22. Vulnerable road users

Introduction

Vulnerable Road Users (VRUs), including pedestrians, cyclists, users of small personal mobility devices, and motorcyclists, are disproportionately exposed to risk in traffic. Their lack of physical protection makes them especially susceptible to serious injuries or death. Children, the elderly, and people with disabilities face additional vulnerability due to limited perceptual abilities and physical fragility. In many cities, road systems prioritise motor vehicles over VRUs, creating hostile environments for walking and cycling that exclude those who cannot operate or afford a car.

This is both a safety and an equity issue. Many VRUs walk or cycle out of necessity, not choice. Inadequate infrastructure places an unfair burden on them, reinforcing patterns of inequality. At the same time, rapid urbanisation and car-centric design contribute to sedentary lifestyles and poorer public health outcomes. Safe, accessible environments for VRUs are essential not only to prevent injury, but to promote healthier, more equitable societies through everyday active mobility.

Learning outcomes

After completing this module, the students should be able to:

- Define what constitutes a vulnerable road user (VRU) and recall key statistics on VRU risk in Africa and globally.
- Explain why VRUs face disproportionately high risks in African contexts, the relationship between speed and injury severity, and the link between sedentary lifestyles and public health.
- Identify infrastructure features that improve or worsen VRU safety and suggest appropriate safe speed limits for different contexts.
- Compare VRU risks in Africa versus Europe, evaluate the role of underreporting, and assess how vehicle type affects injury outcomes.
- Propose strategies combining infrastructure measures to protect VRUs and behavioural interventions, including context-sensitive safety programmes for children.

Key messages to learners

- Walking and cycling are far more dangerous in Africa than in Europe: walking is around 28 times more dangerous per kilometre and cycling is 16 times more dangerous. In Africa, approximately 78% of people walk as their primary mode of transport, making pedestrians the largest yet most at risk road user group.
- Despite the risks, active mobility is crucial for health and equity, making it essential to balance safety with promotion of walking and cycling.
- Many VRU crashes go unreported, meaning the problem is larger than statistics suggest.
- Safe speeds are vital: at 30 km/h a pedestrian has approximately 90% chance of surviving a collision, but at 50 km/h survival drops to around 40%. Evaluations in European cities show injury reductions up to 40% when speed limits are lowered from 50 to 30 km/h in urban areas.

- Safe System principles, accepting human error and designing forgiving road environments, are key to protecting VRUs. This includes safer vehicles, lower speeds, separated infrastructure, and improved post-crash care. In many African contexts, VRU crashes go unreported and victims receive delayed or no emergency care, reinforcing existing social inequalities.
- Infrastructure and behaviour both matter: pedestrians tend to follow direct desire lines and will bypass crossings that require long detours. Context-sensitive measures, such as safe crossings aligned with natural movement patterns, improve safety more effectively than designs that prioritise vehicle flow alone.
- Large vehicles (SUVs, pickups, buses, trucks) present much higher risks to VRUs due to larger size and more rigid fronts. Many imported second-hand vehicles in Africa lack basic pedestrian protection features. Strengthening import standards to include UN regulations on pedestrian protection would significantly reduce fatalities.
- Children are especially vulnerable in traffic due to visibility issues, limited perception, and unpredictable behaviour. Training programmes can help, but infrastructure is critical. It is close-to-impossible and often unethical to train children to behave 'safely' in environments that are inherently unsafe for them.
- Risky behaviours by the vulnerable road users themselves can also trigger serious road accidents and need to be addressed.

Learning activities

Exercise 1

Identify and map a walking or cycling route in a local community. Document hazardous points (e.g. missing sidewalks, high-speed crossings, poor visibility) but also other aspects which could make walking more pleasant (e.g. given space, sidewalk surface quality, obstructions, presence of trees to give shade, etc.). Suggest at least three realistic improvements.

