Subjective Safety of Vulnerable Road Users from a European Perspective – Insights from the ESRA3 Survey

Gerald Furian[1], Susanne Kaiser[1], Aggelos Soteropoulos[1], Dimitrios Nikolaou[2], Konstantinos Kaselouris[2], George Yannis[2]

[1]Austrian Road Safety Board (KFV), Austria
[2]National Technical University of Athens, Greece

Background

Road safety is commonly assessed through objective indicators such as crash and fatality data. However, the subjective dimension—how safe road users feel in everyday traffic—represents a complementary and equally relevant aspect of safety performance. Perceived safety influences mobility choices, willingness to walk or cycle, and acceptance of road-safety policies. Within the Safe-System framework, understanding subjective safety and risk perception is therefore essential for designing inclusive and sustainable transport systems.

The ESRA (E-Survey of Road users' Attitudes) initiative provides the first globally harmonised database of self-reported road-user attitudes, behaviours, and perceptions. Coordinated by the Vias Institute (Belgium) with ten partner organisations, including the Austrian Road Safety Board (KFV) and the National Technical University of Athens (NTUA), ESRA3 was carried out in 2023 across 39 countries, yielding over 37 000 valid responses.

This extended abstract summarises the European findings of the ESRA3 Thematic Report No. 2 – Subjective Safety and Risk Perception (Furian et al., 2024) as well as No. 8 – Infrastructure (Nikolaou et al. 2024) with a specific focus on vulnerable road users (VRUs)—pedestrians, cyclists, motorcyclists, and e-scooter riders. These groups face a higher objective crash risk and often experience reduced subjective safety, yet they play a central role in achieving modal shift targets and Vision Zero objectives and especially walking, cycling and riding the e-scooter became more popular in recent years accompanied by an increase in crashes.

The analysis addresses three core questions: (1) How safe do Europeans feel when using different transport modes, particularly those involving physical exposure (VRUs) as well as how safe they feel when using different infrastructure? (2) How do gender, age, and national context influence these perceptions? (3) How do subjective feelings of safety relate to objectively measured fatality rates across European countries?

Methods

ESRA3 employed a harmonised online-panel methodology. In each of the 22 European participating countries, a representative national sample (typically n = 1 000; total ≈ 23 000 European respondents) of adults aged 18–74 years completed the questionnaire in the

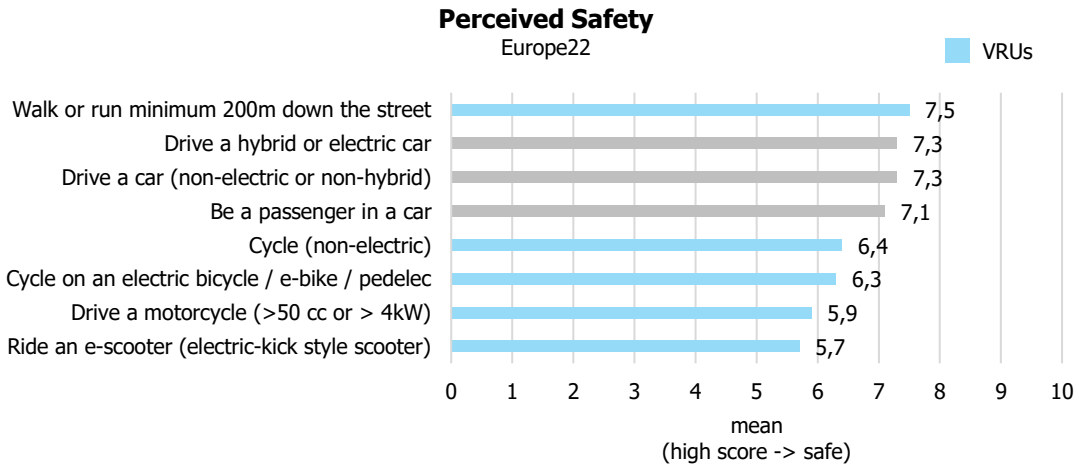
national language. Weighting corrections ensured representativeness by gender and age group.

Regarding the topic subjective safety, participants were asked about their feeling when using different transport, i.e., how safe or unsafe they feel when using different transport modes?" (0–10 scale). Modes included cars, motorcycles, bicycles, e-bikes, walking, and e-scooters. In addition, participants were asked about their perceived safety of infrastructure for different transport modes, i.e., safety rating of roads, cycle lanes or sidewalks (0-7 scale, with 5-7 = safe).

