UNIVERSITY OF TWENTE.

Safer Micromobility

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Key Messages

1 Micromobility is becoming safer

But, an increase in severe injuries from e-scooter crashes is cause for concern. Overall, shared e-scooter crash risk is decreasing as their usage is increasing faster than injuries.

2 Safe infrastructure and vehicle design matter

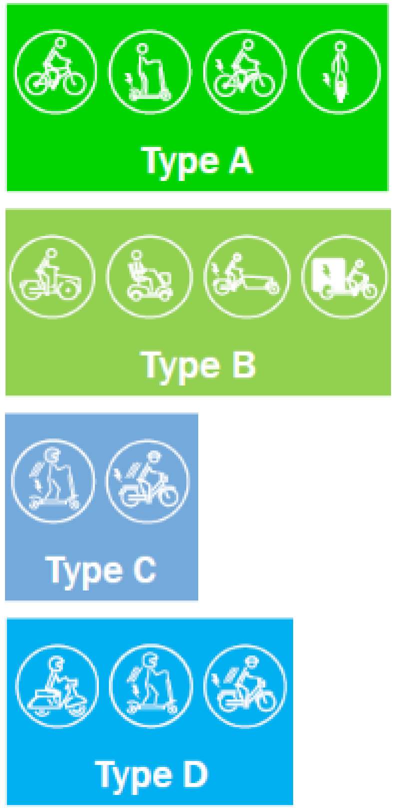
A focus on rider behaviour and safety equipment must be complemented by better infrastructure and improved vehicle design – especially for e-scooters.

3 Reinforcing existing policies improves safety

Road safety measures also make micromobility safer – managing speed, providing training to road users and enforcing rules against impaired driving and riding.

What is Micromobility?

- This report adopts the **ITF's generic approach** to classifying micromobility from a safety perspective – an approach which is descriptive rather than normative.
- This report focuses on **e-scooters and e-bikes weighing less than ~35 kg**, including models that can travel up to 45 km/h or beyond.



Type A: powered or unpowered vehicles weighing less than 35 kg and with a maximum powered design speed of 25 km/h.

Type B: powered or unpowered vehicles weighing between 35 kg and 350 kg and with a maximum powered design speed of 25 km/h.

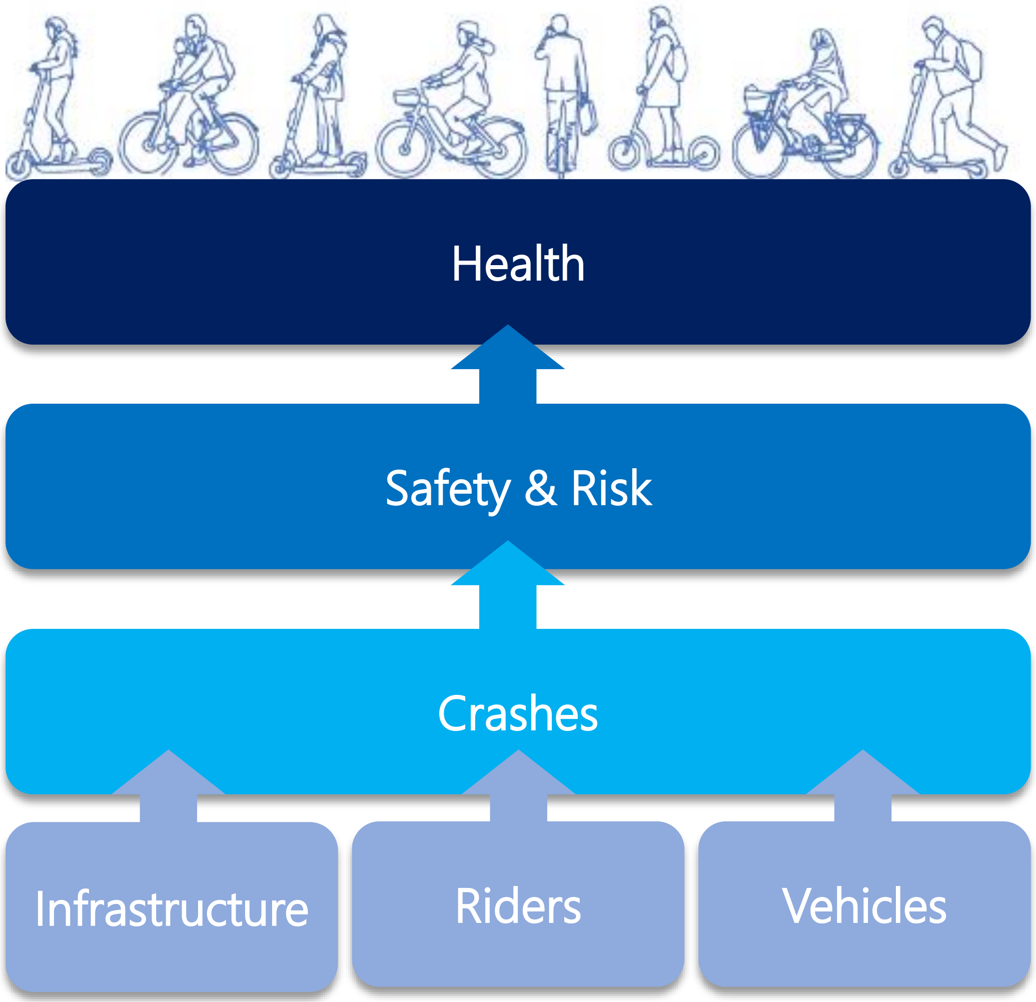
Type C: powered vehicles weighing less than 35 kg and with a design speed between 25 km/h and 45 km/h.

