



SURVEY OF E-
SCOOTER USERS
AND THE GENERAL
PUBLIC IN SLOVENIA



eSCURB: Electric scooters in urban environments: A study of safety, infrastructure, and mobility dynamics

A2.1 Survey of e-scooter users

A3.1 Survey of attitudes towards e-scooters and their use

Project leader from Slovenia partner: Asst. Prof. Tina Cvahte Ojsteršek, Ph.D.

Project leader from Croatian partner: Asst. Prof. Dario Babić, Ph.D.

Project team:

Faculty of Logistics, University of Maribor:

Tina Cvahte Ojsteršek

Darja Topolšek

Simona Šinko

Lazar Pavić

Pija Soršak

Marjan Sternad

Uroš Kramar

Tomaž Kramberger

Martin Fale

Mateja Forte

Faculty of Criminal Justice and Security, University of Maribor:

Igor Areh

Faculty of Transport and Traffic Sciences, University of Zagreb:

Dario Babić

Darko Babić

Mario Fiolić

Shirin Rizehbandi



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Ethical Declaration and Authorship Statement

We declare that this report is the result of the collective authorship of the project team. We declare that the report and its research was carried out in accordance with the principles of research, professional, and academic ethics, as well as with the requirements of the project, its funders, and the funding scheme. The project activities and its results were implemented within the framework of, and in compliance with, the project objectives, conditions, and the applicable rules of the funding agencies.

In preparing the project, we ensured the accuracy, traceability, and credibility of the presented data, consistently cited the sources used, and observed applicable legal and ethical standards. Appropriate scientific and professional sources were used in preparing the project report, and these are listed in the respective bibliographies or source lists. In doing so, we consistently respected copyright and the principles of proper source citation.

Generative artificial intelligence was also used as a support tool, exclusively for the following purposes:

- searching for and reviewing general information, especially for comparing contents throughout sources and searching for statistical sources (tools: ChatGPT and Copilot);
- translating sources and texts from foreign languages and into foreign languages (primarily DeepL and Copilot);
- translating reports between Slovenian, Croatian, and English for reporting and inter-project communication purposes (primarily DeepL and Copilot);
- grammatical and stylistic proofreading of original texts created by the project team (tools: Grammarly and Copilot).

Generative artificial intelligence was not used for independently creating the substantive parts of the research or the project results, but solely as support in processing, understanding, and linguistically optimizing content, as well as for translation between the project languages.

MODAL CHOICE, ACCESSIBILITY AND E-SCOOTER ATTITUDES

Urban mobility has undergone significant changes in recent years due to rapid technological development, environmental concerns, and the growing need for sustainable transportation systems. Cities are increasingly seeking alternatives to private car use in order to reduce traffic congestion, air pollution, and greenhouse gas emissions. As a result, new forms of micromobility, such as electric scooters (e-scooters), have emerged as potential solutions for short-distance urban travel and first- and last-mile connections.

Understanding modal choice—the factors influencing individuals' decisions when selecting a mode of transportation—is essential for developing effective and sustainable transport policies. Modal choice is influenced by a wide range of factors, including travel time, cost, convenience, infrastructure availability, safety, and personal preferences. Additionally, transport accessibility, which refers to the ease with which individuals can reach desired services, activities, and destinations, plays an important role in shaping travel behavior. Differences in accessibility across urban areas may significantly affect how and why people choose certain transport modes.

In recent years, e-scooters have gained popularity in many cities worldwide as a flexible, relatively affordable, and environmentally friendly mode of transport. Despite their rapid adoption, public attitudes toward e-scooters remain mixed. While some users perceive them as convenient and efficient, others raise concerns related to safety, regulation, and their integration into existing transport systems. These attitudes may also vary across different demographic groups, such as age, gender, income, and education level.

Examining the relationships between modal choice, transport accessibility, and attitudes toward e-scooters in relation to demographic characteristics can provide valuable insights into contemporary travel behavior. Such insights can help policymakers and urban planners design transportation systems that better meet the needs of diverse populations while promoting sustainable mobility options.

Table 1 shows mean number of days in a usual week respondent in the sample use different modality modes. As it was expected based on the presented results, "car as a driver" presents the most common way of travel, with 4.54 days on average together with a car as a passenger with 1,93 days on average. Highly ranked is also walking with 3,85 days on average, while mobility modes such as train, bicycles and e-scooter with less than one day per week in average. Overall, the results highlight a **dominance of private car use**, while sustainable and

shared mobility options, particularly **micromobility services**, remain relatively underutilized. The relatively high standard deviations for some modes, especially car use and walking, suggest substantial variability in travel behavior among respondents.

Table 1. Descriptive statistics of transport modes

Transport mode	N	Mean	SD
Car – as a driver	1135	4.54	2.442
Walking	1135	3.85	2.581
Car – as a passenger	1135	1.93	1.963
Bicycle (own)	1135	1.28	1.89
Bus	1135	0.93	1.721
Train	1135	0.41	1.19
Moped, motorcycle, scooter	1135	0.33	1.031
Electric bicycle (own)	1135	0.3	1.117
Electric scooter (own)	1135	0.3	1.053
Bicycle (shared public system)	1135	0.21	0.893
Skateboard, kick scooter, rollerblades, etc.	1135	0.19	0.76
Electric scooter (shared system)	1135	0.08	0.575
Electric bicycle (shared system)	1135	0.08	0.548

The distribution related to different modality modes is also similar when it is used for different purposes. The results show that most respondents commute by car as a driver (63.3%), indicating a strong dependence on private motorized transport. This suggests that the car remains the dominant mode of daily travel to work or school among the surveyed population. The second most common mode is walking (11.4%), which indicates that a notable share of respondents lives relatively close to their workplace or school. Public transport, particularly the bus (8.2%), represents another important commuting option, although its share is considerably lower than that of private car use. Other transport modes are used less frequently. Car travel as a passenger (5.8%) and cycling with a personal bicycle (4.7%) account for a smaller portion of trips. Train use (3.2%) is also relatively limited. Micromobility modes, such as electric scooters and electric bicycles, are used only by a very

small proportion of respondents (below 1%). This suggests that these transport options are not yet widely adopted for commuting purposes in the surveyed sample. Overall, the results presented on Figure 1 highlight a clear dominance of private car commuting, while active mobility and micromobility play a relatively minor role.

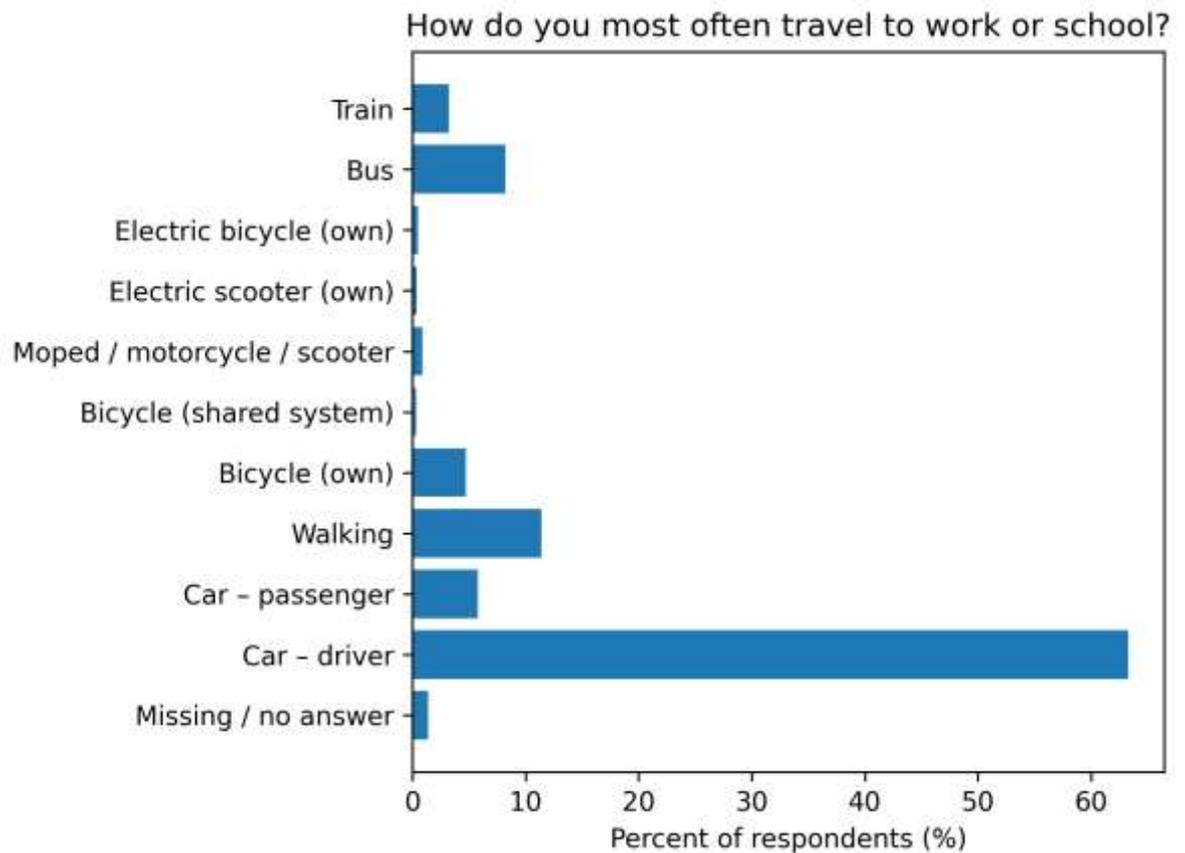


Figure 1: Modality modes choices for work and/or education purposes

Figure 2 illustrates the distribution of respondents' most frequently used modes of travel when going shopping or running errands. The results reveal a strong dominance of private motor vehicles. Specifically, car drivers account for the largest share (67.4%), indicating that personal car use remains the primary mobility choice for everyday tasks. An additional 17.4% travel as car passengers, further emphasizing the central role of automobiles in local mobility patterns. Altogether, more than 84% of respondents rely on cars, suggesting a highly car-dependent environment. Walking represents the third most common mode at 8.2%, showing that a notable—but still minority—portion of the population conducts errands within walkable distances. Cycling accounts for only a small proportion, with owned bicycles at 2.6% and rental bicycles nearly negligible. The minimal use of micromobility options is further reflected in the very low shares for electric scooters and electric bicycles, each contributing less than 1% of the responses. Public transport appears to play a modest role,

with bus travel at 1.9% and train travel nearly absent. These results suggest that public transport is not a primary choice for short, daily errand-related trips. Overall, the data indicate a transportation landscape dominated by private car use, with limited uptake of active or sustainable mobility options. This pattern highlights potential opportunities for policy measures aimed at improving public transport accessibility, enhancing walking and cycling infrastructure, and promoting alternative mobility choices that could reduce reliance on private vehicles.

