International Transport Forum

CPB
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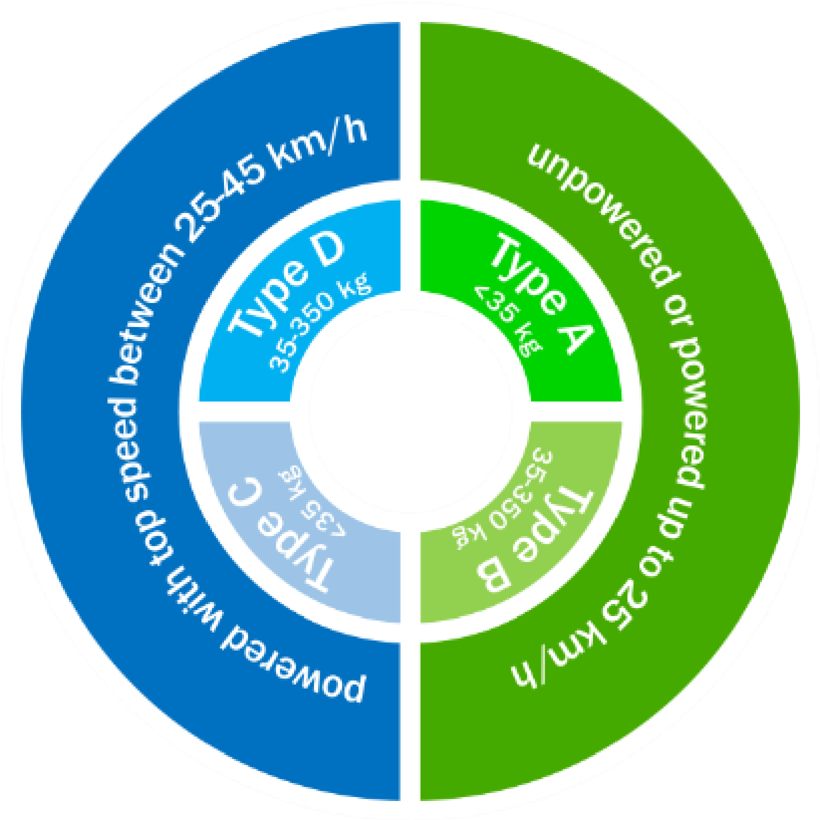
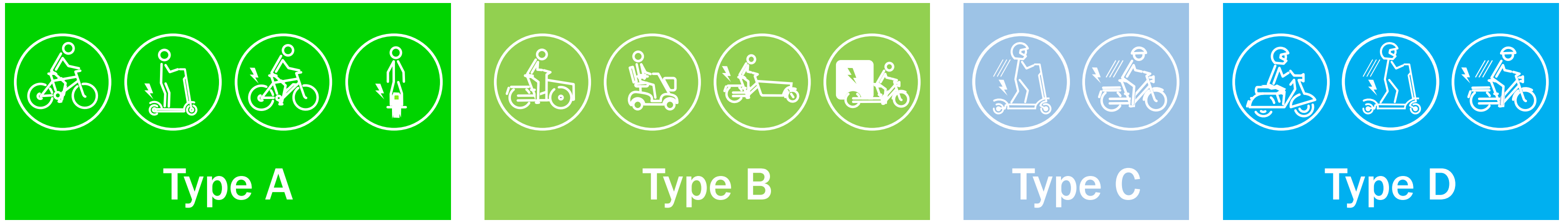
Safer Micromobility

Micromobility provides viable options for car-free travelling and improves first and last-kilometre connectivity to public transport, but it must be safe.

What is micromobility?





Following the Safe System approach and highlighting two key crash severity parameters – speed and mass – the ITF identifies four broad micromobility vehicle types:

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.