Type D: powered vehicles weighing between 35 kg and 350 kg and with a design speed between 25 km/h and 45 km/h.

Micromobility Safety

How to assess micromobility safety?

- Micromobility safety must be addressed in the **broader context of health** since poor safety results in degraded health outcomes.
- **Crash risk** addresses the probability of harm faced by micromobility users.
- **Crashes and injuries** are relevant harms.
  - Investigation of their **occurrence and nature**.
  - Investigation of the factors contributing to the number and severity of crashes – notably **vehicles, riders and infrastructure**.



Methodology

- This report focuses on the safety impact of MM devices and specifically on **e-scooters and e-bikes**
- Both shared and owned e-scooters and e-bikes are considered and throughout the analysis there is an **effort to differentiate between them**
- To investigate key MM safety trends and risks an **extensive review** of the scientific and “grey” literature was conducted.
  - Findings at the **international level** were summarized and synthesized
  - **95 relevant studies** were identified and considered appropriate for this review
  - Most of e-scooter studies is based on the **2018-2020 data**
  - Resources on e-bikes are dated from **2007 to 2022**
- A **questionnaire** was crafted and completed by a select group of 5 MM Operators, arranged in alphabetical order:

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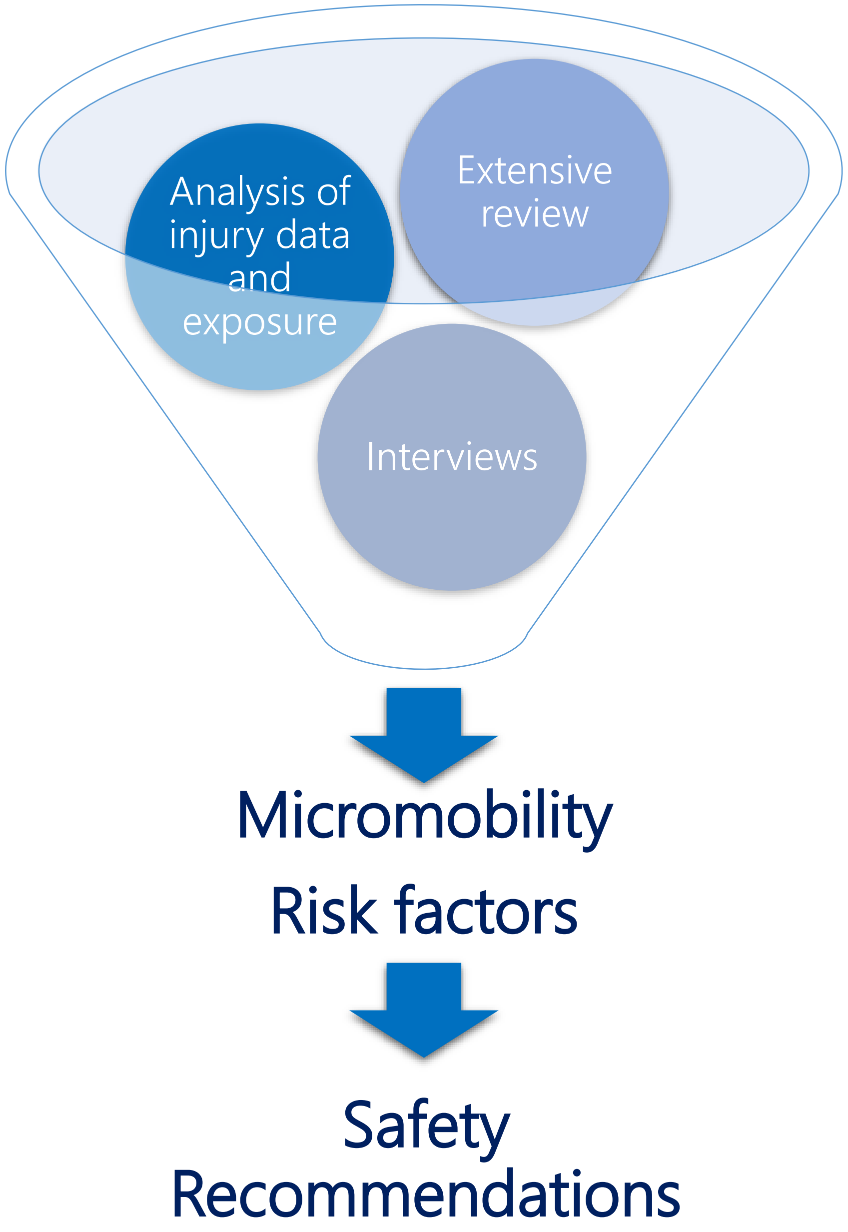
  - to gather comprehensive insights into the **safety aspects** encompassing both the physical features and the digital facets of MM vehicles
  - to identify **challenges and lessons-learned**