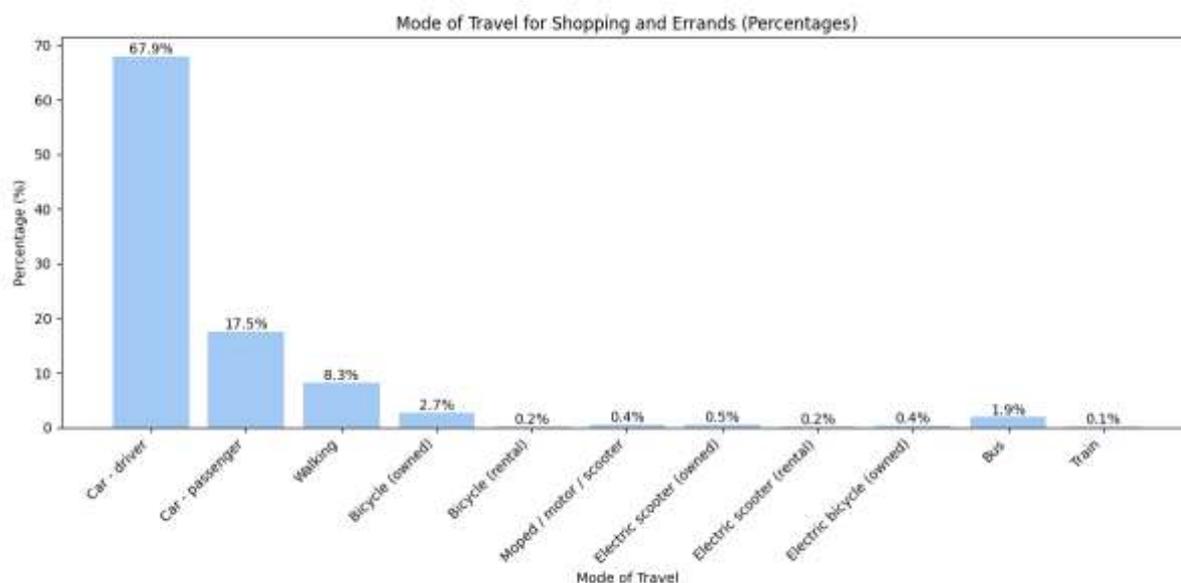


Figure 2: Modality modes choices for shopping and other errands purposes

Figure 3 presents the distribution of respondents' most frequently used modes of travel when engaging in leisure activities, such as sports, hobbies, family visits, meeting friends, and similar social events. The results indicate that private motor vehicles play a dominant role in leisure-related mobility. The largest share of respondents (40.7%) reported traveling as car drivers, while another 20.2% travel as car passengers. Taken together, these two categories account for more than 60% of all leisure trips, confirming a high degree of dependence on private automobiles even for non-essential, discretionary activities.

Walking emerges as the third-most common leisure travel mode, representing 19.4% of respondents. Compared with travel for shopping or errands, this higher proportion suggests that individuals may choose walking more often when the trip purpose is recreational or social, or when destinations are closer and integrated within local neighbourhoods.

Cycling also accounts for a larger share in leisure mobility than in utilitarian travel. Owned bicycles constitute 9.4%, marking a noticeable increase compared with their share in daily errand-related trips. This pattern corresponds with broader behavioural trends in which cycling is frequently used as a form of physical activity or recreation, rather than as a primary

mode for practical transportation. Rentals, however, remain negligible, indicating that leisure cycling is primarily dependent on personally owned bicycles rather than shared systems.

Use of micromobility devices—including electric scooters and electric bicycles—remains modest, each contributing between 1% and 2% of trips. While still limited, their presence suggests a gradual diversification of leisure mobility modes, potentially linked to younger demographic groups or urban centre accessibility. Public transport use also remains low: buses account for 2.4%, while train use is minimal (0.4%). This indicates that public transport is not currently a preferred choice for leisure activities among surveyed respondents, possibly due to service coverage, convenience factors, or the flexibility offered by private vehicles for discretionary travel.

Overall, the distribution reflects a clear pattern: although leisure mobility is somewhat more varied than travel for daily errands, private car use remains predominant, followed by notable shares of walking and cycling. The findings underscore the importance of developing strategies that encourage a shift toward more sustainable leisure travel modes—such as improving walkable environments, expanding cycling infrastructure, and enhancing access to public transport for recreational destinations.

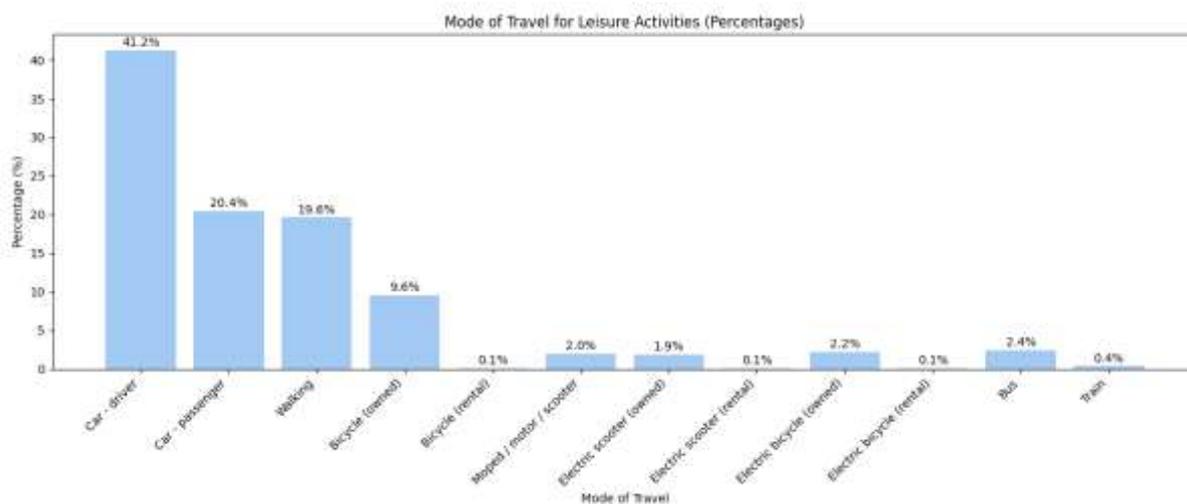


Figure 3: Modality modes choices for leisure activities

The descriptive statistics presented in Table 2 provide a detailed insight into the factors that respondents consider important when choosing a mode of transport. The results show that reliability of the means of transport (M = 4.35) and personal safety (M = 4.26) are the two most highly valued aspects, indicating that functional and safety-related criteria play a central role in mobility decision-making. Both variables also show relatively moderate standard deviations, suggesting consistent responses among participants.

Cost-related and convenience-oriented factors are also rated relatively high. Acceptable costs (M = 4.06), ease of use (M = 4.05), and barriers due to congestion (M = 3.98) represent important practical considerations. These values point toward a general preference for transportation options that are affordable, straightforward, and able to minimize delays. The importance of parking availability and price (M = 3.97) further emphasizes the relevance of car-oriented infrastructure for the sample.

Efficiency-oriented factors—such as short travel times (M = 3.95) and adaptability to personal needs (M = 3.93)—show slightly lower but still substantial mean scores. This indicates that, although speed and flexibility matter, they are somewhat less dominant than reliability and safety. Meanwhile, factors such as travel distance (M = 3.83), comfort during travel (M = 3.83), and suitable travel timing (M = 3.78) remain moderately important, reflecting a general desire for convenience and well-structured travel conditions.

Elements associated with public transport, including timetables and schedules (M = 3.72) and availability of alternatives (M = 3.71), show mid-range means accompanied by higher standard deviations, especially for public transport schedules (SD = 1.685). This suggests more diverse experiences or perceptions among respondents, likely related to differences in geographic location, frequency of service, or personal dependence on public transport.

Lower-rated factors include environmental impacts (M = 3.16) and fun/enjoyment of use (M = 3.03). These results imply that sustainability and enjoyment are not primary considerations for most respondents when choosing their transport mode. Interestingly, privacy (M = 3.51) and door-to-door transport options (M = 3.39) are also rated as moderately important, which aligns with the generally higher preference for private vehicles observed in other parts of the study.

Overall, the results illustrate that users prioritize functional, safety-related, and cost-related criteria over experiential or environmental aspects. The findings highlight the importance of improving reliability, safety, and affordability across mobility systems, while also offering insight into potential barriers to adopting more sustainable or alternative modes of transport.

Table 2: Descriptive statistics: importance of different factors when choosing mobility mode

Factor	N	Mean	SD
Reliability of the means of transport	1135	4.35	1.534
Personal safety	1135	4.26	1.523

Acceptable costs	1135	4.06	1.553
Ease of use	1135	4.05	1.516
Barriers due to traffic congestion	1135	3.98	1.514
Availability and price of parking	1135	3.97	1.548
Short travel time	1135	3.95	1.561
Adaptability to my needs	1135	3.93	1.506
Travel distance	1135	3.83	1.582
Comfort during travel	1135	3.83	1.527
Travel schedule (hour/day)	1135	3.78	1.542
Public transport timetables	1135	3.72	1.685
Availability of alternatives	1135	3.71	1.554
Weather conditions	1135	3.68	1.561
Luggage capacity	1135	3.68	1.574
Availability of information	1135	3.64	1.587
Safe transport of children	1135	3.63	1.862
Passenger capacity	1135	3.58	1.606
Privacy	1135	3.51	1.617
Door-to-door transport option	1135	3.39	1.601
Environmental impacts	1135	3.16	1.581
Enjoyment of use	1135	3.03	1.58

The results presented in Table 3 reveal a complex and uneven landscape of transport accessibility, availability, and ease of use across different modes. The findings illustrate the coexistence of traditional transport behaviours with emerging mobility options, showing that users' mobility choices are influenced by a combination of infrastructural, socio-economic, and experiential factors. Car accessibility—whether as a driver (86.3%) or as a passenger (91.9%)—is notably the highest among all transport modes. This pattern is consistent with mobility trends in many cities where private car ownership remains widespread, and road infrastructure is optimized primarily for motorised transport. The high ease-of-use ratings (76.8% and 68.5%) further reinforce the central role of cars in everyday mobility. These findings indicate that the private car continues to serve as a convenient, reliable, and socially dominant mode of transport, maintaining its status even amid increasing discussions about sustainability. However, this reliance on car travel also highlights potential barriers to the

adoption of more sustainable alternatives. High accessibility and ease of use form a strong behavioural lock-in: users already perceive the car as both available and effortless, reducing motivation to transition to low-carbon modes unless infrastructure or policy changes shift these perceptions.

Active modes—particularly walking and personal bicycle use—show substantially lower accessibility and ease-of-use scores compared to motorised modes. Walking is reported inaccessible by 58.5% of respondents, and only 18.3% perceive it as easy to use. These results may reflect several structural issues: long commuting distances, inadequate pedestrian infrastructure, poor weather conditions, or perceived safety limitations. The low ease-of-use score suggests that walking is not merely physically demanding for some users but may also be perceived as impractical in existing transport networks. Similarly, personal bicycle use exhibits low accessibility (15.4%) and low ease-of-use (11.5%). Factors such as lack of dedicated cycling infrastructure, hilly terrain, safety concerns, or insufficient bicycle ownership may contribute to these perceptions. The data imply that despite being a central focus of sustainable mobility policies, active modes may require significant urban design improvements before they become viable alternatives to car travel.

Public transport modes show mixed results. While train accessibility is relatively high at 59.5%, bus accessibility is disproportionately low at 15.9%. This discrepancy may be linked to route coverage, service frequency, scheduling reliability, or geographic distribution of stations and stops. The ease-of-use data further emphasise these challenges: only 15.9% find buses easy to use, compared with 44.3% for trains. The comparatively better performance of trains may be associated with simpler route structures, higher comfort, or predictable schedules. In contrast, bus networks often require more complex route navigation, involve more transfers, and are more susceptible to traffic delays. Overall, these results suggest that the public transport system faces limitations that reduce its competitiveness against private cars or even emerging micro-mobility options.

The data reveal two contrasting trends within micro-mobility. Private electric scooters, skateboards, and similar devices show high ease-of-use ratings (75–86%), indicating strong user comfort once access is available. However, accessibility remains uneven. For example, private e-scooters are accessible to 73.4% of respondents, whereas private e-bicycles are accessible to only 11.5%. This discrepancy may reflect differences in ownership cost, storage needs, or familiarity. Shared micro-mobility systems—such as shared bicycles and shared e-scooters—show generally low accessibility (11.5–17.6% for shared bicycles; 64.1% for shared e-scooters). These patterns suggest that the physical availability of shared vehicles is inconsistent across urban areas. Despite this, ease-of-use remains moderate to high, indicating that once users locate a shared vehicle, they typically find it simple to operate. This combination of low accessibility but high usability suggests missed potential for micro-mobility. Expanding station density, improving fleet redistribution, and integrating shared systems with public transport nodes could increase adoption and address first- and last-mile mobility needs.