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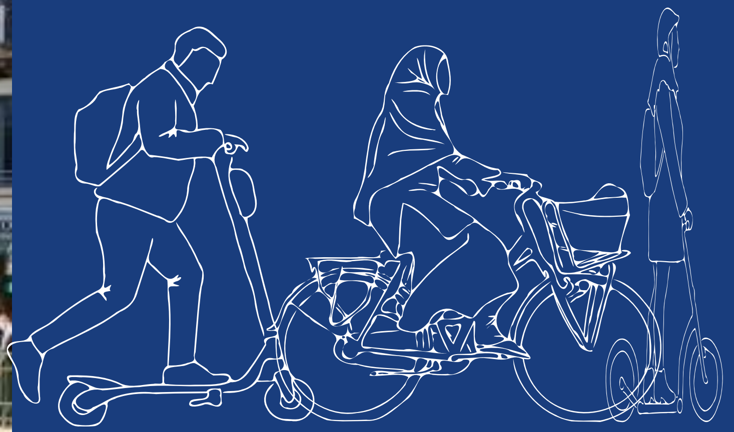
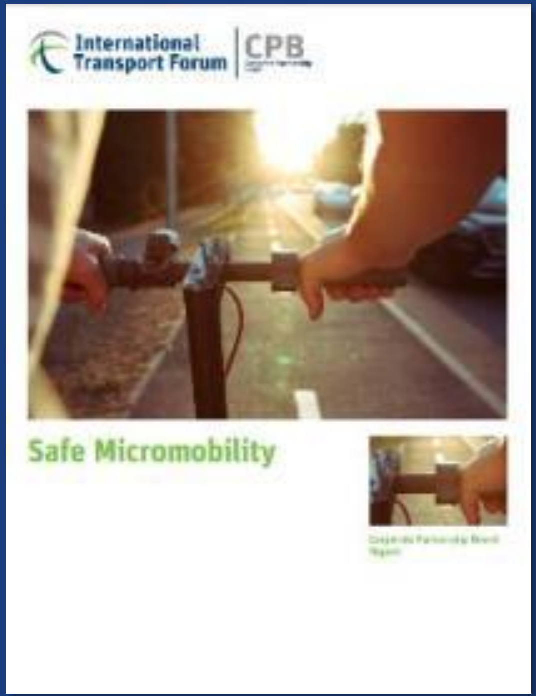
ITF focuses on e-scooters and e-bikes weighing less than ~35 kg, including models that can travel up to 45 km/h or beyond.

Safe Micromobility (2020)