Exercise 2

Conduct a speed observation outside a school or a market. Record the number of vehicles exceeding 30 km/h. Discuss the implications for VRU safety and suggest possible countermeasures.

Assessment quiz

The assessment quiz can be used as a part of the examination, or as another form of learning activities.

Question 1

Is walking per kilometre travelled more dangerous in Africa than in Europe?

a. Yes (correct)
b. No (incorrect)

Comment (shown after the answer has been given):

Walking is around 28 times more dangerous per kilometre in Africa than in Europe.

Question 2

At what speed does a pedestrian's survival chance drop to around 40% in a collision?

a. 30 km/h (incorrect)
b. 50 km/h (correct)
c. 70 km/h (incorrect)

Comment (shown after the answer has been given):

At 30 km/h a pedestrian has approximately 90% chance of survival. At 50 km/h this drops to around 40%, and at 70 km/h the chances for survival are below 10%. This relationship is universal all over the world and is primarily defined by the biomechanical tolerance of the human body.

Question 3

Which type of vehicles present highest risks for pedestrians?

a. Light passenger cars (incorrect)
b. SUVs, pickups, heavy trucks (correct)
c. Motorcycles (incorrect)

Comment (shown after the answer has been given):

Vehicles with high, rigid fronts transfer more energy to a pedestrian's vital organs on impact. Many imported second-hand vehicles in Africa lack energy-absorbing bumpers and pedestrian detection systems, further increasing the risk.

Question 4

Why is underreporting a major challenge for VRU safety?

a. It hides the true scale of the problem (correct)
b. It reduces traffic congestion (incorrect)
c. It encourages safer driving (incorrect)

Comment (shown after the answer has been given):

Many crashes involving pedestrians and cyclists, especially in informal settlements, go unrecorded. This leads to underestimation of the problem and insufficient allocation of resources for VRU safety measures.

Question 5

What is true regarding VRUs according to the Safe System principles?

a. People never make mistakes (incorrect)
b. Roads and vehicles should be designed to forgive human error (correct)
c. Speed is not an important factor in VRU safety (incorrect)

Comment (shown after the answer has been given):

The Safe System approach recognises that humans make mistakes. Roads, vehicles, and speeds should be designed to prevent crashes where possible, and to ensure that crashes that do occur are not fatal or seriously injurious. This is especially important for VRUs who lack physical protection.

Recommended reading and resources for students

- Welle, B., Liu, Q., Li, W., Adriazola-Steil, C., King, R., Sarmiento, C., & Obelheiro, M. (2015). *Cities safer by design: guidance and examples to promote traffic safety through urban and street design*. World Resources Institute. https://files.wri.org/d8/s3fs-public/CitiesSaferByDesign_final.pdf
- WHO. (2023). *Status report on road safety in the WHO African Region*. World Health Organization. https://iris.who.int/bitstream/handle/10665/378194/9789290314363-eng.pdf

Recommended (additional) reading for teacher

- Adeloye, D., Thompson, J. Y., Akanbi, M. A., Azuh, D., Samuel, V., Omoregbe, N., & Ayo, C. K. (2016). The burden of road traffic crashes, injuries and deaths in Africa: a systematic

review and meta-analysis. *Bulletin of the World Health Organization*, 94, 510–521A. https://doi.org/10.2471/BLT.15.163121