Table 3: Accessibility, availability, and ease of use of different modes of transport

Modes of transport	Accessibility and availability (in %)			Ease of use (in %)		
	No	Yes	Missing	No	Yes	Missing
Car – as a driver	10,7%	86,3%	3%	20%	76,8%	3,2%
Walking	58,5%	38,4%	3,1%	78,5%	18,3%	3,2%
Car – as a passenger	5,8%	91,9%	3,1%	28,1%	68,5%	3,3%
Bicycle (own)	82%	15,4%	2,6%	85,6%	11,5%	2,9%
Bus	78,4%	15,9%	2,4%	78,4%	15,9%	5,7%
Train	35,9%	59,5%	4,7%	50,7%	44,3%	4,9%
Moped, motorcycle, scooter	82,5%	14,5%	3%	21,9%	75,2%	3%
Electric bicycle (own)	85,6%	11,5%	2,9%	82,7%	14,3%	3%
Electric scooter (own)	21,6%	73,4%	5%	9,1%	86,4%	4,5%
Bicycle (shared public system)	85,6%	11,5%	2,9%	82,7%	14,3%	3%
Skateboard, kick scooter, rollerblades, etc.	43,2%	53,9%	2,9%	10,3%	85,1%	4,6%
Electric scooter (shared system)	31,5%	64,1%	4,4%	61 %	34,4%	4,6%
Electric bicycle (shared system)	77,4%	17,6%	4,9%	83,2%	11,9%	4,9%

Conclusion

This study provides a comprehensive assessment of modal choice, accessibility, and user attitudes within an urban mobility context, revealing a mobility landscape still overwhelmingly dominated by private car use across all trip purposes. Despite increasing policy attention to sustainable transport strategies, active mobility, public transport, and micromobility modes—particularly e-scooters—remain marginal in daily travel behaviour. The results indicate a persistence of car-oriented mobility structures supported by high accessibility, ease of use, and entrenched travel habits.

E-scooters, both privately owned and shared, represent an emerging but still limited component of the modal distribution. Usage frequencies across all trip purposes remain below one day per week on average, situating e-scooters among the least utilized modes in

the dataset (mean \approx 0.3 days for private and 0.08 days for shared systems). Their role in commuting, shopping, and leisure trips is similarly modest, with less than 1% of respondents identifying e-scooters as their primary mode for these purposes. This low uptake suggests that e-scooters have not yet achieved functional relevance in meeting regular mobility needs in the studied population.

Nevertheless, the attitudinal and accessibility data point to untapped potential. Private e-scooters display comparatively high accessibility (73.4%) and notably high ease-of-use perceptions (86.4%), indicating that once individuals have access to the device, operational barriers are minimal. Shared e-scooter systems show moderate accessibility (64.1%) and relatively strong usability ratings, although their spatial availability appears inconsistent. These findings imply that infrastructural and systemic constraints—rather than negative user perceptions—constitute the primary barriers to broader adoption.

In contrast, other active and sustainable modes exhibit simultaneously low accessibility and low ease-of-use, suggesting that e-scooters may be comparatively better positioned to expand if infrastructural and regulatory frameworks are strengthened. Yet their marginal role in current mobility patterns reflects structural dependencies on private car travel, insufficient integration with public transport networks, and limited dedicated micromobility infrastructure.

Overall, the findings underscore the need for more deliberate urban mobility policies that address accessibility gaps, improve safety and infrastructure for micromobility, and incorporate e-scooters into multimodal transport planning. Enhancing station density, ensuring consistent fleet distribution, and developing protected micromobility corridors may facilitate greater uptake. Given their high ease-of-use ratings and flexibility for short distances, e-scooters hold potential to support first- and last-mile connectivity and reduce car dependence—yet realizing this potential requires coordinated improvements across infrastructure, regulation, and public transport integration.

E-SCOOTER USER ANALYSIS

The study on e-scooter use in Slovenia provides a comprehensive insight into this increasingly widespread form of micromobility. It focuses on user behaviour, motivations, safety perceptions, infrastructure, rule compliance, and the broader context in which e-scooters are used. The analysis is based on a representative sample of 134 participants and combines descriptive data with in-depth factor-analytic models, enabling an understanding of both visible and latent behavioural patterns.

Users most frequently ride e-scooters on cycle tracks, cycle lanes, urban roads and, to a considerable extent, on sidewalks. E-scooters are most commonly used for leisure and daily errands, somewhat less for commuting to work, and only rarely for school or tourism. A typical ride covers around five kilometres, although the average indicates the presence of some longer and occasionally very long trips. The findings also show that users mostly avoid the riskiest behaviours. Riding under the influence or using a handheld phone is uncommon, although protective equipment is not used consistently. From a safety perspective, the most prominent issues include infrastructural shortcomings such as high or poorly lowered curbs, damaged road surfaces, and a lack of continuous cycling infrastructure, as well as cars overtaking too closely, which reduces riders' sense of safety.

Motivational factors reveal that e-scooters are primarily valued as an efficient and convenient means of transport. Riding is faster than walking, helps avoid car use, and provides a comfortable option, particularly in hot weather. Practical aspects therefore dominate, complemented by moderately important considerations such as environmental friendliness and cost-effectiveness. Feelings of safety or gaining physical activity play a smaller role compared to convenience and utility.

A crucial finding concerns the legal understanding of where e-scooters may be used. While users are highly accurate in recognising that cycling infrastructure is permitted, understanding of legality on sidewalks and in pedestrian zones is extremely low. This leads to widespread misinterpretation and incorrect choice of riding surfaces, revealing a critical gap in the clarity and communication of existing regulations.

Socio-demographic differences among users prove largely insignificant. Age, gender, education, income, and driving licence possession seldom influence behavioural patterns, motivations, or safety perceptions. The only consistently important contextual factor is place of residence: urban users would most likely switch to car travel if e-scooters were unavailable, whereas rural residents tend to rely more on public transport or other forms of micromobility. Context thus shapes behaviour more strongly than demographics. In addition, longer rides tend to combine higher levels of both risky and protective behaviour, while younger users more frequently engage in phone or audio use during riding.

When considering measures to improve rule compliance, users express the strongest support for increased enforcement. Enhanced police or municipal monitoring is perceived as the most effective approach, followed by higher fines and awareness campaigns. Mandatory registration or testing receives weaker endorsement. These preferences suggest that a balanced combination of enforcement and educational initiatives is more acceptable than additional administrative obligations.

The summary of key challenges points to three particularly problematic areas: infrastructural deficiencies, unclear regulation, and conflict-prone interactions with motor traffic. Because e-scooters often fill a gap in the wider transport system and are used mainly for short distances, they cannot be addressed in isolation. Improvements in infrastructural continuity, regulatory clarity, and the design of high-risk urban zones could substantially reduce both safety risks and rule violations.

Against this backdrop, the report concludes with clear recommendations. Better, continuous, and high-quality infrastructure tailored to bicycle and e-scooter mobility is essential. Equally important is consistent communication of rules on where e-scooter riding is permitted, as gaps in understanding substantially increase risks. Enhanced enforcement, complemented by targeted awareness efforts, appears to be the most promising approach to increasing safety and compliance. Future solutions should support the integration of e-scooters into the broader transport ecosystem, simplify multimodal travel, and specifically address user groups that display somewhat riskier patterns.

Overall, the findings show that e-scooters in Slovenia are used thoughtfully, relatively safely, and with clearly recognised practical advantages, while the greatest challenges stem from the unpreparedness of the built environment and insufficiently defined systemic support. The research thus lays solid groundwork for improvements that could significantly enhance the sustainability and safety of contemporary micromobility.

Introduction

The rapid growth of electric scooters as a form of micromobility has significantly affected contemporary transport systems, particularly in urban environments where different transport modes, regulatory frameworks, and infrastructure types intersect. Electric scooters offer a flexible and efficient alternative to motorised travel, yet their increasing presence in everyday traffic also raises important concerns related to safety, rule compliance, infrastructure allocation, and rider behaviour.

In many contexts, the uptake of e-scooters has occurred faster than the adaptation of traffic regulations and infrastructure, resulting in inconsistencies between actual riding practices, perceived legality, and expected behaviour in shared traffic spaces. A detailed understanding of how e-scooter users behave in traffic, as well as which factors influence their riding decisions, is therefore essential for the development of evidence-based safety measures and sustainable mobility policies.

This study is based on a survey questionnaire specifically designed for users of electric scooters in Slovenia. The full questionnaire consists of 31 questions covering a broad range of topics related to e-scooter use. In this report, however, the analysis focuses on 13 substantive questions that address how e-scooter riders behave in traffic and which factors shape their riding practices. These questions capture patterns of use, self-reported behaviour, perceived safety, and key influences on the decision to use an e-scooter in different traffic environments. In addition, nine socio-demographic questions are examined in order to better understand the role of user characteristics in shaping riding behaviour and safety-related perceptions.

By combining behavioural and contextual information with socio-demographic data, the study provides a structured insight into e-scooter use that goes beyond descriptive accounts and allows for a more nuanced interpretation of rider behaviour within the existing transport system.

Contribution of the report

The main contribution of this report lies in its comprehensive and multidimensional analysis of e-scooter use, integrating behavioural, perceptual, infrastructural, and socio-demographic perspectives within a single empirical framework. Rather than examining isolated variables, the study identifies broader underlying dimensions of motivation, riding behaviour, perceived safety, and attitudes towards regulatory measures through factor-analytical approaches.

An important contribution of the report is the empirical demonstration of substantial inconsistencies between actual riding behaviour and perceived legal permissibility of different traffic environments, highlighting regulatory ambiguity as a key factor in

non-compliant riding practices. In addition, the results provide robust evidence that socio-demographic characteristics explain relatively little variation in most behavioural patterns, pointing to a largely homogeneous user population, while still revealing meaningful differences linked to age, travel purpose, and prior traffic accident involvement.

Finally, the study systematically documents the role of infrastructure quality and interactions with motor traffic as dominant elements shaping riders' perceived safety, thereby reinforcing the importance of spatial and infrastructural conditions in discussions of micromobility safety.

Structure of the report

The report is structured to guide the reader from contextual background to detailed empirical analysis. Following the introduction, sample characteristics are presented to establish the analytical framework. The subsequent sections report descriptive findings on e-scooter use and riding behaviour, followed by factor analyses that identify key factors underlying motivations, behaviours, safety perceptions, and regulatory attitudes. The later sections examine associations between these dimensions and socio-demographic and travel-related variables. The report concludes with an interpretative discussion of the findings and offers recommendations relevant to policy, infrastructure planning, and future research.

All results presented in the report are reported using appropriate descriptive and inferential statistics. Where relevant, measures of effect size are provided to support the interpretation of statistical significance.

Survey results and analysis

This chapter presents the results of the survey on electric scooter use in Slovenia. The findings are organised thematically, following the questionnaire's structure and the study's analytical approach.

Sample description

The sample consisted of 134 participants from Slovenia. Among them, 80 respondents identified as men (59.7%) and 54 women (40.3%). Participants ranged in age from 15 to 65 years, with a mean age of 39.90 years (SD = 12.84).