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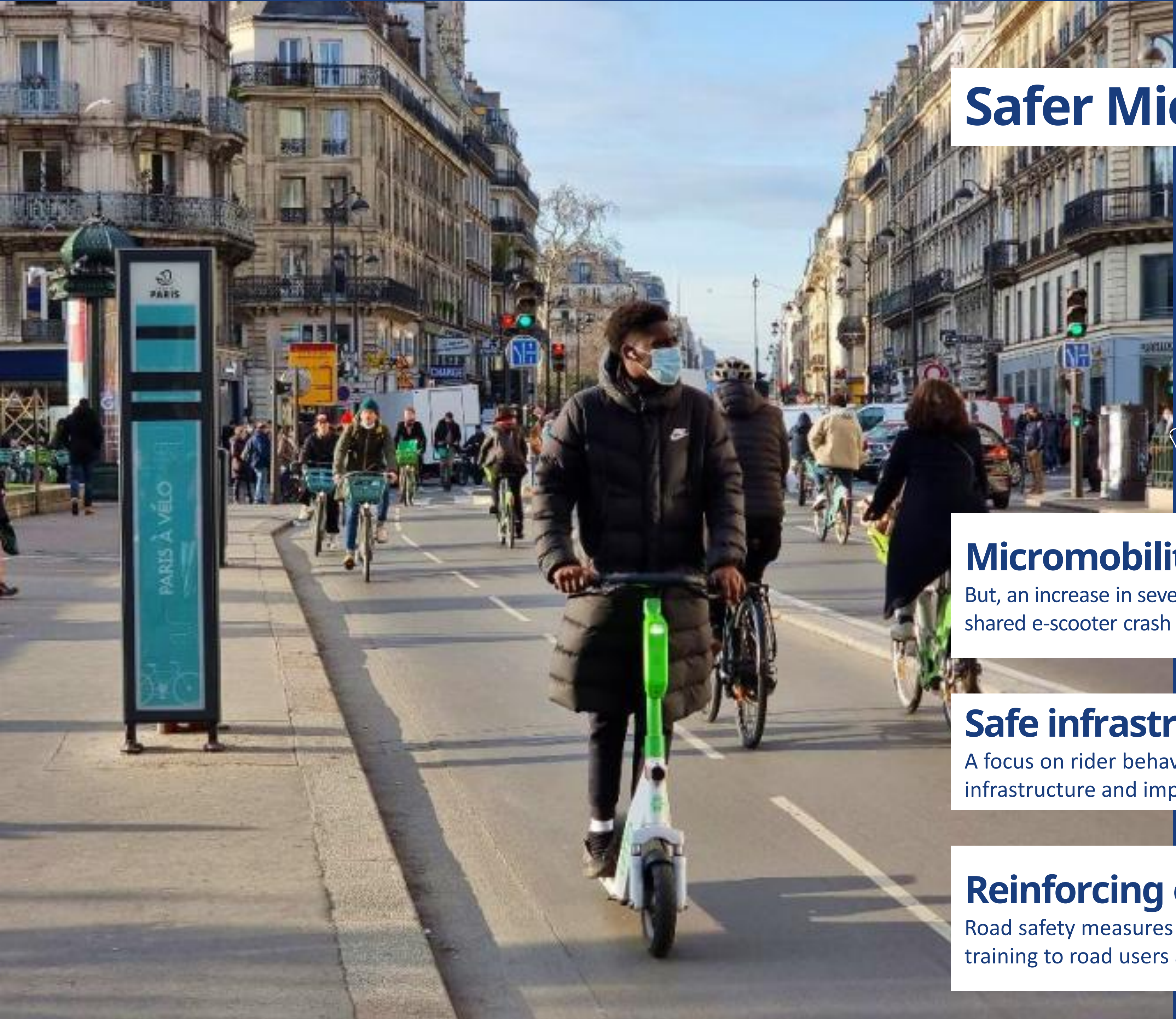
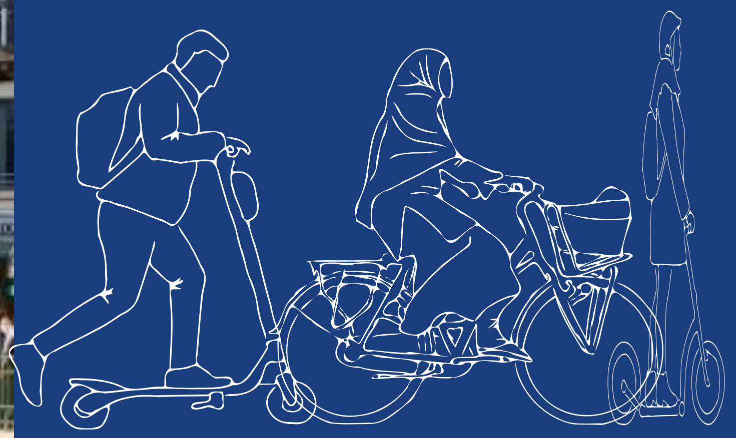
Safe Micromobility



Safer Micromobility (2024)



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.

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

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.

How to assess micromobility safety?

Safety and health

From a health perspective, active and passive forms of micromobility are not equal.

Lack of data on micromobility trips and crashes makes it hard to assess crash risk.