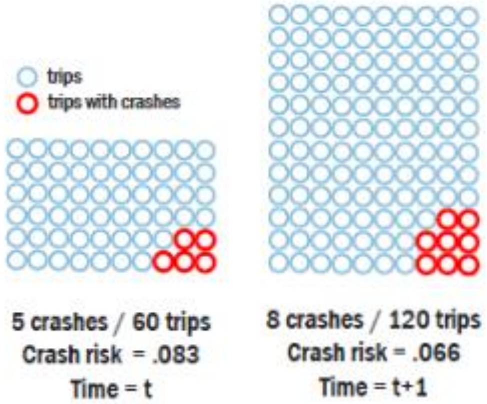


Safety and Health

- Policy must balance the **positive health contributions** of active modes vs the adverse health outcomes of all micromobility when assessing safety, physical accessibility and other policies.
- Active travel's positive contribution to good health is **far greater** than the negative health impacts of crashes and rider exposure to air pollution.
- From a health perspective, **active and passive forms** of micromobility are not on the same footing.
- While cycling involves physical activity, e-scooters require less effort, but both are linked to **active lifestyles**.
- A **key factor** to consider when looking at micromobility-linked health outcomes is how non-active micromobility replaces walking and cycling vs highly sedentary car travel.

Micromobility Crash Risk

- Crash risk recognizes **that safety is not solely determined by the number of incidents** but is also influenced by how much individuals are exposed to potential risks.
- **Risk may diminish even with a rise in absolute crash numbers**, emphasizing the complex interplay between exposure and road safety outcomes.



- **Lack of data** on micromobility trips and crashes makes it hard to assess micromobility crash risk.
  - Official crash statistics suffer from **underreporting**, showing only part of the crash risk.
  - **Reliable exposure data** – especially for privately owned micromobility trips – is rarely available.

Shared Micromobility Casualty Risk

- In 2022, shared e-scooter casualties requiring medical treatment per Mio trips fell **by 26% across EU** compared to 2021.
- Comparisons of e-scooter crash risk versus the crash risk of other forms of micromobility are **sparse.**
- Micromobility operators report e-scooter risk levels 32% lower than **e-bike risk** within their fleets across nine European countries.
- In contrast, other studies indicate that e-scooter risk levels are up to **four times higher** for e-scooters than for bicycles.
- **Multiple factors** may explain these differences, including different types of vehicles, use patterns and contexts.
- **Robust cross-micromobility** crash risk assessments are needed to better guide policy.

Shared e-scooter casualties requiring medical treatment per Mio trips

Market	2021	2022	YoY
Austria	4.1	1.5	-63.6%
Belgium	7.1	7	-1.8%
Bulgaria	NA	NA	NA
Cyprus	NA	NA	NA
Czech Rep	9.2	15.6	69.3%
Denmark	8.6	14.8	72.3%
Finland	5	2.9	-41.6%
France	9	12.1	34.8%
Germany	4.3	4	-7.7%
Greece	NA	NA	NA
Italy	12.1	4.4	-63.3%
Norway	3.2	2.7	-17.5%
Poland	4.9	4.5	-8.0%
Portugal	22.3	25	12.0%
Slovenia	NA	NA	NA
Spain	22.4	14.8	-34.1%
Sweden	5.2	5.3	0.5%
Switzerland	2.2	4.4	100.3%
UK	31.9	20.6	-35.5%
		Cumulative	-25.7%

Source: MMfE

Micromobility Crashes

- Most reported micromobility crashes result in only **minor injuries**.
- **Severe injuries** comprise a small portion of total reported injuries, and a relatively small percentage of reported micromobility crashes lead to fatal injuries.
- **Fatality rates** are very low for all injury-inducing crashes (<1%), with no clear difference between e-scooters, e-bikes and conventional bikes.

Injuries		Vehicle Type	%
Severity	No injury (% of riders)	es	6-9%
	Minor injury (% of casualties)	es	56-70%
		eb	65-70%
	Severe injury (% of casualties)	es	8-13%
		eb	5-17%
	Fatality (% of casualties)	es	<1%
		eb	<1.3%
		cb	<0.2%

es = electric scooter, eb = electric bike, cb = conventional bike
Casualties: injuries and fatalities.
All sources are detailed in the accompanying technical report.

Micromobility Injury Patterns

- E-scooter injuries are characterised by injuries concentrating in the **head and face**, particularly the lower third (chin and jaw).
- **Upper and lower extremities** injuries are also common among e-scooter crashes.
- E-scooterists presented with a greater share of head, face, and neck injuries **than cyclists**.

Injuries		Vehicle Type	%
Injured Body Region (% of casualties)	Upper extremity	es	25-55%
	Lower extremity	es	23-45%
	Head/ Face	es	Head: 18-41% Face: 30-60%
		cb	Head: 20-24% Face: 20%
		eb	Head: 35%

es = electric scooter, eb = electric bike, cb = conventional bike

Casualties: injuries and fatalities.