Most respondents (78.68%, n = 107) reported not being involved in any e-scooter-related traffic accidents. A total of 25 respondents indicated some form of involvement: as e-scooter riders (7.35%, n = 10), as other road users (4.41%, n = 6), or as witnesses (8.82%, n = 12). As multiple responses were permitted, the total number of reported witness cases exceeds the number of respondents who selected this option (n=18). A small proportion (2.94%, n = 4) did not provide an answer to this question.

The socio-demographic characteristics of the respondents indicate a heterogeneous sample across education, employment status, and place of residence. Table 1 presents a detailed overview of the sample characteristics, including gender, age, driving licence status, employment status, highest level of completed education, place of residence, net disposable household income, and involvement in e-scooter-related incidents.

Table 2. Descriptive data

Variable	Category	n	f (%)
Gender	Male	78	57.35
	Female	54	39.71
Age	15-24 years	23	16.91
	25-34 years	22	16.18
	35-44 years	39	28.68
	45-54 years	31	22.79
	55-65 years	19	13.97
	Without answer	2	1.47
Driving licence status	Motorcycles (categories A, A1, A2)	59	43.38
	Passenger car (category B)	122	89.71
	Goods vehicle over 3.5 t (categories C, C1, CE)	13	9.56
	Buses and other motor vehicles for carrying passengers with more than 8 seats (categories D, D1)	1	0.74

	Without any driving licence	1	0.74
Employment status	Student	18	13.24
	Employed (in an employment relationship)	94	69.12
	Self-employed	9	6.62
	Farmer status or independent cultural worker or similar	2	1.47
	Retired	4	2.94
	Unemployed	5	3.68
	Other	1	0.74
	Without answer	3	2.21
Highest level of education completed	Primary school	3	2.21
	Vocational secondary school	22	16.18
	General secondary school or grammar school	32	23.53
	Post-secondary vocational education (or Higher vocational education)	17	12.50
	College education (or Higher education)	22	16.18
	University education	23	16.91
	Specialization	0	0.00
	Master's degree	12	8.82
	Doctorate (PhD)	2	1.47
Place of residence	In the city	59	43.38
	In the suburbs	35	25.74
	In the countryside	39	28.68
Net disposable income per household member	Below average	40	29.41
	Approximately average (+/- 10% of that amount)	47	34.56
	Above average	28	20.59
	Prefer not to answer	18	13.24
Involvement in an incident	No	107	78.68
	Yes, as an e-scooter rider	10	7.35
	Yes, as another road user	6	4.41
	Yes, as a witness	12	8.82
	Without answer	4	2.94
Type of incident or crash	Collision with a pedestrian	4	16
	Collision with a car	11	44
	Collision with another vehicle	6	24
	Collision with an object	3	12
	Fall due to poor infrastructure	7	28
	Fall due to inattentiveness	6	24
	Technical issues	0	0
	Other	0	0

Building on the sample characteristics presented above, the next section summarises the descriptive findings related to e-scooter use. The descriptive results section covers typical riding environments, travel distances and speeds, multimodal travel behaviour, trip

purposes, and perceived decision factors. Results provide an overview of where and how respondents use e-scooters in everyday contexts and form the basis for subsequent analyses.

Descriptive results

Riding environments

The results in Table 2 show that respondents most frequently ride e-scooters on cycling infrastructure. Dedicated cycle paths or tracks are reported by more than three-quarters of respondents (75.74%).

In addition, over half of respondents report riding on marked cycling lanes on the roadway (53.68%) and on roads within built-up areas without designated cycling infrastructure (48.53%). Nearly half of respondents (49.26%) indicate that they also ride on sidewalks, while 30.88% report riding in pedestrian zones. Non-public traffic surfaces, such as private yards or playgrounds, are used by 30.15% of respondents. Roads outside built-up areas represent the least frequently reported riding environment (19.85%).

Regarding compliance with traffic regulations, 50 respondents (36.76%) report never riding on prohibited surfaces, such as sidewalks or roads outside built-up areas. In contrast, 59.56% of respondents admit to riding in prohibited areas at least occasionally. However, this result should be interpreted with caution, as the question does not allow assessment of whether respondents were aware that these surfaces were prohibited at the time of riding.

Among respondents who report non-compliant behaviour, the largest group consists of those who ride on sidewalks but avoid riding on roads outside built-up areas (39.71%). A smaller group of respondents (10.29%) ride on roads outside built-up areas but not on sidewalks, while 9.56% report using both prohibited surfaces.

Table 3. Distribution of riding surfaces reported by e-scooter users

Riding surfaces	n	f (%)
In a pedestrian zone	42	30.88
On the sidewalk	67	49.26
On a dedicated cycle path or track	103	75.74
On a marked cycling lane on the roadway	73	53.68

On a road within a built-up area without a designated cycling facility	66	48.53
On a road outside a built-up area	27	19.85
On areas that are not public traffic surfaces (e.g., private yard, playground)	41	30.15

Substitution patterns

The next question examined potential substitution patterns by asking respondents which mode of transport they would use for trips currently made by e-scooter if the e-scooter were unavailable. The results are presented in Table 3.

The most frequently reported substitute is private car use as a driver, selected by 59 respondents (43.38%). Active transport modes collectively represent a substantial share of potential substitutions. Walking is reported by 25 respondents (18.38%), personal regular bicycles by 27 respondents (19.85%), public bike-sharing systems by 7 respondents (5.15%), and personal electric bicycles by 11 respondents (8.09%).

In contrast, public transport options are rarely selected. Only two respondents (1.47%) report substituting e-scooter trips for bus travel, and one respondent (0.74%) reports substituting e-scooter trips for train travel. Motorised two-wheelers are almost absent, with only one respondent (0.74%) indicating this option, while substitution with non-motorised micromobility modes (e.g., skateboard or kick scooter) is not reported.

When grouped into broader categories, active transport modes account for just over half of all responses (51.47%), while private motorised transport represents 44.85%. Public transport accounts for only a marginal share of substitutions (2.21%).

Table 4. Substitution patterns for trips currently made by e-scooter

Substitution for trips by e-scooter		
Substitution for trips by e-scooter	n	f (%)
Car – as a driver	59	43.38
Car – as a passenger	2	1.47
Walking	25	18.38
Regular bicycle (personal)	27	19.85
Regular bicycle (rented from a public bike-sharing system)	7	5.15
Moped, motorcycle, scooter	1	0.74
Skateboard, kick scooter, rollerblades and similar	0	0.00
Electric bicycle (personal)	11	8.09

Electric bicycle (rented from a public bike-sharing system)	0	0.00
Bus	2	1.47
Train	1	0.74
No answer	1	0.74
Sum	136	100

Typical trip distance

In addition to riding environments and substitutes, respondents were asked to estimate the typical one-way distance of their e-scooter trips. Figure 1 illustrates the distribution of self-reported typical one-way e-scooter trip distances, expressed in kilometres. The distribution is centred around shorter distances, with a median and mode of 5 km, indicating that most e-scooter trips are relatively short.

The mean trip distance is notably higher ($M = 6.86$ km, $SD = 7.38$), reflecting a right-skewed distribution with a long tail of longer journeys. While most trips fall within a short-to-medium distance range, a smaller number of respondents report substantially longer trips, with distances extending up to 45 km.

Overall, the results suggest that e-scooters are predominantly used for short-distance travel, with a limited number of longer trips.

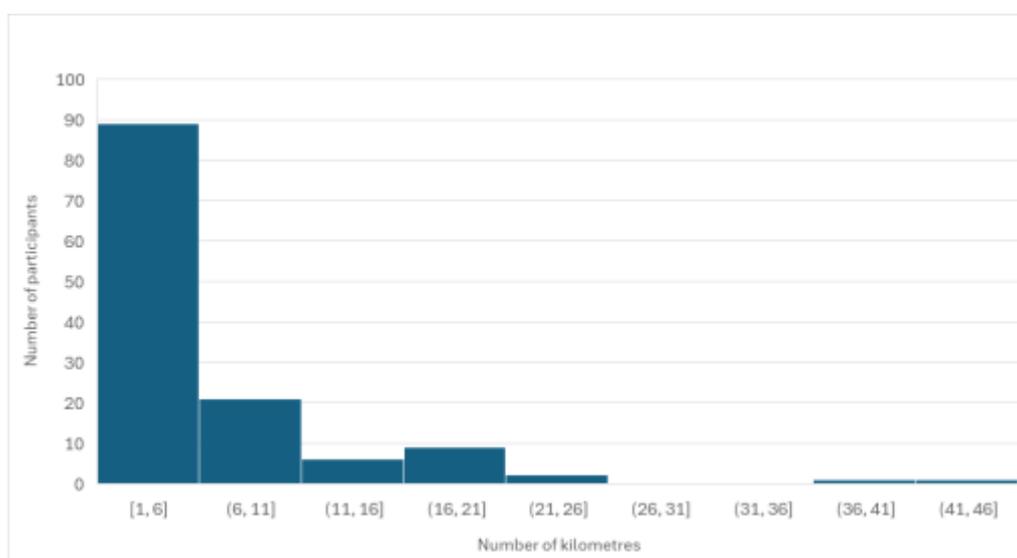


Figure 1. Typical one-way e-scooter trip distance

Combining the e-scooter with other transport modes

In addition, respondents were asked whether they combine e-scooter use with other modes of transport within a single trip. The responses show an almost even split: 69 respondents (50.74%) report combining e-scooters with at least one other mode of transport, while 67 respondents (49.27%) report using e-scooters as a standalone mode for their trips.

Table 4 presents the modes most frequently combined with e-scooter use among respondents who reported multimodal trips. Private motorised transport dominates these combinations. E-scooters are most often combined with trips made by private car, driven by the respondent (41 respondents; 59.42%), followed by car use as a passenger (21 respondents; 30.43%).

Public transport also plays a notable role in multimodal e-scooter use. Trains are combined with e-scooters by 20 respondents (28.99%), while buses are reported by 16 respondents (23.19%). Active modes are less frequently combined: 17 respondents (24.64%) report walking as part of the same trip, while regular bicycles (4.35%), shared bicycles (1.45%), and electric bicycles (4.35%) are reported only occasionally.

The remaining modes, including mopeds or motorcycles (2.90%) and small non-motorised micromobility devices such as skateboards or kick scooters (2.90%), are rarely used in combination with e-scooters.

Table 5. Modes combined with an e-scooter on the same trip

Modes combined with an e-scooter	n	f (%)
Car – as a driver	41	59.42
Car – as a passenger	21	30.43
Walking	17	24.64
Regular bicycle (personal)	3	4.35
Regular bicycle (rented from a public bike-sharing system)	1	1.45
Moped, motorcycle, scooter	2	2.90
Skateboard, kick scooter, rollerblades and similar	2	2.90
Electric bicycle (personal)	3	4.35
Electric bicycle (rented from a public bike-sharing system)	1	1.45
Bus	16	23.19
Train	20	28.99

Purposes for using an e-scooter

Respondents were asked to indicate the purposes for which they use an e-scooter. As shown in Table 5, the most frequently reported purposes are leisure activities (61.76%) and errand or daily task trips (60.29%).

Approximately one-third of respondents report using e-scooters for commuting to work (33.09%), while tourism-related trips are reported by 30.15% of respondents. Commuting to school is the least common purpose, reported by 6.62% of respondents.

Beyond respondent trip purposes, e-scooter use is often multi-purpose. A total of 40.44% of respondents report using e-scooters for only one type of trip, while the majority use them for multiple purposes. Specifically, 28.68% of respondents report using e-scooters for two types of trips, 27.21% for three types, and 2.95% for four or more types.

Table 6. Purposes of using an e-scooter

Purpose	n	f (%)
Commute to work	45	33.09
Commute to school	9	6.62
Trips for errands or daily tasks	82	60.29
Leisure activities	84	61.76
Tourism purposes	41	30.15

In addition to trip purposes, respondents were asked to evaluate the importance of different factors influencing their decision to use an e-scooter instead of other modes of transport.