Micromobility crash risk

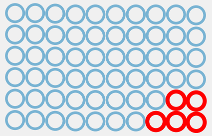
Risk reflects the probability of crashes and their severity. It is characterised as the road safety outcome for an amount of exposure, such as the overall number of trips or distance travelled.

-26%
shared e-scooter casualty risk in Europe (2022/2021)

Safety risk can improve even as crash numbers go up

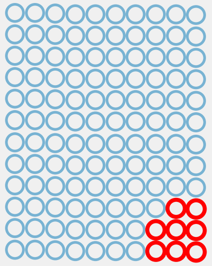
If trips increase faster than crashes, then overall crash risk decreases

○ trips
○ trips with crashes



5 crashes / 60 trips
Crash risk = .083
Time = t

60% increase in number of crashes
but
20% reduction of crash risk

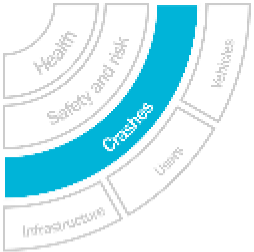


8 crashes / 120 trips
Crash risk = .066
Time = t+1

Injury severity is correlated to crash mechanisms, vehicle types and road users.

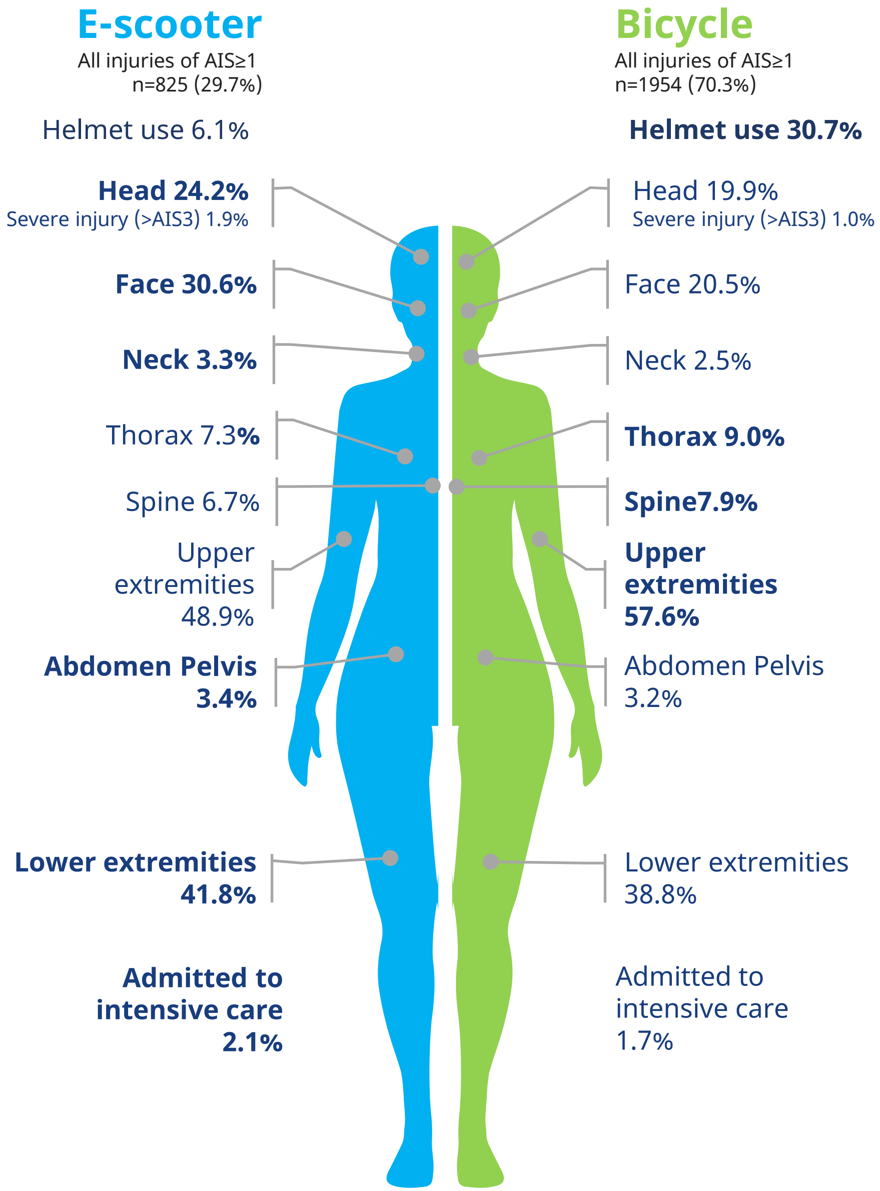
Micromobility crashes

- 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**.
- Most e-scooter and bicycle-related crashes **involve the rider and no other road user**.
- Most **fatal micromobility crashes involve a motor vehicle**.



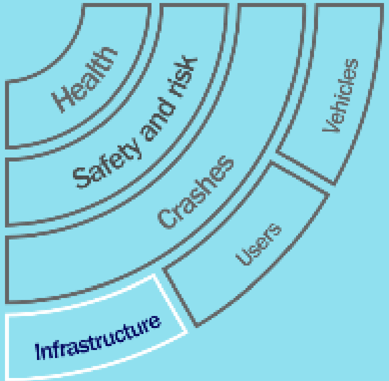
E-scooter and bicycle crash injuries are different