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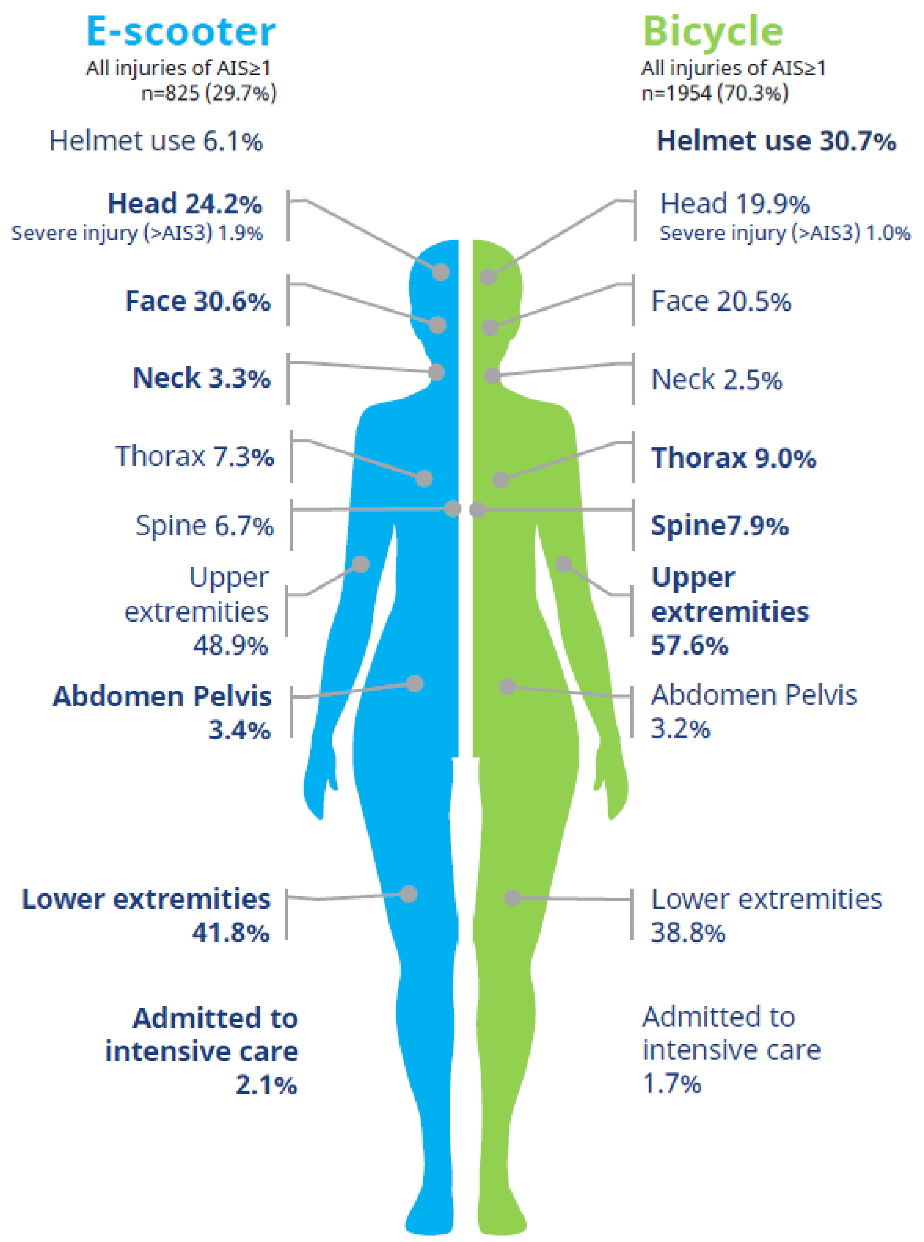


Adapted from Benhamed et al., 2022

Micromobility Crash Types

- Most e-scooter-related crashes **involve the rider and no other road user** accounting for up to 93% of all reported e-scooter-related casualties
- E-scooter-related casualties resulting from **falls** constitute a substantial proportion of overall e-scooter-related casualties (64-85%).
- This range compares with the respective percentage of **cyclist** single road user collision casualties due to falls (75%).
- Injuries resulting from **e-scooter-motor vehicle** collisions account for 8-19% of all e-scooter-related casualties, a slightly higher proportion than for bicycle injuries.
- The **co-existence of pedestrians** and e-scooter riders results in pedestrian injuries (1 to 10% of all e-scooter-related casualties).

Collisions		Vehicle type	%
Involved road users (% of casualties)	Single road user	es	93%
	Multiple road users	es	7%
Falls	% of total crashes	es	79-90%
	% of total casualties	es	64-85%
		cb	75%
With objects	% of total casualties	es	1-39%
With motor vehicles	% of total casualties	es	8-19%
		cb	10%
	% of total fatalities	es	>86% (24% hit-and-run)
		cb	93-96%
With pedestrians	Involved pedestrians (% of total crashes)	es	4-17%
	Injured pedestrians (% of total casualties)	es	1-10%
	tripped over (of non-rider casualties)	es	30%
	Struck (of non-rider casualties)	es	59%

es=electric scooter, eb=electric bike, cb=conventional bike

Casualties: persons injured and fatalities.

All sources are detailed in the accompanying technical report.

Micromobility Crash Factors: Infrastructure

- Safe and convenient **cycling infrastructure** can attract road users to micromobility
- **Poorly maintained surfaces**, with potholes and other irregularities, contribute to 30-40% of e-scooter crashes.
- **Physically separated and continuous** micromobility infrastructure, existing both on segments and intersections, can enhance safety further.
- **Narrow lane widths** can elevate micromobility crash risk due to proximity to stationary and moving motor vehicles.
- Cycling infrastructure and parking infrastructure are important for **pedestrian safety and comfort**
- **Speed management – especially of cars –** helps reduce both crashes and their severity.