Factors influencing the use of e-scooters

Overall, the use of e-scooters is primarily motivated by practical and utility-related factors. Four items receive particularly high ratings, with approximately three-quarters of respondents assigning scores of 4 or 5. These include avoiding the use of a car (M = 4.13), convenience (M = 4.10), being better than walking in hot weather (M = 4.06), and being faster than walking (M = 3.98).

Economic and value-oriented considerations show moderate importance. Cost effectiveness achieves a mean score of 3.68, with 61.48% of respondents rating it as important or very

important, while environmental friendliness has a slightly lower mean score ($M = 3.57$). In both cases, a substantial proportion of respondents select the neutral midpoint of the scale, indicating that these factors are of mixed or situational relevance.

Enjoyment-related motives present a more heterogeneous pattern. While “fun and relaxation” receives a mean score of 3.53 and is rated as important or very important by 54.41% of respondents, the relatively large proportion of neutral responses suggests that this factor is salient for many users but not a decisive driver for all.

In contrast, safety- and health-related factors are rated as less important on average. Feeling safer from crime while walking ($M = 2.65$), feeling safer from other road users ($M = 2.64$), and getting physical exercise during the trip ($M = 2.68$) all receive lower mean scores and display greater dispersion in responses.

Table 7. Importance of factors influencing e-scooter use

Factors	1	2	3	4	5	No answer	M	SD
Because it is faster than walking.	7 5.15%	4 2.94%	22 16.18%	49 36.03%	53 38.97%	1 0.74%	3.98	1.15
Because it is convenient.	6 4.41%	3 2.21%	20 14.71%	49 36.03%	58 42.65%	0 0.00%	4.10	1.03
Because it is fun and relaxing.	12 8.82%	128.82%	37 27.21%	36 26.47%	38 27.94%	1 0.74%	3.53	1.29
Because it is better than walking in hot weather.	7 5.15%	3 2.21%	23 16.91%	45 33.09%	58 42.65%	0 0.00%	4.06	1.07
Because it allows me to reach my destination without driving a car.	6 4.41%	6 4.41%	20 14.71%	37 27.21%	67 49.26%	0 0.00%	4.13	1.10
Because it is cost-effective.	10 7.41%	7 5.19%	35 25.93%	42 31.11%	41 30.37%	1 0.74%	3.68	1.23
Because it is environmentally friendly.	11 8.09%	10 7.35%	43 31.62%	34 25.00%	38 27.94%	0 0.00%	3.57	1.20
Because I feel safer from crime when using it compared to walking.	40 29.41%	24 17.65%	35 25.74%	18 13.24%	19 13.97%	0 0.00%	2.65	1.39
Because I also get exercise during the trip.	32 23.53%	27 19.85%	47 34.56%	13 9.56%	17 12.50%	0 0.00%	2.68	1.28
Because I feel safer from other road users when riding an e-scooter.	29 21.32%	27 19.85%	52 38.24%	14 10.29%	13 9.56%	1 0.74%	2.64	1.24

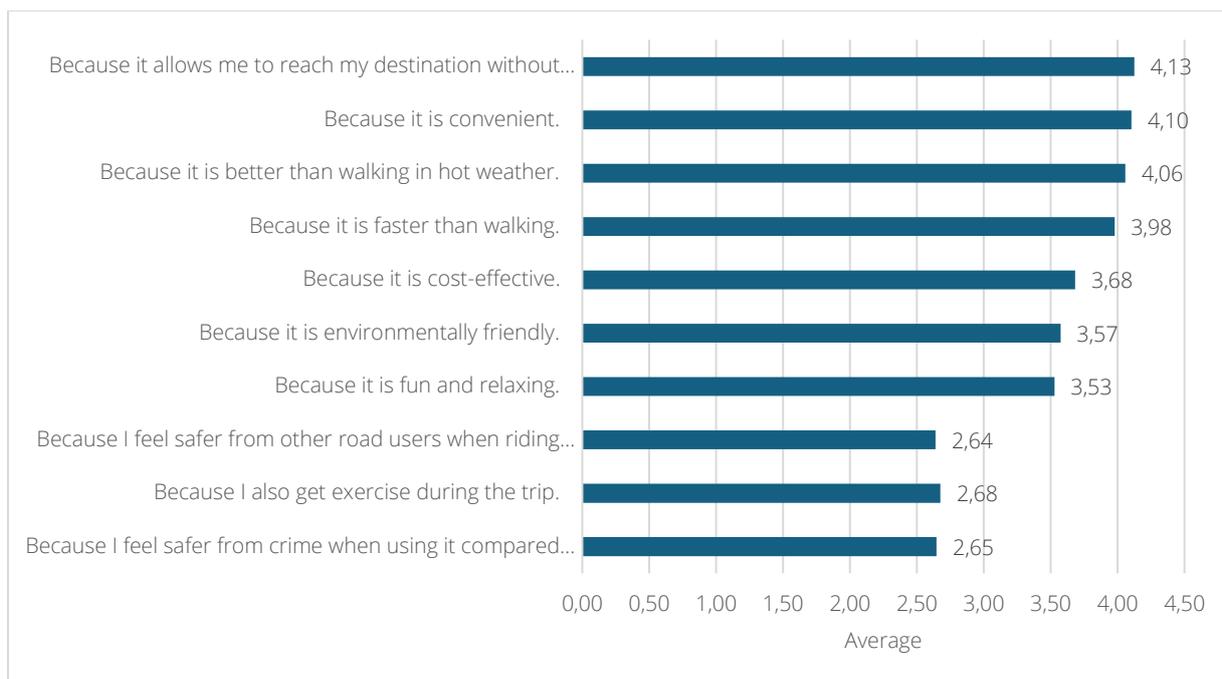


Figure 2. Mean ratings of decision factors for e-scooter use

Changes in the use of other transport modes

Respondents were asked how their frequency of using other transport modes had changed since they started using an e-scooter. The results are summarised in Table 7.

For most transport modes, respondents report little or no change in usage frequency. The majority indicate that they use cars (67.65%) and walking (58.82%) about the same as before adopting e-scooters. A similar pattern is observed for train travel, with 47.06% of respondents reporting no change.

Nevertheless, two modes show a pronounced tendency towards reduced use. More than half of respondents (51.47%) report using mopeds, motorcycles, and scooters less frequently after adopting e-scooters. A substantial decrease is also reported for bus use, with 44.85% of respondents indicating reduced usage.

Across all modes, a relatively small proportion of respondents report increased usage. For example, 8.09% report increased car use, while 12.50% report walking more often since starting to use an e-scooter.

Table 8. Change in use of other modes since starting to use an e-scooter

Mode	I use it more	I use it about the same	I use it less	No answer

Car – as a driver or passenger	11 8.09%	92 67.65%	32 23.53%	1 0.74%
Walking	17 12.50%	80 58.82%	38 27.94%	1 0.74%
Regular or electric bicycle	13 9.56%	66 48.53%	53 38.97%	4 2.94%
Moped, motorcycle, scooter	10 7.35%	51 37.50%	70 51.47%	5 3.68%
Bus	12 8.82%	60 44.12%	61 44.85%	3 2.21%
Train	15 11.03%	64 47.06%	53 38.97%	4 2.94%

Typical riding speed

Respondents were asked to estimate their typical riding speed when using an e-scooter during ordinary rides, excluding special environments such as pedestrian zones. The distribution of self-reported speeds is shown in Figure 3.

Reported riding speeds are strongly clustered around 20 km/h. The mean speed is 19.81 km/h (SD = 7.47), while the median and mode are both 20 km/h, indicating a clear preference for this speed.

Variability in riding speed is moderate. Based on the mean and standard deviation, most reported speeds fall within a range of approximately 12 to 27 km/h. However, the full range of responses is wide, extending from very low speeds (2 km/h) to high speeds of up to 50 km/h, suggesting occasional instances of unusually slow or fast riding.

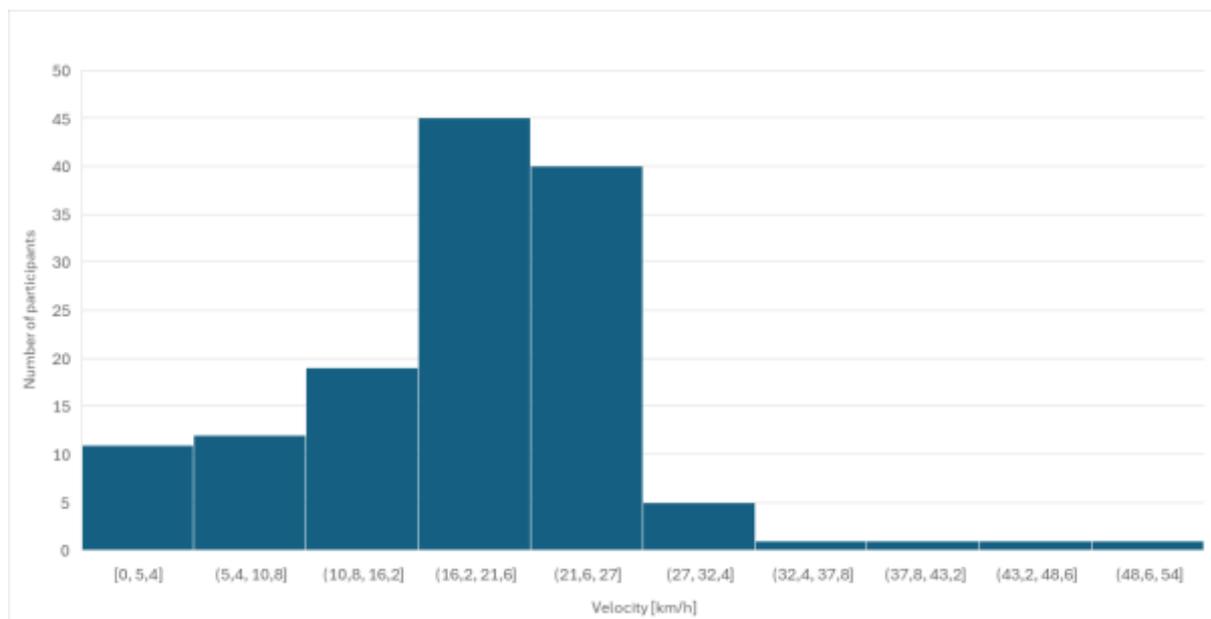


Figure 3. Distribution of self-reported e-scooter riding speeds (km/h)

Perceived permissible areas

After addressing several other questions, we asked respondents to clarify whether they believed riding an e-scooter was allowed in the specified areas (see Table 8).

Most respondents correctly identify cycling infrastructure as permissible for e-scooter use. A dedicated cycle path or track is selected by 84.56% of respondents, while 72.06% consider marked cycling lanes on the roadway to be allowed. Roads within built-up areas without designated cycling facilities are also frequently perceived as permissible (57.35%).

At the same time, substantial uncertainty is evident regarding shared and non-standard traffic environments. Pedestrian zones are considered permissible by 21.32% of respondents, while 28.68% indicate that riding on sidewalks is allowed. In addition, nearly one-third of respondents (32.35%) believe that riding on roads outside built-up areas is permitted.

Non-public traffic surfaces, such as private yards or playgrounds, are perceived as permissible by 38.24% of respondents, suggesting that some respondents interpret these spaces as falling outside formal traffic regulation.

Overall, despite relatively high recognition of cycling infrastructure as permissible, the accuracy of responses across all locations is low. Only one respondent selected exclusively those areas that are legally permitted under current regulations, indicating widespread uncertainty regarding the legal framework for e-scooter use.