Weighted means and national rankings were calculated; differences by gender and age were tested using Chi^2, i.e., to assess if the answers depend significantly on the gender and on the age group, respectively, as well as Cramer's V, and Eta^2, i.e., to assess the strength of the association between variables. For the advanced analysis, mean subjective-safety scores were merged with CARE (2022) fatality data for each country to assess relationships between perception and fatalities among VRUs using a descriptive, graphical analysis and regression lines.

Results

Across Europe, walking (mean 7.5/10) and driving electric/hybrid cars (7.3) were perceived as safest, while e-scooter riding (5.7) and motorcycling (5.9) were least safe; cycling ranked mid-level (6.4). Northern European countries (Denmark, Finland, Switzerland) reported the highest overall safety perception, whereas Southern/Eastern countries (Greece, Italy, Bosnia) were lowest. Among VRUs, pedestrians felt safest (mean 7.5), followed by cyclists (6.4), motorcyclists (5.9), and e-scooter riders (5.7) (see Figure 1).



Reference population: all road users who used this specific transport mode in the past 12 months

[Figure 1: Mean subjective-safety scores for selected transport modes – European average]

Women consistently felt less safe than men, in particular for walking, cycling, driving a motorcycle and riding an e-scooter ($p<0.01$), although the association of perceived safety and gender was predominantly small (Eta-squared≤0.01). In addition, with regard to active modes perceived safety decreased with age for cycling and riding an e-scooter in particular ($p<0.01$), with associations of small strength (Eta-squared<0.06) (see Table 1).

[Table 1: Overview on association between subjective safety and gender and age groups for selected transport modes – statistical tests]

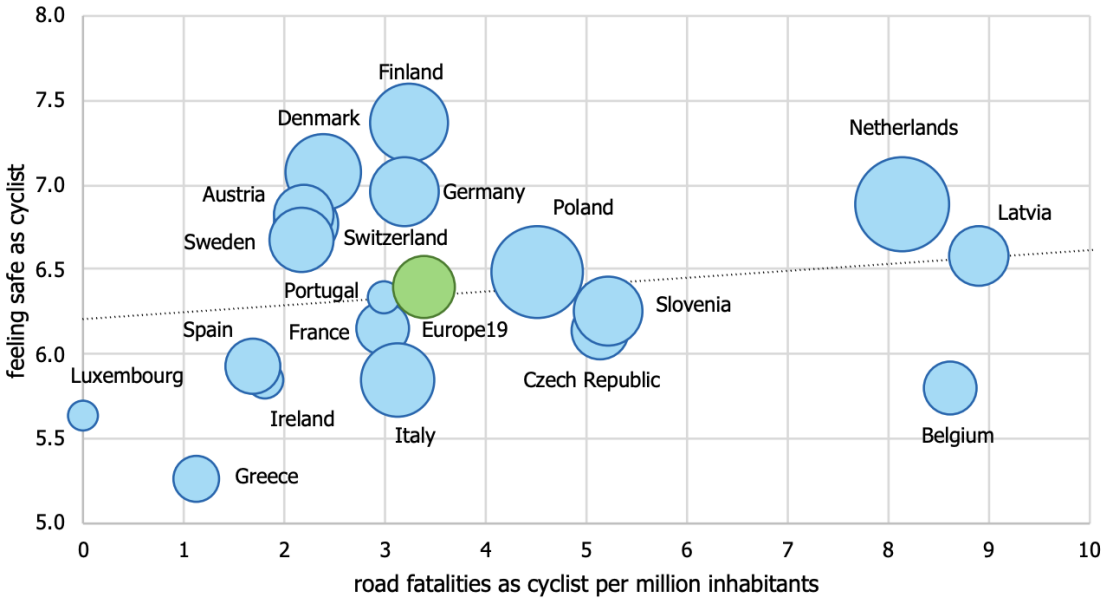
	Gender					**Age Group**								
	Mean Subj. Safety Score		*ANOVA*	*p-value*	*Eta-squared*	*Mean Subj. Safety Score*						*ANOVA*	*p-value*	*Eta-squared*
	male	female				18-24y	25-34y	35-44y	45-54y	55-64y	65-74y			
Drive a car (non-electric or non-hybrid)	7,4	7,2	16.64	**<0.001**	0.002	7,1	7,2	7,3	7,3	7,4	7,5	2.80	0.016	0.002
Drive a hybrid or electric car	7,4	7,1	5.64	0.018	0.003	6,9	7,1	7,3	7,4	7,6	8,0	7.27	**<0.001**	0.013
Drive a motorcycle (>50 cc or > 4kW)	6,0	5,6	7.38	**0.007**	0.005	5,5	6,0	6,1	5,6	5,8	6,2	2.11	0.061	0.006
Cycle (non-electric)	6,4	6,2	8.00	**0.005**	0.002	6,6	6,5	6,4	6,2	6,1	6,2	5.80	**<0.001**	0.006
Cycle on an electric bicycle / e-bike / pedelec	6,4	6,2	4.78	0.029	0.002	6,1	6,6	6,5	6,0	6,2	6,4	3.50	**0.004**	0.008
Walk or run minimum 200m down the street	7,6	7,4	14.09	**<0.001**	0.002	7,6	7,3	7,5	7,5	7,4	7,5	2.18	0.054	0.002
Be a passenger in a car	7,1	7,1	1.70	0.193	0.000	7,3	7,0	7,0	7,0	7,1	7,3	5.16	**<0.001**	0.003
Ride an e-scooter (electric-kick style scooter)	5,9	5,5	9.35	**0.002**	0,006	5,5	5,9	6,0	5,0	5,0	5,7	6.48	**<0.001**	0.017