Risk factor	Vehicle type	%
Poor road infrastructure (% of tot. crashes)	es	30-40%
Paved vs unpaved road	es	2.66 greater crash risk
Road environment	es	Traffic lane: 23-55% (all)
	es	Sidewalk: 17-58% (all)
	es	Bike lane: 0.04-25% (all)
	es	Intersection: 65% (% of total fatalities)
	cb	Intersection: 67% (% of total fatalities)
	es	Non-junction: 17% (% of total fatalities)
	cb	Non-junction: 17-27% (% of total fatalities)

es = electric scooter, eb = electric bike, cb = conventional bike

All sources are detailed in the accompanying technical report.

Recommendations: Infrastructure

For Authorities

- **Proactively maintain micromobility infrastructure**

  To minimise the risk of micromobility-related crashes caused by potholes, debris etc., authorities should undertake regular maintenance of infrastructure, especially in high micromobility traffic areas.

- **Establish a dedicated and well-connected micromobility network**

  Authorities should develop a comprehensive urban plan that incorporates mixed and protected "light traffic lanes" for all micromobility modes, ensuring connectivity with existing transportation networks.

- **Establish micromobility parking policy and designate parking areas where needed**

  Authorities should formulate consistent micromobility parking guidelines that enhance its use. This includes establishing clearly marked and well-delineated parking zones for e-scooters and bicycles at the curb or on pedestrian or shared zones, mainly in core urban areas.

For Micromobility Operators

- **Establish collaborative partnerships with authorities for infrastructure condition reporting**

  Micromobility operators, armed with valuable data collected through in-vehicle sensors on potholes, falls, and near crashes, should play an active role in the proactive maintenance of urban infrastructure.

- **Onboard parking zones in shared micromobility apps and deploy smart docking in high-traffic areas**

  Shared micromobility apps should onboard designated parking areas and restrictions. Deploying smart docking and charging stations in high pedestrian or vehicular traffic zones can reduce obstruction on sidewalks.

Micromobility Crash Factors: Riders (1/2)

- Behaviour, experience and other rider-related factors **strongly correlate** with micromobility safety

- Rider-related safety factors associated with bicycles **differ from those of e-scooters**, especially concerning nighttime riding, alcohol consumption and helmet use.

- E-scooter riders are **mostly younger males**.

- Evidence indicates that **male and female e-scooter riders** display similar injury and crash probabilities.

Micromobility Crash Factors:
Riders (2/2)

- **RUI:** Injured e-scooterists show **higher alcohol use** compared to conventional bike riders.
- **Helmet use:** In contrast with bicycle riders, injured e-scooter riders display **low levels of helmet-wearing** – even when required by law.
- **Double riding:** Tandem riding contributes to **up to 17%** of all e-scooter related casualties.
- **Visibility:** E-scooter crashes resulting in injuries **predominantly happen** under conditions of low visibility.
- **User experience:** Inexperienced **e-scooter riders** are linked to high crash risk, whether due to a limited number of rides or unfamiliarity with the local context
- **Speeding:** Speeding has been found as a **risk factor for e-scooter** injuries (~30%)

Risk factor	Vehicle type	Effect
Nighttime (% of fatal crashes)	es	82%
	eb	48%
	cb	57%
	es	43%
Nighttime & Reduced lighting (% of casualties)	es	30-44%
	cb	14-28%
	eb	18%
Nighttime crash risk	es	4.8 crashes per 100 000 trips vs 2.2 for daytime crashes
Helmet use (% of casualties)	es	0-3%
	cb	16-64%
	eb	53%
Alcohol	es	Fatalities: 41%
	es	Casualties: 7-53%
	cb	Casualties: 6-13%
Double riding (% of casualties)	es	14-17%: >one rider/ vehicle
Experience	es	24-37% of injuries occurred during the 1st ride
	es	78% of crashes involved riders with low riding rates

es = electric scooter, eb = electric bike, cb = conventional bike

Casualties: persons injured and fatalities

All sources are detailed in the accompanying technical report.

Recommendations:
Riders

For Authorities

- **Implement a 30km/h (or lower) speed limit in areas with high micromobility use**

  Authorities should default to 30 km/h (or 20 km/h) speed limits for car and truck traffic in areas with high micromobility traffic.

- **Establish low-speed limits for micromobility vehicles in pedestrian or shared zones**

  In areas where micromobility riders legally can or must share pedestrian spaces, authorities should default to establishing a safe (~6-10 km/h) speed limit for micromobility modes to enhance pedestrian safety.

- **Promote the use of appropriate helmets**

  Authorities should encourage helmet use for private and shared micromobility in a way that does not discourage using active micromobility, which would diminish overall health benefits.

- **Take enforcement action against risky micromobility riding**

  Authorities should impose penalties for illegal micromobility riding, including:
  - speeding for micromobility vehicles in speed-restricted zones,
  - riding under the influence of drugs and alcohol,
  - riding under the age limit,
  - riding with two or more people,
  - riding on sidewalks when it is forbidden,
  - riding outside designated infrastructure where its use is obligatory,
  - illegal parking.

- **Introduce rider education in secondary schools**

  Micromobility training should be integrated into the curriculum of secondary schools.

Recommendations: Riders

For Micromobility Operators

- **Provide safety feedback via telematics data**

  Operators can use telematics data on speeding, acceleration/deceleration or distracted riding to provide riders with post-trip feedback. Real-time safety alerts to riders could also be considered where these do not contribute to rider distraction.