Table 9. Perceived permissible areas for e-scooter use

Perceived permissible areas	n	f (%)
In a pedestrian zone	29	21.32
On the sidewalk	39	28.68
On a dedicated cycle path or track	115	84.56
On a marked cycling lane on the roadway	98	72.06
On a road within a built-up area without a designated cycling facility	78	57.35
On a road outside a built-up area	44	32.35
On areas that are not public traffic surfaces (e.g., private yard, playground)	52	38.24

Self-reported riding behaviour

Respondents were asked to report how frequently they engage in a range of behaviours when riding an e-scooter. Responses were collected on a five-point scale, ranging from 1 (“never”) to 5 (“always”). The results are presented in Table 9.

Overall, the self-reported frequency of most risky behaviours is low, indicating generally cautious riding practices among respondents. Behaviours such as riding under the influence of alcohol or other prohibited substances ($M = 1.48$), using a handheld mobile phone while riding ($M = 1.52$), and crossing intersections against a yellow or red traffic signal ($M = 1.60$) are reported as “never” by a clear majority of respondents. Similarly, near-collision incidents when turning ($M = 1.46$) and misjudging the speed of other road users while overtaking ($M = 1.58$) are rarely reported.

Several behaviours, however, show higher average frequencies and greater variability. Listening to music through headphones ($M = 1.93$) and using a hands-free mobile phone while riding ($M = 1.91$) indicates a moderate level of engagement in potentially distracting activities. Speed-related behaviours also warrant attention: while riding above 25 km/h is relatively uncommon ($M = 1.90$), riding above 5 km/h in pedestrian zones stands out with a higher mean score ($M = 2.64$), suggesting more frequent deviations from recommended speed limits in shared spaces.

Positioning-related behaviours, such as riding very close to pedestrians or other road users ($M = 1.76$) or riding on the wrong side of the lane ($M = 1.72$), are generally infrequent but not absent. Quick acceleration at traffic lights occurs occasionally ($M = 1.90$), reflecting competitive or time-saving behaviour among a minority of riders.

In contrast to the generally low frequency of overtly risky behaviours, the use of protective equipment shows substantial variation. Helmet use has a mean score of 2.88, with respondents reporting both consistent non-use and habitual use. A similar pattern is observed for the use of reflective accessories ($M = 2.80$), suggesting inconsistent adoption of protective measures despite relatively cautious riding behaviour in other domains.

Table 10. Self-reported riding behaviours when using an e-scooter

Behaviour	1	2	3	4	5	No answer	M	SD
I use a mobile phone hands-free while riding (headphones, speaker, etc.).	80 58.82%	13 9.56%	21 15.44%	13 9.56%	7 5.15%	2 1.44%	1.91	1.27
I use a mobile phone while riding, holding it in my hands.	102 75.00%	10 7.35%	15 11.03%	2 1.47%	6 4.41%	1 0.74%	1.52	1.05
I listen to music through headphones.	81 59.56%	15 11.03%	18 13.24%	9 6.62%	12 8.82%	1 0.74%	1.93	1.34
I use a protective helmet.	46	15	22	13	39	1	2.88	1.65

	33.82%	11.03%	16.18%	9.56%	28.68%	0.74%		
I use reflectors (such as reflective accessories).	40 29.41%	26 19.12%	22 16.18%	13 9.56%	33 24.26%	2 1.48%	2.80	1.56
I ride under the influence of alcohol or other prohibited substances.	104 76.47%	12 8.82%	10 7.35%	3 2.21%	6 4.41%	1 0.74%	1.48	1.04
I cross an intersection when the traffic light is yellow or red.	97 71.32%	14 10.29%	12 8.82%	5 3.68%	7 5.15%	1 0.74%	1.60	1.13
I ride at a speed above 25 km/h.	80 58.82%	20 14.71%	16 11.76%	6 4.41%	13 9.56%	1 0.74%	1.90	1.33
I ride at a speed above 5 km/h in a pedestrian zone.	35 25.74%	30 22.06%	33 24.26%	20 14.71%	16 11.76%	2 1.48%	2.64	1.33
I ride so close to a pedestrian or another road user that I would struggle to stop safely in an emergency.	89 65.44%	16 11.76%	13 9.56%	7 5.15%	10 7.35%	1 0.74%	1.76	1.26
I ride on the wrong side of the lane (or cycle track).	81 59.56%	25 18.38%	20 14.71%	4 2.94%	5 3.68%	1 0.74%	1.72	1.06
I accelerate quickly at a traffic light to overtake another road user.	70 51.47%	27 19.85%	24 17.65%	7 5.15%	6 4.41%	2 1.48%	1.90	1.15
When turning, I almost hit a pedestrian or another road user.	107 78.68%	8 5.88%	11 8.09%	4 2.94%	5 3.68%	1 0.74%	1.46	1.02
I underestimate the speed of an oncoming pedestrian or another road user when overtaking.	98 72.06%	14 10.29%	11 8.09%	6 4.41%	6 4.41%	1 0.74%	1.58	1.10
I carry another person on the e-scooter with me.	85 62.50%	16 11.76%	17 12.50%	11 8.09%	6 4.41%	10.74%	1.79	1.20

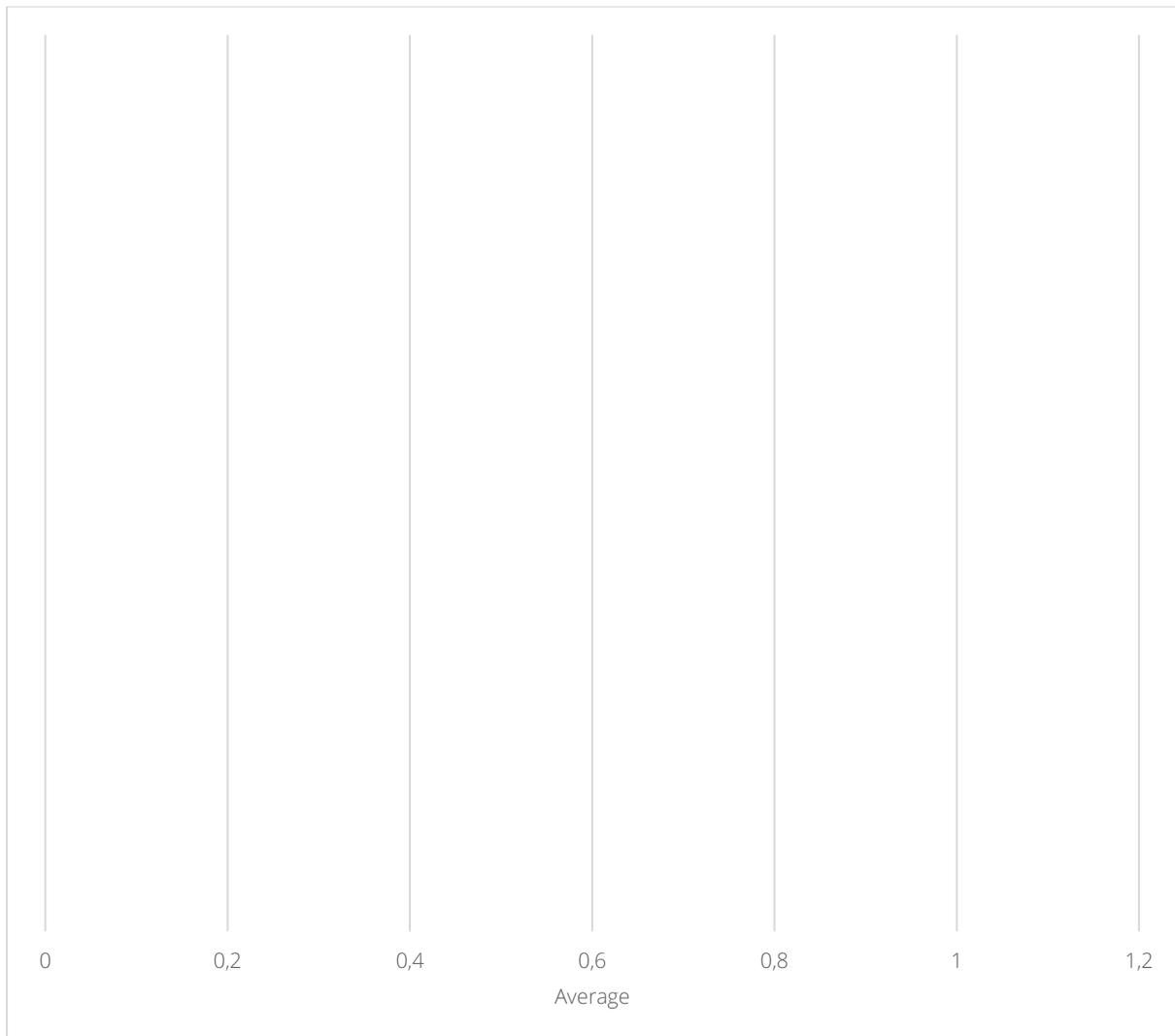


Figure 4. Mean scores for self-reported riding behaviours

Perceived impact of environmental and traffic factors on riding safety

Respondents were asked to assess how frequently various environmental and traffic-related factors hinder their riding experience, cause difficulties, or make them feel less safe when using an e-scooter. Responses were collected on a five-point scale ranging from 1 (“never”) to 5 (“always”), and the results are presented in Table 10.

Infrastructure-related factors emerge as the most prominent sources of discomfort and reduced perceived safety. Excessively high or poorly lowered curbs receive the highest mean score ($M = 4.03$), with 69.85% of respondents reporting that this issue occurs “often” or “always.” Similarly, poor, pothole-ridden road surfaces are reported as a frequent problem ($M = 4.01$), followed closely by a lack of appropriate cycling infrastructure ($M = 3.94$).

In addition to infrastructure deficiencies, interactions with motor traffic constitute a major concern. Cars overtaking without sufficient lateral clearance receive a high mean score ($M =$

3.70), indicating that close encounters with motor vehicles substantially undermine riders' perceived safety.

A second group of factors reflects moderate but still relevant challenges. Heavy car traffic on shared surfaces (M = 3.38), improperly parked vehicles (M = 3.35), and a high number of pedestrians or cyclists in the same space (M = 3.27) are reported as recurring difficulties by a sizeable proportion of respondents.

Other factors are perceived as comparatively less problematic. Interactions with other e-scooter riders receive a lower mean score (M = 2.80), suggesting that peer interactions represent a less significant source of perceived risk than infrastructure quality or motor traffic conditions.