- E-scooter riders experience a **greater share of head, face and neck injuries** than cyclists -- up to twice the incidence of severe head injuries and between 50% to 100% more maxillofacial injuries.
- This difference may partly be explained by significantly **lower helmet use** among e-scooter riders, though helmets generally do not prevent maxillofacial injuries.
- A higher incidence of **alcohol-involved crashes for e-scooter riders** may also help explain these differences.
- Injuries to **lower extremities are more prevalent among e-scooter riders than cyclists** – possibly reflecting injuries sustained as e-scooter riders hop off their e-scooter just before or at the moment of losing control.

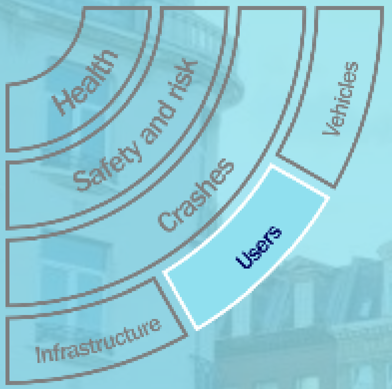


Adapted from Benhamed et al., 2022

Micromobility crash factors: Infrastructure



Poorly maintained surfaces, with potholes and other irregularities, contribute to 30-40% of e-scooter crashes

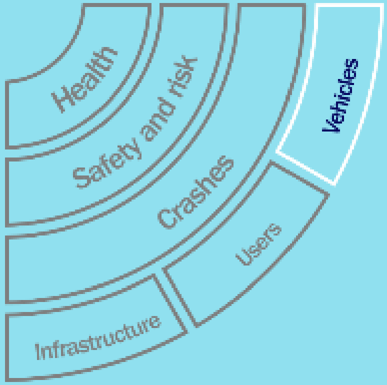


Micromobility crash factors: Riders

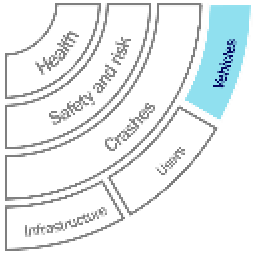
Rider-related safety factors associated with bicycles are different to those of e-scooters