- **Provide economic incentives for safe riding**

  Shared micromobility operators may encourage helmet use with economic incentives such as providing free helmets or discounts to encourage safety-conscious ridership.

- **Implement mandatory initial rider training**

  To enhance rider safety, shared micromobility operators can require new riders to pass through safe riding screens for the first few rides they make to help ensure that riders are familiar with local rules and guidelines before embarking on their e-scooter trips.

- **Verify age to start riding**

  Operators should implement age verification procedures to ensure riders meet the minimum age requirements defined in each city, ensuring compliance with local regulations and safety standards.

Micromobility Crash Factors: Vehicles (1/2)

- The **rapid uptake of micromobility** vehicles, specifically e-scooters, brings a range of safety concerns linked to vehicle design.
- E-scooters, e-bikes and conventional bicycles **differ greatly** in their design and stability.
- A key distinction between e-scooters and bicycles lies in the **rider's position**.
- The **standing posture** on e-scooters has been identified as risky, particularly during braking to manoeuvre around or away from obstacles.
- The following **design features of micromobility modes** have been found to positively affect MM safety: max design speed limit of powered micromobility vehicles, larger wheels and tires, and foot platform area for e-scooters brakes, back and front lights, bells.

Micromobility Crash Factors: Vehicles (2/2)

Various e-scooter and bicycle characteristics and safety

E-scooters

Head height
Higher head height and distance to the ground due to standing position may increase head acceleration in crashes

Centre of gravity
Higher and more forward centre of gravity reduces stability and makes the rider more prone to vaulting over the handlebar in forward crashes.

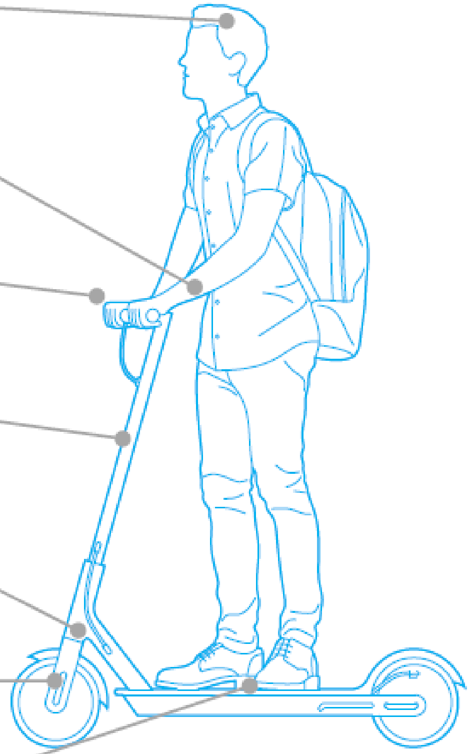
Braking
Single front braking reduces stability and contributes to loss of rear wheel ground contact in emergency braking

Steering column
Steering column serves as a fulcrum, increasing the risk of the rider vaulting over the handlebar in forward crashes if the rider places weight on it

Wheel size
Smaller wheel sizes are more agile but more prone to deflection and stoppage by obstacles. Less gyroscopic stability

Acceleration
Throttle-initiated acceleration can be more sudden

Platform
A narrow or insufficiently large platform reduces rider stability



Newer shared e-scooter models address these design issues with larger wheels, wider tyres, lower and more anterior frame/battery weight distribution, dual front and back braking and wider foot platforms.

Bicycles

E-bikes are generally heavier and operated at higher speeds than traditional bikes, increasing kinetic energy in self-crashes and crashes with pedestrians and other users.

Head height
Lower head height means less free-fall distance and lower acceleration to the ground in a crash

Centre of gravity
Lower and less forward centre of gravity contributes to more stability, better emergency braking and less risk of vaulting over the handlebar in crashes

Braking
Standard dual mechanical or hydraulic brakes and a low centre of gravity provide improved emergency braking

Steering column
Steering column near centre of gravity, high frame attachment point and large wheel size reduce handlebar vaulting risk

Wheel size
Larger wheels prevent deflection, improve obstacle clearing and provide gyroscopic stability, but are less agile

Acceleration
Pedalling-initiated acceleration can be less sudden

Recommendations:
Vehicles & Management

For Authorities

➢ Set universal technical requirements for e-scooter design

Establishing and joining technical standards for e-scooters is essential.
E-scooter standards should account for the following:

- maximum speed (e.g. <20/25 km/h. Vehicles operating at higher speeds would be regulated differently and more stringently)
- maximum power (e.g. <250-500 W. Vehicles with higher power should be regulated differently and more stringently)
- minimum wheel size (the larger, the better)
- foot platform area (e.g. at least 150 cm^2)
- dual, separate and hand-initiated braking systems
- independent front and rear lights
- indicator lights (due to the difficulties of using handsignals)
- reflective markings
- phone attachment feature.

➢ Adopt riding support systems in micromobility vehicles

Authorities should foster the adoption of riding support systems in micromobility vehicles including automatic emergency braking assistance, audible warning devices providing alerts when speeding, detection technology capable of assessing factors like unsteady movement, occupancy detection sensors and alerts when inappropriately parking.