Table 11. Perceived impact of environmental and traffic factors on safety when riding an e-scooter

Traffic factors	1	2	3	4	5	No answer	M	SD
Poor, pothole-ridden road surface.	2 1.47%	8 5.88%	30 22.06%	40 29.41%	54 39.71%	2 1.48%	4.01	1.00
Excessively high curbs or poorly lowered curbs.	2 1.47%	9 6.62%	28 20.59%	39 28.68%	56 41.18%	2 1.48%	4.03	1.02
Lack of appropriate cycling infrastructure.	2 1.47%	10 7.35%	31 22.79%	42 30.88%	49 36.03%	2 1.48%	3.94	1.02
Lack of parking spaces for e-scooters.	28 20.59%	19 13.97%	32 23.53%	22 16.18%	33 24.26%	2 1.48%	3.10	1.46
Other e-scooter riders.	29 21.32%	21 15.44%	48 35.29%	17 12.50%	18 13.24%	4 2.94%	2.80	1.29
Improperly parked vehicles.	16 11.76%	15 11.03%	41 30.15%	30 22.06%	32 23.53%	2 1.48%	3.35	1.29
Heavy car traffic on the surfaces where I ride.	10 7.35%	15 11.03%	49 36.03%	34 25.00%	26 19.12%	2 1.48%	3.38	1.14
High number of pedestrians or cyclists on the surfaces where I ride.	13 9.56%	18 13.24%	48 35.29%	30 22.06%	25 18.38%	2 1.48%	3.27	1.20
Cars are overtaking me without sufficient lateral clearance.	7 5.15%	14 10.29%	34 25.00%	36 26.47%	43 31.62%	2 1.48%	3.70	1.18

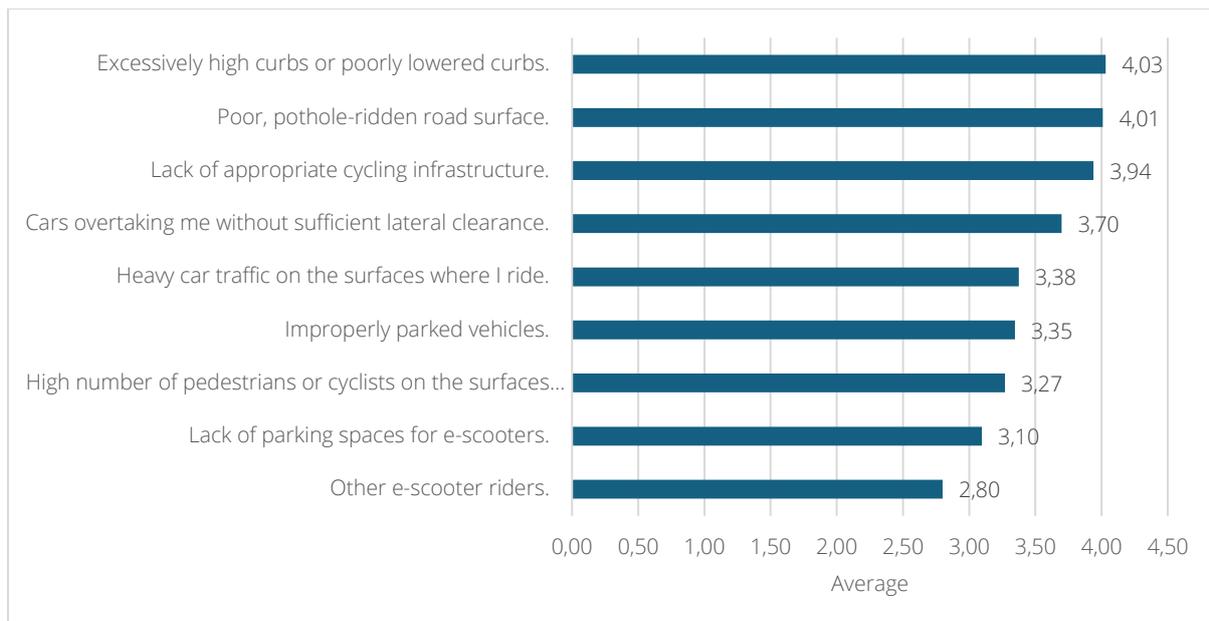


Figure 5. Mean scores for factors affecting safety perception while riding an e-scooter

Perceived effectiveness of measures to improve compliance

Respondents were asked to evaluate how effective different measures would be in encouraging greater compliance with traffic regulations when using an e-scooter. Responses were recorded on a five-point scale ranging from 1 ("never") to 5 ("always"). The results are presented in Table 11.

Enforcement-based measures are perceived as the most effective means of improving compliance. Increased enforcement by police or municipal wardens receives the highest mean score ($M = 3.73$), with 58.70% of respondents indicating that this measure would encourage compliance "often" or "always." Similarly, higher monetary fines are viewed as relatively effective ($M = 3.43$), with 48.55% of respondents rating this measure as "often" or "always" effective.

Educational and informational approaches receive moderate support. Awareness campaigns achieve a mean score of 3.49, with just over half of respondents indicating that such measures would be effective. This suggests that informational interventions are seen as helpful, but less compelling than direct enforcement.

Structural and administrative measures are perceived as less convincing. Mandatory e-scooter registration ($M = 3.13$) and mandatory driving tests ($M = 3.06$) receive lower mean scores and show greater variability in responses, indicating weaker and more divided support among respondents.

Table 12. Perceived effectiveness of measures to improve compliance with traffic regulations when using e-scooters

Measures	1	2	3	4	5	No answer	M	SD
Higher monetary fines	17 12.50%	11 8.09%	41 30.15%	28 20.59%	37 27.21%	2 1.48%	3.43	1.32
Increased enforcement by police or municipal wardens	10 7.35%	6 4.41%	38 27.94%	35 25.74%	44 32.35%	3 2.21%	3.73	1.19
Awareness campaigns	14 10.29%	12 8.82%	37 27.21%	36 26.47%	35 25.74%	2 1.48%	3.49	1.26
Mandatory e-scooter registration (with an identification plate, e.g., registration)	28 20.59%	20 14.71%	27 19.85%	25 18.38%	34 25.00%	2 1.48%	3.13	1.48
Mandatory e-scooter driving test	29 21.32%	21 15.44%	30 22.06%	21 15.44%	33 24.26%	2 1.48%	3.06	1.48

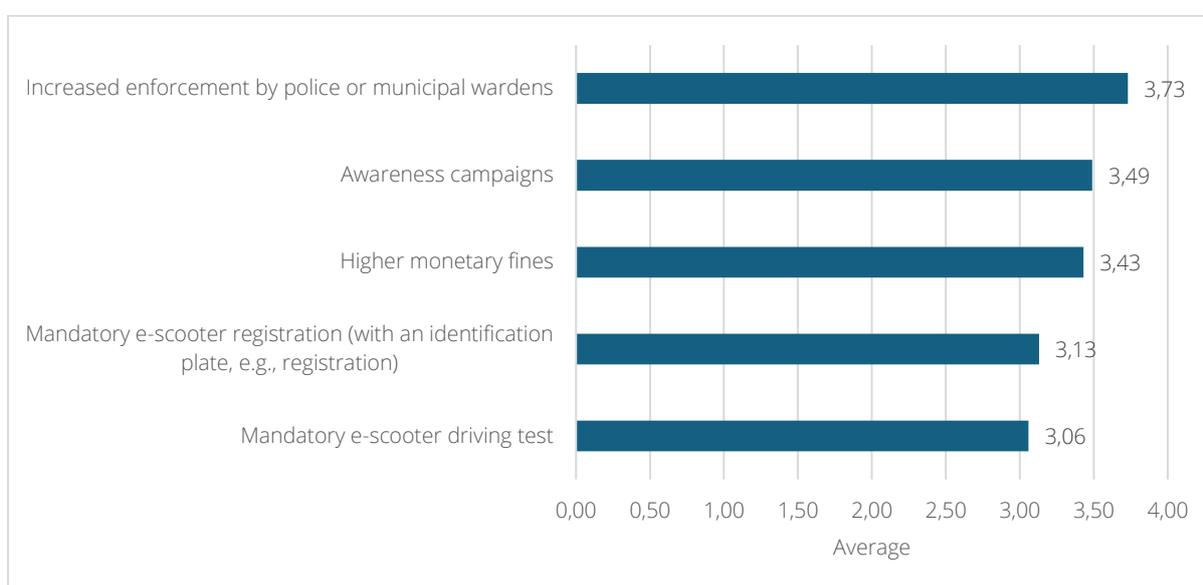


Figure 6. Mean scores for proposed measures to increase compliance

Summary of descriptive results

The descriptive results indicate that e-scooters are used as a flexible and multifunctional mode of transport, integrated into a wide range of everyday travel contexts. Respondents most frequently use e-scooters on cycling infrastructure and urban roads, primarily for short to medium distances, but also occasionally for substantially longer trips. E-scooter use serves multiple purposes—most commonly leisure and daily errands—and is often embedded within multimodal journeys rather than used as a standalone mode of transport.

At the same time, the findings reveal notable tensions between use patterns, perceived safety, and regulatory understanding. While self-reported engagement in overtly risky riding behaviours is generally low, certain practices—such as speed choice in pedestrian zones,

distraction through audio use, and inconsistent use of protective equipment—remain prevalent. Respondents identify infrastructure quality and interactions with motor traffic as the primary sources of reduced perceived safety, and widespread uncertainty persists regarding the legal permissibility of riding in specific environments. In terms of potential improvements, enforcement-based measures are perceived as more effective than educational or administrative approaches in encouraging compliance with traffic regulations.

Taken together, these descriptive insights provide a nuanced picture of e-scooter use that combines elements of utility, convenience, and intramodality with infrastructural and regulatory challenges. They establish the empirical foundation for the subsequent analytical sections, which further explore latent dimensions and relationships between behavioural, perceptual, and socio-demographic variables.

Factor analysis

While the descriptive results presented in the previous section provide a detailed overview of respondent variables, many of the examined items are conceptually related and likely reflect broader underlying dimensions. For example, several decision-making factors capture different aspects of convenience and efficiency, multiple riding behaviours relate to rule compliance and risk-taking, and a range of environmental conditions describe similar types of infrastructural or traffic exposure. Analysing these items in isolation, therefore, offers limited insight into the structure of attitudes, perceptions, and behaviours associated with e-scooter use.

To address this, factor analysis was employed to identify the latent constructs underlying groups of related variables and to reduce the dataset's dimensionality. By examining patterns of correlation among observed variables, factor analysis allows the extraction of conceptually coherent dimensions that capture common variance across multiple items. This approach provides a more parsimonious and interpretable representation of the data while retaining the essential information from the original variables.

The derived factors serve as the basis for subsequent analyses, including the construction of composite scales and the examination of associations among behavioural, perceptual, and socio-demographic variables. By moving from respondent indicators to underlying dimensions, the analysis provides a more robust foundation for interpreting the complex interplay between behaviour, infrastructure, regulation, and safety in e-scooter use.

Structure of motivations for e-scooter use

To examine the underlying structure of motivations for e-scooter use, a factor analysis was conducted on the set of items measuring the importance of decision-making factors presented in Section 2.2.5. Given the conceptual overlap between several items, a data-reduction technique was used to identify coherent latent dimensions that capture common motivational patterns among respondents.

Principal Axis Factoring with Direct Oblimin rotation was applied, as correlations between underlying constructs were theoretically expected. The suitability of the data for factor analysis was confirmed by a high Kaiser–Meyer–Olkin measure of sampling adequacy (KMO = 0.866) and a significant Bartlett’s test of sphericity ($\chi^2(df = 45) = 745.23, p < .001$). Based on the scree plot and interpretability criteria, three factors were retained.

The first factor, labelled **Efficiency and convenience**, captures motivations related to functional advantages of e-scooter use. High factor loadings are observed for items indicating that e-scooters are faster than walking, convenient, allow trips without using a car, and are preferable to walking in hot weather. The item “fun and relaxation” also loads primarily on this factor, suggesting that enjoyment is closely associated with perceived ease and comfort rather than constituting a standalone motivational dimension.

The second factor, termed **Safety and health**, reflects motivations linked to personal security and physical activity. Items loading on this factor include feeling safer from other road users, feeling safer from crime compared to walking, and getting exercise during the trip. This dimension represents a more respondently oriented set of motivations, distinct from the primarily instrumental character of the first factor.

The third factor, labelled **Cost and sustainability**, comprises items related to economic considerations and environmental values, specifically cost-effectiveness and environmental friendliness. Although this factor comprises only two indicators, the items exhibit strong inter-item correlations, indicating a coherent motivational dimension centred on longer-term economic and societal considerations.

The factors show moderate intercorrelations, supporting the use of oblique rotation and indicating that different motivational dimensions are related but not redundant. Reliability analyses demonstrate good internal consistency for the Efficiency and Convenience and Safety and Health factors, while the Cost and Sustainability factor, due to its limited number of items, is interpreted with additional caution. Composite factor scores were therefore constructed to enable their use in subsequent analyses examining associations with behaviour, safety perceptions, and socio-demographic characteristics.