- Cervero, R. B. (2013). Linking urban transport and land use in developing countries. *Journal of Transport and Land Use*, 6(1), 7–24. https://doi.org/10.5198/jtlu.v6i1.425
- Dinh, D. D., Vũ, N. H., McIlroy, R. C., Plant, K. A., & Stanton, N. A. (2020). Effect of attitudes towards traffic safety and risk perceptions on pedestrian behaviours in Vietnam. *IATSS Research*, 44(3), 238–247. https://doi.org/10.1016/j.iatssr.2020.01.002
- Godthelp, H., & Ksentini, A. (2024). Specific road safety issues in low- and middle income countries (LMICs): an overview and some illustrative examples. *Traffic Safety Research*, 8, e000068. https://doi.org/10.55329/sdtu9515
- Grundy, C., Steinbach, R., Edwards, P., Green, J., Armstrong, B., & Wilkinson, P. (2009). Effect of 20 mph traffic speed zones on road injuries in London, 1986-2006: controlled interrupted time series analysis. *BMJ*, 339, b4469. https://doi.org/10.1136/bmj.b4469
- Haghighi, M., Bakhtari, F., Sadeghi-Bazargani, H., & Nadrian, H. (2021). Strategies to promote pedestrian safety from the viewpoints of traffic and transport stakeholders in a developing country: a mixed-method study. *Journal of Transport & Health*, 22, 101125. https://doi.org/10.1016/j.jth.2021.101125
- ITF. (2015). *Improving safety for motorcycle, scooter and moped riders*. International Transport Forum. https://doi.org/10.1787/9789282107942-en
- ITF. (2018). *Speed and crash risk*. International Transport Forum. https://www.itf-oecd.org/sites/default/files/docs/speed-crash-risk.pdf
- Kobusingye, O. C., Hyder, A. A., Bishai, D., Hicks, E. R., Mock, C., & Joshipura, M. (2005). Emergency medical systems in low- and middle-income countries. *Bulletin of the World Health Organization*, 83(8), 626–631. https://pmc.ncbi.nlm.nih.gov/articles/pmid/16184282/
- Lubbe, N., Wu, Y., & Jeppsson, H. (2022). Safe speeds: fatality and injury risks of pedestrians, cyclists, motorcyclists, and car drivers impacting the front of another passenger car as a function of closing speed and age. *Traffic Safety Research*, 2, e000006. https://doi.org/10.55329/vfma7555
- Luka, N. (2023). Walking beyond the city? On the importance of recreational mobilities for landscape planning, urban design, and public policy. *Mobilities*, 18(5), 789–804. https://doi.org/10.1080/17450101.2023.2242001
- Pires, C., Meesmann, U., Areal, A., Wardenier, N., Granié, M.-A., Furian, G., Nikolaou, D., Jankowska-Karpa, D., Lyon, C., Møller, M., Surges, F., Nakamura, H., & Stelling, A. (2025). Measuring road safety performance and culture: a comparative study of 39 countries. *IATSS Research*, 49(3), 335–352. https://doi.org/10.1016/j.iatssr.2025.07.001
- Ropaka, M., Nikolaou, D., & Yannis, G. (2020). Investigation of traffic and safety behavior of pedestrians while texting or web-surfing. *Traffic Injury Prevention*, 21(6), 389–394. https://doi.org/10.1080/15389588.2020.1770741
- Rosén, E., Stigson, H., & Sander, U. (2011). Literature review of pedestrian fatality risk as a function of car impact speed. *Accident Analysis & Prevention*, 43(1), 25–33. https://doi.org/10.1016/j.aap.2010.04.003
- WHO. (2023). *Global status report on road safety*. World Health Organization. https://iris.who.int/bitstream/handle/10665/375016/9789240086517-eng.pdf
- Yannis, G., & Michelaraki, E. (2024). Effectiveness of 30 km/h speed limit—a literature review. *Journal of Safety Research*, 92, 490–503. https://doi.org/10.1016/j.jsr.2024.11.003

- Yannis, G., Nikolaou, D., Laiou, A., Stürmer, Y. A., Buttler, I., & Jankowska-Karpa, D. (2020). Vulnerable road users: cross-cultural perspectives on performance and attitudes. *IATSS Research*, 44(3), 220–229. https://doi.org/10.1016/j.iatssr.2020.08.006

Prepared by experts

In case you have specific questions, need a discussion partner, or just want feedback on your lecture materials, you may reach out the author(s) of this module. Please, put 'AfroSAFE curriculum' in the email subject.

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