Safe management

➢ Establish and collect data on distinct micromobility categories in safety statistics

Creating distinct categories for each micromobility mode (i.e., conventional bikes, e-bikes, e-scooters, speed e-scooters/e-bikes, monowheels/e-unicycles) in road traffic casualty records, including police records and medical records, improves safety assessment. Additionally, collecting exposure data for each category is essential to calculate casualty risk accurately.

Recommendations:
Vehicles & Management

For Micromobility Operators

- **Ensure systematic maintenance of micromobility fleets**

  Operators should maintain their fleets in good repair and follow state-of-the-art maintenance protocols, emphasizing regular checks and upkeep of essential components, including brakes, lights and batteries.

- **Enable context-dependent maximum speed control using geofencing**

  Shared micromobility operators can employ geofencing technology to smoothly and dynamically lower maximum speeds to designated speed limits in high-risk zones, such as pedestrian areas or during risky hours like nighttime, prioritising safety for all road users.

- **Restrict e-scooter access if tandem riding and/or alcohol use is detected**

  Shared micromobility operators should be encouraged to incorporate in-vehicle sensors to detect tandem riding and introduce in-app tests to identify users under the influence of alcohol and drugs. If violations are detected, e-scooter access can be disabled, ensuring responsible and sober usage.

- **Implement riding support systems in shared e-scooters**

  Operators should be encouraged to implement safe riding support systems in e-scooters, including automatic emergency braking assistance and detection technology capable of assessing factors like unsteady movement, tandem riding and inappropriate parking.

Safe management

- **Enable in-vehicle or in-app crash detection technology**

  Shared micromobility operators can enhance the safety and user experience of their services and address the low micromobility crash data availability by integrating crash detection technology into their vehicles or mobile applications.

Benefits from 30km/h Speed Limit (1/2)

according to international literature

*Setting a speed limit of 30 km/h where people and traffic mix, make streets **safer, healthier, greener and more liveable***

Road crashes reduction

- Reductions in speed limits are intended to improve road safety by **decreasing travelling speed** and thus reducing the risk of crashes occurring and the severity of crashes that do occur
- The risk of death is almost **five times higher** in collisions between a car and a pedestrian at 50 km/h compared to the same type of collisions at 30 km/h

Air pollution reduction

- Streets that promote safe walking and cycling can **reduce car dependency** and harmful vehicle emissions that contribute to climate change
- City-wide 30 km/h speed limit reduce carbon dioxide and nitrous oxide emissions from diesel cars, and particulate matter emission from both diesel and petrol cars, thus **reducing air pollution**

Benefits from 30km/h Speed Limit (2/2)

according to international literature

Fuel consumption reduction

- Lower speeds lead to **lower fuel consumption**
- **Smoother traffic flow** leads to additional fuel economy (eco-driving)

Traffic flow improvement

- **Motor traffic volumes decrease**, since slower speeds encourage active, sustainable and shared travel
- Reducing the speed limit at 30km/h improves traffic flow, **reduces congestion** and improves travel times as there is less stop/start traffic movement

Sustainable improvement

- Calm driving in lower speeds is a mean of **healthier living** for all road users; and especially children and the elderly walk more freely
- Significant increase (in the mid-term) of **pedestrian, cyclists and e-scooter active mobility** and Public Transport passengers

Cities with 30 km/h Speed Limit

A/A	City	Implementation Started
40	Amsterdam	December 2023
39	Wales	September 2023
38	Bologna	July 2023
37	Florence	November 2022
36	Copenhagen	June 2022
35	Lyon	March 2022
34	Den Haag	December 2021
33	Zurich	December 2021
32	Toulouse	November 2021
31	Vienna	September 2021
30	Paris	August 2021
29	Montpellier	August 2021
28	Münster	July 2021
27	Valencia	May 2021
26	Leuven	April 2021
25	Brussels	January 2021
24	Nantes	August 2020
23	Glasgow	January 2020
22	Antwerp	January 2020
21	Barcelona	December 2019

A/A	City	Implementation Started
20	Lille	August 2019
19	Helsinki	May 2019
18	Madrid	September 2018
17	Bilbao	June 2018
16	Strasbourg	February 2017
15	Dublin	January 2017
14	Berlin	January 2017
13	Edinburgh	July 2016
12	London	June 2016
11	Grenoble	January 2016
10	Ljubljana	September 2015
9	Luxembourg	August 2015
8	Ghent	April 2015
7	Bristol	2015
6	Munich	2011
5	Brighton	2010
4	Hove	2010
3	Warrington	July 2005
2	Stockholm	2004
1	Graz	September 1992

30km/h Speed Limit in Cities (1/2)

[Yannis, G., & Michelaraki, E. (2024). Review of City-Wide 30 km/h Speed Limit Benefits in Europe Sustainability, 16(11), 4382]

City-wide 30km/h speed limits led to **average reduction** in: (meta-analyses from 17 cities and 70 studies)

- Fatalities by **37%**
- Serious injuries by **38%**
- Road crashes by **23%**
- Emissions by **18%**
- Noise by **2.5 db**
- Fuel consumption by **7%**
- Traffic congestion by **2%**

30km/h Speed Limit in Cities (2/2)

[Yannis, G., & Michelaraki, E. (2024). Review of City-Wide 30 km/h Speed Limit Benefits in Europe Sustainability, 16(11), 4382]

Fatalities:

