E-scooter incidents in Berlin: an evaluation of risk factors and injury patterns* Emergency Medicine Journal Published Online First: 07 June 2021
[151] Moftakhar, T., Wanzel, M., Vojcsik, A. et al. *Incidence and severity of electric scooter related injuries after introduction of an urban rental programme in Vienna: a retrospective multicentre study*. Arch Orthop Trauma Surg 141, 1207–1213, 2021.
[152] Coelho A, Feito P, Corominas L, Sánchez-Soler JF, Pérez-Prieto D, Martínez-Diaz S, Alier A and Carles Monllau J, Electric Scooter-Related Injuries: A New Epidemic in Orthopedics July 2021
[153] Meyer, HL., Kauther, M.D., Polan, C. et al. *E-scooter, e-bike and bicycle injuries in the same period – a prospective comparative study of a Level 1 trauma center.* Trauma surgeon (2022)
[154] As advised by North Bristol NHS Trust (19% of e-scooter casualties over a four week long observational study sustained a head injury)
[155] Posirisuk P, Baker C, Ghajari M, *Computational prediction of head-ground impact kinematics in e-scooter falls*, Accident Analysis & Prevention, Volume 167, 2022, 106567, ISSN 0001-4575
[156] As advised by Chris Uff Consultant Neurosurgeon Clinical Lead for Neurosurgery and Molly Hilling, Clinical Nurse Specialist for Neurotrauma at Royal London Hospital
[157] Fisher, J, Exponent, (2) Post | Feed | LinkedIn
[158] Baloise crash test highlights consequences of accidents involving electric scooters and bikes, www.baloise.com
[159] RCAR - Scooter testing, www.rcar.org
[160] Testing by UTAC Millbrook for Tin Man Communications on behalf of Guide Dogs UK
[161] Posirisuk P, Baker C, Ghajari M, *Computational prediction of head-ground impact kinematics in e-scooter falls*, Accident Analysis & Prevention, Volume 167, 2022, 106567, ISSN 0001-4575
[162] BS EN 1078:2012+A1:2021, Helmets for pedal cyclists and for users of skateboards and roller skates

Recommendation	Reasoning	Evidence, precedence and examples
10. Riding on the footway (pavement) or footpath to be prohibited	Aligns with the Law and Highway Code.	• Pedestrians, especially the elderly and those who are visually impaired, are at risk of harm from vehicles which are using the same space. • Trial rental e-scooters are not permitted to be used on the pavement.[163]
11. Rider age limit of at least 16 years	An e-scooter rider must be competent to use the e-scooter and understand the rules governing other road vehicles.	• Aligns with the minimum age for obtaining a provisional driving licence for learning to rider a moped.[164] • Aligns with recommendations from other groups promoting use of private e-scooters and other e-micromobility.[165]
12. Carrying of a passenger to be prohibited	The weight of the e-scooter is a fundamental part of the risk which the e-scooter creates. • Higher vehicle weight increases the kinetic energy of the e-scooter when ridden increasing risk of injury to other road users and causing braking to be less effective.	• e-scooters are designed, on average, for a maximum carrying capacity of 100kg.[166] Studies have found that adult e-scooter riders suffer abdominal injuries as a result of shock from the handlebars It could therefore be implied that child passengers, standing in front of the rider, are at additional risk of head injury from impact with the stem and handlebars.[167]

[163] E-scooter trials: guidance for users - GOV.UK (www.gov.uk)
[164] Riding a motorcycle, moped or motor tricycle: Bike categories, ages and licence requirements - GOV.UK (www.gov.uk)
[165] Policy Recommendations for Rideables
[166] From a survey of e-scooters available at a UK retailer
[167] Electric scooters: helmets are of vital importance, press release from VIAS institute (Belgian Road Safety Research Institute), 28 May 2020

Recommendation	Reasoning	Evidence, precedence and examples
13. Riding when under the influence of drink or drugs, including medicine, to be prohibited	e-scooter riders are prone to falls especially if riding under the influence of drink or drugs.	• Aligns with legislation (Section 4 of The Road Traffic Act) and the Highway Code rules for drivers.[168] • As e-scooters are balance based, the alcohol limit which renders a rider unfit to ride will be lower than that for a driver of a motor vehicle. • Evidence, including studies from abroad, show that over 25% of e-scooter riders who are treated in emergency departments are intoxicated.[169, 170, 171]
Dangerous or careless riding to be an offence	e-scooter users are vulnerable to injury from other motor vehicles as well as causing injury to other road users.	• Aligns with legislation (The Road Traffic Act) and the Highway Code rules for other vehicle users, including for drivers. • 20% of casualties from collisions involving e-scooters in 2020 and in the first part of 2021, as reported in national statistics, were not e-scooter riders.[172]
Use of a handheld mobile phone to be prohibited	Aligns with rules for drivers.	• Riders should be in full control of their e-scooter at all times.[173] • The safety, particular when turning, has been assessed as severely limited by one-handed driving.[174]