- **Nighttime and reduced lighting** conditions are positively correlated with both injury and fatal crashes (30-44% of e-scooter-related casualties).
- **Alcohol impairment** is a prominent cause of e-scooter riders' injuries.
- Injured e-scooter riders display low levels of **helmet-wearing** – even when required by law (up to 11% observed shared e-scooter riders wear helmets).
- Evidence suggests that while current bicycle helmet standards are generally well-adapted to bicycle crashes, they may not provide **sufficient protection from face and jaw injuries** common in e-scooter crashes.
- **Tandem riding** contributes to 17% of all e-scooter-related casualties. Evidence indicates that 2% to 5% of all observed trips involve two riders on a single e-scooter.
- **Inexperienced riders** are linked to high crash risk

Micromobility crash factors: Vehicles



E-scooters differ greatly in their design, stability and speed from both electric and conventional bicycles



Various e-scooter and bicycle characteristics and safety

E-scooters

Head height
Higher head height and distance to the ground due to standing position increases 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.

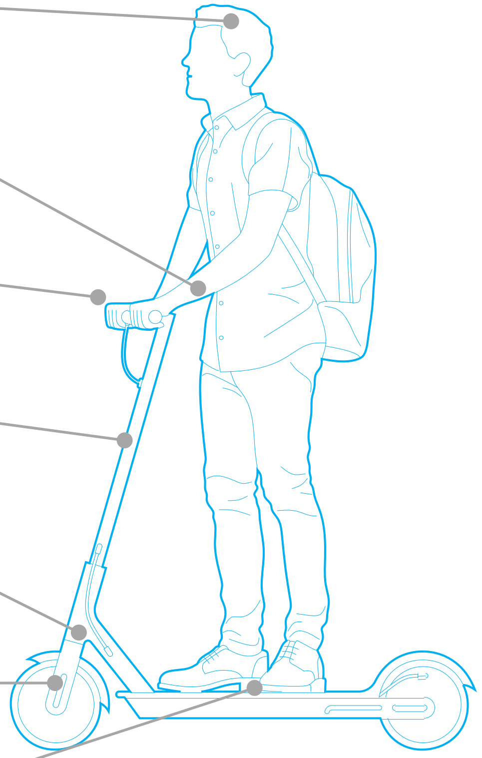
Braking
Single front braking reduces stability and contributes to loss of rear wheel ground contact in emergency braking

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

Synthesis of micromobility safety recommendations
for Public Authorities and Operators

Safe infrastructure

1. Proactively maintain micromobility infrastructure (Authorities)
2. Establish a dedicated and well-connected micromobility network (Authorities)
3. Establish micromobility parking policy and designate parking areas where needed (Authorities)
4. Establish collaborative partnerships with authorities for infrastructure condition reporting (Operators)
5. Onboard parking zones in shared micromobility apps and deploy smart docking in high-traffic areas (Operators)

Safe riders

6. Implement a 30km/h (or lower) speed limit in areas with high micromobility use (Authorities)
7. Establish low-speed limits for micromobility vehicles in pedestrian or shared zones (Authorities)
8. Take enforcement action against risky micromobility (Authorities)
9. Promote the use of appropriate helmets (Authorities)
10. Introduce rider education in secondary schools (Authorities)
11. Enable real-time safety interventions via telematics (Operators)
12. Provide post-trip feedback via telematics data (Operators)
13. Provide economic incentives for safe riding (Operators)
14. Implement mandatory initial rider training (Operators)
15. Verify age to start riding (Operators)

Safe vehicles

16. Set universal technical requirements for e-scooter design (Authorities)
17. Adopt riding support systems in micromobility vehicles (Authorities)
18. Ensure systematic maintenance of micromobility fleets (Operators)
19. Enable context-dependent maximum speed control using geofencing (Operators)
20. Restrict e-scooter access if tandem riding and/or alcohol use is detected (Operators)
21. Implement riding support systems in shared e-scooters (Operators)

Safe management

22. Establish and collect data on distinct micromobility categories in safety statistics (Authorities)
23. Enable in-vehicle or in-app crash detection technology (Operators)

Thank you

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International Transport Forum (ITF).

Link to the technical report and references

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