- *63% and 55% reduction* in Bristol and Brussels

Serious injuries:

- *72% and 50% reduction* in Münster and Grenoble

Road crashes:

- *46% and 40% reduction* in London and Paris

Emissions:

- *29% and 25% reduction* in Berlin and Graz

Noise:

- *3 db reduction* in Paris and Berlin

Energy:

- *12% and 10% reduction* in Münster and Brussels

Traffic congestion:

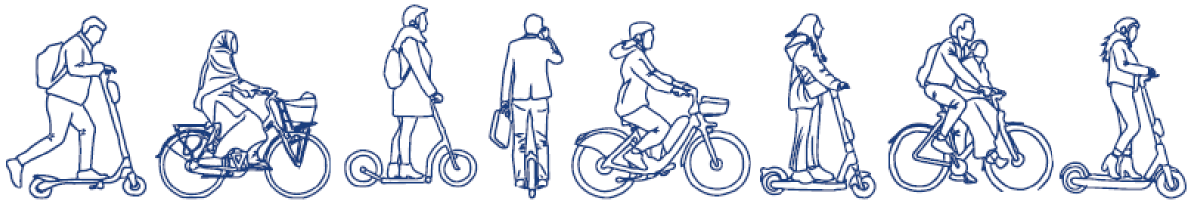
- *9% and 2% reduction* in Grenoble and Bilbao

City	Safety			Emissions		Energy	Traffic
	Crashes	Fatalities	Injuries	CO_2, NO_x, PM	Noise	Fuel	Congestion
Bologna	-38%	-33%	-10%	-23%			-3%
Zurich	-16%	-25%	-20%		-1.7 dB		
Paris	-40%		-25%		-3 dB		
Münster			-72%	↓	↓	-12%	
Brussels	-10%	-55%	-37%		-2.5 dB	-10%	
Glasgow		-31%					
Helsinki	-9%		-42%				
Bilbao	-28%			-19%			-2%
Berlin	-10%			-29%	-3 dB		
London	-46%	-25%	-25%	-10%			
Grenoble	↓	↓	-50%				-9%
Edinburgh	-38%	-23%	-33%	-8%			-2.4%
Bristol		-63%					
Brighton			-45%				
Hove			-45%				
Warrington			-43%				
Graz	-12%		-20%	-25%	-2.5 dB		

** grey colour indicates that the impact of the implementation of 30 km/h in this city has not been examined yet*
*** the symbol ↓ indicates that the quantitative effect of this measure has not been provided; only qualitative impact is given*
**** these reductions refer to a comparison period before and after the implementation of 30 km/h speed limits which is not the same among all cities examined*

Summary of key Micromobility Risk Factors

A **holistic approach** that combines improved infrastructure, safe riding behaviour, vehicle design standards, and safety and exposure data collection is essential to improve micromobility safety.



Risk Factors	Safe Riders	Safe Infrastructure	Safe Vehicles
Safe Riders			
Speeding	● high	● medium	● high
Helmet use	● high	● low	● medium
Under the influence	● high	● low	● low
Visibility	● high	● high	● high
Double riding	● high	● low	● low
User experience/ Riders age	● high	● medium	● high
Mobile phone use	● high	● low	● medium
Rider’s stability	● high	● high	● high
Safe Infrastructure			
Poor road infrastructure	● low	● high	● low
Riding location	● medium	● high	● low
Parking	● high	● high	● low
Safe Vehicle			
Wheel size	● low	● low	● high
Maximum design speed	● low	● low	● high
Braking system	● low	● low	● high
Lights and auditory	● low	● low	● high
E-scooter foot platform	● low	● low	● high
Safe Management			
Micromobility safety data availability	● high	● high	● high
Post - care	● high	● high	● high

● high correlation, ● medium correlation, ● low correlation

Summary of Micromobility Safety Recommendations

Safe Infrastructure

Proactively maintain micromobility infrastructure (Authorities)

Establish a dedicated and well-connected micromobility network (Authorities)

Establish micromobility parking policy and designate parking areas where needed (Authorities)

Establish collaborative partnerships with authorities for infrastructure condition reporting (Operators)

Onboard parking zones in shared micromobility apps and deploy smart docking in high-traffic areas (Operators)

Safe Riders

Implement a 30km/h (or lower) speed limit in areas with high micromobility us (Authorities)

Establish low-speed limits for micromobility vehicles in pedestrian or shared zones (Authorities)

Take enforcement action against risky micromobility (Authorities)

Promote the use of appropriate helmets (Authorities)

Introduce rider education in secondary schools (Authorities)

Enable real-time safety interventions via telematics (Operators)

Provide post-trip feedback via telematics data (Operators)

Provide economic incentives for safe riding (Operators)

Implement mandatory initial rider training (Operators)

Verify age to start riding (Operators)

Safe Vehicles

Set universal technical requirements for e-scooter design (Authorities)

Adopt riding support systems in micromobility vehicles (Authorities)

Ensure systematic maintenance of micromobility (Operators)

Enable context-dependent maximum speed control using geofencing (Operators)

Restrict e-scooter access if tandem riding and/or alcohol use is detected (Operators)

Implement riding support systems in shared e-scooters (Operators)

Safe Management

Establish and collect data on distinct micromobility categories in safety statistics (Authorities)

Enable in-vehicle or in-app crash detection technology (Operators)

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