[168] Road Traffic Act 1988 (legislation.gov.uk)
[169] As advised by Royal Hospital London major trauma unit (where 6 out of 9 patients treated in 2021 have been intoxicated)
[170] As advised by North Bristol NHS Trust (28% of e-scooter casualties over a four week long observational study were intoxicated)
[171] Blomberg SNF, Rosenkrantz OCM, Lippert F, et al. *Injury from electric scooters in Copenhagen: a retrospective cohort study*. BMJ Open 2019;9:e033988.
[172] Reported road casualties Great Britain: e-Scooter factsheet 2020, www.gov.uk, Reported road casualties Great Britain: e-Scooter factsheet year ending June 2021, www.gov.uk
[173] General rules, techniques and advice for all drivers and riders (103 to 158) - The Highway Code - Guidance - GOV.UK (www.gov.uk)
[174] Bierbach, M; Adolph, T; Frey, A; Kollmus, B; Bartels, O; Hoffmann, H; Halbach, *A, Study on small electric vehicles,* Federal Highway Research Institute -BASt-, Bergisch Gladbach, Report F 125, November 2018

Recommendation	Reasoning	Evidence, precedence and examples
14. In-person rider training is recommended	An e-scooter rider should be competent to use the e-scooter and understand the rules governing other road vehicles. • e-scooters handle in a different way to pedal cycles, which many people are familiar with. • e-scooters are a vulnerable vehicle, especially when used amidst other road traffic.	• Instantaneous power from the electric motor gives an e-scooter a greater rate of acceleration in comparison to human-power, especially from a standing start. This can lead to lack of control, accentuated in the novice rider.[175] • Participants in a survey felt that the availability of training would make public space safer for vulnerable people and over 75% considered training for riding in traffic was at least somewhat important.[176] • e-scooters must be ridden safely and responsibly. In person riding training which includes instruction to riders on their balance and control is already available. It could be made more widely available.[177, 178] • From a survey, people who neither cycle nor drive as part of their regular journeys, and therefore are less experienced in road traffic, are more likely to use an e-scooter.[179]
Third party insurance for riders is recommended	The purchase of insurance provides a potential means of redress for third parties and increases the sense of responsibility by the rider.	• Uninsured e-scooter riders place a burden of cost on the MIB and other road users.[180] • Insured drivers are more likely to drive more responsibly (they are less likely to use a defective vehicle, abuse substances or drive while disqualified).[181] • Insurance for e-scooters is mandatory in other countries on an annual basis. Demonstration of insurance can be through the use of stickers or plates as is applicable to mopeds and other two wheels motor vehicles.[182, 183] • e-scooter insurance needs to include registration and logging on the insurance database.[184] • Should e-scooters be classified as motor vehicles then, under the existing Road Traffic Act, third party insurance would be mandatory.[185]

[175] As advised by TRL, 20210705
[176] Sherriff G, Blazejewski L, Lomas M, and Larrington-Spencer HM, *E-scooters in Greater Manchester: second interim report*, University of Salford Healthy Active Cities Team, 2022
[177] Rollsafe e-scooter safety training, Rolltech.uk
[178] https://www.bikeworks.org.uk/micromobility-booking/
[179] Sherriff G, Blazejewski L, Lomas M, and Larrington-Spencer HM, *E-scooters in Greater Manchester: second interim report*, University of Salford Healthy Active Cities Team, 2022
[180] As advised by the MIB
[181] Police launch national campaign to protect road users from uninsured drivers (mib.org.uk)
[182] Moped insurance - cheap for mopeds, scooters & Co | ADAC, www.adac.de
[183] Electric scooter insurance, Assurance trottinette électrique et NVEI > Devis gratuit - Lecomparateurassurance
[184] Road Traffic Act 1988 (legislation.gov.uk). Section 143-156
[185] Road Traffic Act 1988 (legislation.gov.uk), Section 143 and Road Traffic Act 1988 (legislation.gov.uk), Section 145

Other considerations in relation to safe rider behaviour

- It may be appropriate to create a new vehicle type under the Type L1e-B or L1e-C categories.
- Further research is needed into the suitable helmet design for e-scooters. There may be implications for the way riders fall, for example over the handlebars, resulting in higher energy impacts and different impact points. Facial injuries are being recorded in e-scooter casualties. More research to understand the mechanisms involved in these injuries is needed.[186, 187]
- It may be possible to utilise telematics, through mobile phones, to track rider behaviour. This could be used to target training or give insurance discounts.
- Infrastructure developments are required to improve the road environment for all vulnerable road users, including e-scooter riders. Surveys have found that the majority of people (75%) felt that "being able to ride on separated lanes for e–scooters" was important.[188]
- Riders should be encourage to inform the police if there is a collision involving an injury. This aligns with rules for drivers as all road 'accidents' resulting in human death, personal injury or property damage occurring on a road or other public place should be notified to the police within 24 hours of an occurrence.[189]

[186] Blomberg SNF, Rosenkrantz OCM, Lippert F, et al. *Injury from electric scooters in Copenhagen: a retrospective cohort study*. BMJ Open 2019
[187] Alwani, M., Jones, A. J., Sandelski, M., Bandali, E., Lancaster, B., Sim, M. W. et al. (2020). *Facing Facts: Facial Injuries from Stand-up Electric Scooters*.
[188] Sherriff G, Blazejewski L, Lomas M, and Larrington-Spencer HM, *E-scooters in Greater Manchester: second interim report*, University of Salford Healthy Active Cities Team, 2022
[189] Road Traffic Act 1988 (legislation.gov.uk) Section 170

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