- VRUs highlighted in blue; p-value <0.01 highlighted in bold
- Threshold for effect size (Eta-squared): Small: 0.01, Medium: 0.06, Large: 0.14

With regard to the perceived safety of infrastructure from VRUs, motorcyclists (and moped riders) across Europe felt safer on throughfares and high-speed roads (% safe = 61.1%) compared to other streets and roads in urban areas (% safe = 45.5%). Cyclists and pedestrians across Europe felt considerably safer on rural roads and roads connecting towns and villages as well as streets and roads in urban areas with cycle lanes and sidewalks compared to having no such infrastructure on these roads.

The advanced analysis revealed negative correlations between perceived safety and fatality rates, for motorcyclists, and pedestrians—countries with fewer fatalities (e.g., Switzerland,

Denmark) report higher perceived safety. For cyclists, a positive relationship emerged: nations with greater cycling exposure (e.g., Netherlands, Denmark) show higher perceived safety despite higher per-capita fatality rates, highlighting cultural and exposure effects. A similar relationship is also observable for e-scooter riders (see Figure 2).



bubble diameter: proportional to the percentage of regular cyclists (at least a few days a month)

[Figure 2: Relation between perceived safety and fatality rates for cyclists in Europe]

Conclusion

The ESRA3 results provide a comprehensive European picture of subjective safety. Vulnerable road users perceive substantially lower safety than occupants of enclosed vehicles, with pedestrians feeling most secure and motorcyclists and e-scooter riders least. Gender and age differences persist, and Southern and Eastern Europe show both higher objective and subjective risk levels. In addition, there is a higher level of perceived safety by cyclists and pedestrians for urban and rural roads with cycle lanes and sidewalks, while motorcyclists (and moped riders) feel least safe when using streets and roads in urban areas.

Subjective safety correlates negatively with fatality rates for most modes, suggesting that perception partially reflects reality. For cyclists, the inverse relationship indicates that exposure and cycling culture increase comfort even amid higher risks. Such findings confirm that subjective safety indicators usefully complement traditional crash statistics, offering insight into confidence and risk awareness among VRUs. Continued monitoring through future ESRA waves will enable longitudinal assessment to better understand temporal trends and the impact of interventions and support evidence-based policy within the Vision Zero framework.

Keywords: subjective safety; risk perception; ESRA3; Europe; vulnerable road users; pedestrians; motorcyclists; e-scooters; gender differences; fatalities

Justification of selected topics:
This paper uses data from the ESRA3 survey and the EU CARE database to analyse subjective safety and risk perception across 22 European countries, with a specific focus on vulnerable road users (pedestrians, cyclists, motorcyclists, and e-scooter riders). The analysis contributes to the development of *road safety performance indicators* by linking perceived safety with actual fatality data, thereby providing a complementary perspective to traditional crash statistics. The study fits under *Analysis of road safety data* and *Road safety performance indicators and surrogate measures*, while addressing the *Vulnerable road users* theme as the core of the paper.