Table 13. Factor Analysis Assumptions: KMO and Bartlett's Test (Importance of factors influencing e-scooter use)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,866
Bartlett's Test of Sphericity	Approx. Chi-Square	745,227
	df	45
	Sig.	<,001

Table 14. Factor Pattern Matrix (Importance of factors influencing e-scooter use)

	Factor		
	1	2	3
Because it is faster than walking.	,871		
Because it is convenient.	,841		
Because it allows me to reach my destination without driving a car.	,734		
Because it is better than walking in hot weather.	,693		
Because it is fun and relaxing.	,553	,342	
Because I feel safer from other road users when riding an e-scooter.		,903	
Because I also get exercise during the trip.		,802	
Because I feel safer from crime when using it compared to walking.		,729	
Because it is cost-effective.			,722
Because it is environmentally friendly.			,660

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Table 15. Factor Correlation Matrix (Importance of factors influencing e-scooter use)

Factor Correlation Matrix			
Factor	1	2	3
1	1,000	,345	,549
2	,345	1,000	,446
3	,549	,446	1,000

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Structure of self-reported riding behaviours

To explore the underlying structure of self-reported riding behaviours, a factor analysis was conducted on the set of items measuring potentially risky and protective practices when using an e-scooter, as presented in Section 2.2.9. These items capture a broad range of behaviours related to rule compliance, interaction with other road users, speed choice, protective equipment use, and distraction, and are therefore likely to reflect multiple, conceptually distinct behavioural patterns.

Principal Axis Factoring with Direct Oblimin rotation was applied, given the expectation that different behavioural tendencies may be correlated. The data were well suited for factor analysis, as indicated by an excellent Kaiser–Meyer–Olkin measure of sampling adequacy (KMO = 0.912) and a significant Bartlett's test of sphericity ($\chi^2(df = 105) = 1319.68, p < .001$). Based on the scree plot and factor interpretability, three behavioural factors were retained.

The first factor, labelled **Risky and violative riding behaviour**, captures behaviours that involve rule violations, risky interactions with other road users, and inadequate situational judgement. High loadings are observed for items related to riding on the wrong side of the lane, underestimating the speed of other road users while overtaking, near collisions when turning, riding too close to others to stop safely, and accelerating aggressively to overtake. Indicators of riding under the influence, crossing intersections against traffic signals, carrying passengers, and exceeding speed limits also contribute to this factor, reflecting a general pattern of elevated risk-taking and reduced compliance.

The second factor, termed **Safety compliance (protective practices)**, represents the consistent use of protective equipment while riding. This factor is defined primarily by helmet use and reflective accessories, reflecting a behavioural tendency towards visibility and personal protection rather than immediate riding dynamics. Although this factor comprises only two indicators, the items exhibit sufficient internal coherence to justify their interpretation as a distinct behavioural dimension.

The third factor, labelled **Phone and audio use while riding**, encompasses behaviours related to distraction and divided attention. Strong loadings are observed for listening to music through headphones and using a mobile phone hands-free while riding, with a moderate cross-loading for handheld phone use. The negative factor loadings reflect the statistical orientation of the factor axis rather than a conceptual inversion; for interpretative clarity, factor scores were aligned so that higher values indicate more frequent engagement in phone- and audio-related activities while riding.

Correlations between the three factors indicate that the behavioural dimensions are related but distinct. In particular, the relationship between risky or violative riding behaviours and phone/audio use suggests differentiated riding styles rather than a single generalised risk profile. Reliability analyses show excellent internal consistency for the Risky and Violative Behaviour factor and good reliability for the Phone and audio use factor. As the Safety

compliance factor consists of two items only, reliability is interpreted alongside the reported inter-item correlation. Composite scores were constructed for all three factors and are used in subsequent analyses examining associations with safety perceptions, motivational dimensions, travel characteristics, and socio-demographic variables.

Table 16. Factor Analysis Assumptions: KMO and Bartlett's Test (Self-reported potentially risky riding behaviours)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,912
Bartlett's Test of Sphericity	Approx. Chi-Square	1319,679
	df	105
	Sig.	<,001

Table 17. Factor Pattern Matrix (Self-reported potentially risky riding behaviours)

Pattern Matrix ^a	Factor		
	1	2	3
I underestimate the speed of an oncoming pedestrian or another road user when overtaking.	,898		
I ride on the wrong side of the lane (or cycle track).	,888		
When turning, I almost hit a pedestrian or another road user.	,851		
I ride so close to a pedestrian or another road user that I would struggle to stop safely in an emergency.	,806		
I accelerate quickly at a traffic light to overtake another road user.	,759		
I ride under the influence of alcohol or other prohibited substances.	,702		
I cross an intersection when the traffic light is yellow or red.	,647		
I carry another person on the e-scooter with me.	,577		
I ride at a speed above 5 km/h in a pedestrian zone.	,528		
I ride at a speed above 25 km/h.	,449		
I use reflectors (such as reflective accessories).		,853	
I use a protective helmet.		,600	
I use a mobile phone hands-free while riding (headphones, speaker, etc.).			-,865
I listen to music through headphones.			-,728
I use a mobile phone while riding, holding it in my hands.	,346		-,645

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Table 18. Factor Correlation Matrix (Self-reported potentially risky riding behaviours)

Factor Correlation Matrix			
Factor	1	2	3
1	1,000	,119	-,635
2	,119	1,000	-,180
3	-,635	-,180	1,000

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Structure of perceived environmental and traffic safety conditions

To identify the underlying structure of environmental and traffic-related factors affecting perceived safety while riding an e-scooter, a factor analysis was conducted on the set of items presented in Section 2.2.10. These items describe a range of infrastructural conditions and traffic interactions that may influence riders' perceived comfort, stress, and sense of safety during everyday trips.

Principal Axis Factoring with Direct Oblimin rotation was applied, as the perceived quality of infrastructure and exposure to traffic conflicts were expected to be interrelated. The data were suitable for factor analysis, with a Kaiser–Meyer–Olkin measure of sampling adequacy of 0.864 and a significant Bartlett's test of sphericity ($\chi^2(df = 36) = 535.76, p < .001$). Based on the scree plot and factor interpretability, a two-factor solution was retained.

The first factor, labelled **Traffic exposure and conflict**, captures perceived safety challenges associated with interactions with other road users and traffic conditions. High to moderate loadings are observed for items related to heavy car traffic on riding surfaces, a high number of pedestrians or cyclists, improperly parked vehicles, interactions with other e-scooter riders, and cars overtaking without sufficient lateral clearance. The inclusion of limited e-scooter parking availability in this factor suggests that respondents experience parking-related issues as part of a broader set of traffic-related constraints and conflicts.

The second factor, termed **Infrastructure quality**, reflects the physical condition and suitability of the built environment for e-scooter use. This dimension is characterised by very high loadings for excessively high or poorly lowered curbs and poor, pothole-ridden road surfaces, as well as a moderate loading for the lack of appropriate cycling infrastructure.

Together, these items describe deficiencies in infrastructure continuity and maintenance that directly affect riding comfort and perceived safety.

The two factors show a moderate positive correlation, indicating that higher perceived traffic exposure and conflict tend to co-occur with lower perceived infrastructure quality. Reliability analyses indicate good to high internal consistency for both Traffic Exposure and Conflict and Infrastructure Quality. Composite factor scores were therefore computed and used in subsequent analyses examining relationships with riding behaviour, safety compliance, and socio-demographic characteristics.

Table 19. Factor Analysis Assumptions: KMO and Bartlett's Test (Perceived impact of environmental and traffic factors on safety)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,864
Bartlett's Test of Sphericity	Approx. Chi-Square	535,762
	df	36
	Sig.	<,001

Table 20. Factor Pattern Matrix (Perceived impact of environmental and traffic factors on safety)

Pattern Matrix ^a	Factor	
	1	2
Heavy car traffic on the surfaces where I ride.	,896	
High number of pedestrians or cyclists on the surfaces where I ride.	,735	
Improperly parked vehicles.	,698	
Other e-scooter riders.	,672	
Cars are overtaking me without sufficient lateral clearance.	,575	
Lack of parking spaces for e-scooters.	,552	
Excessively high curbs or poorly lowered curbs.		,947

Poor, pothole-ridden road surface.	,743
Lack of appropriate cycling infrastructure.	,556

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Table 21. Factor Correlation Matrix (Perceived impact of environmental and traffic factors on safety)

Factor Correlation Matrix		
Factor	1	2
1	1,000	,547
2	,547	1,000

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Structure of perceived compliance measures

To examine the underlying structure of respondents’ perceptions of measures to improve compliance with traffic regulations when using e-scooters, a factor analysis was conducted on the items presented in Section 1.2.11. These items capture different regulatory approaches, ranging from enforcement and punishment to administrative requirements and informational measures.

Principal Axis Factoring with Direct Oblimin rotation was applied, as different regulatory attitudes were expected to be interrelated rather than independent. The data were suitable for factor analysis, with a Kaiser–Meyer–Olkin measure of sampling adequacy of 0.724 and a significant Bartlett’s test of sphericity ($\chi^2(df = 10) = 393.30, p < .001$). Based on the scree plot and interpretability criteria, a three-factor solution was retained. A two-factor solution resulted in a Heywood case, indicating model misspecification and further supporting the three-factor structure.

The first factor, labelled **Punishment and enforcement**, is characterised by high loadings for higher monetary fines and increased enforcement by police or municipal wardens. This dimension reflects a regulatory orientation centred on external control and deterrence, aiming to improve compliance through monitoring and sanctions.

The second factor, termed **Licensing and mandatory requirements**, comprises items related to mandatory e-scooter registration and compulsory driving tests. These items load strongly—and negatively—on the factor, reflecting the arbitrary orientation of the factor axis rather than an inverse conceptual relationship. For interpretative clarity, factor scores were

aligned so that higher values represent stronger support for mandatory and registration-based measures.

The third factor, labelled **Awareness campaigns**, consists of a single indicator measuring perceived effectiveness of informational and educational interventions. Given that this factor includes only one item, it is analysed as a standalone variable in subsequent analyses rather than as a composite scale.

Correlations among the factors indicate that support for enforcement-based measures is inversely related to support for licensing and mandatory requirements, while also being positively associated with support for awareness campaigns. Reliability analyses show good internal consistency for the Punishment and Enforcement and Licensing and Mandatory Requirements factors. Composite scores were constructed for the two multi-item factors and used in subsequent analyses assessing relationships with behavioural patterns, motivational dimensions, and safety perceptions.

Table 22. Factor Analysis Assumptions: KMO and Bartlett's Test (Perceived effectiveness of measures to improve compliance with traffic regulations)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,724
Bartlett's Test of Sphericity	Approx. Chi-Square	393,300
	df	10
	Sig.	<,001

Table 23. Factor Pattern Matrix (Perceived effectiveness of measures to improve compliance with traffic regulations)

Pattern Matrix ^a	Factor		
	1	2	3
Higher monetary fines	,849		
Increased enforcement by police or municipal wardens	,629		,441
Mandatory e-scooter registration (with an identification plate, e.g., registration)		-,955	
Mandatory e-scooter driving test		-,854	
Awareness campaigns			,529

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Table 24. Factor Correlation Matrix (Perceived effectiveness of measures to improve compliance with traffic regulations)

Factor Correlation Matrix			
Factor	1	2	3
1	1,000	-,653	,670
2	-,653	1,000	-,653
3	,670	-,653	1,000

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Summary of factor analysis

Taken together, the factor analyses reveal that seemingly diverse attitudes, perceptions, and self-reported behaviours related to e-scooter use can be meaningfully organised into a limited number of coherent latent dimensions. Across motivational, behavioural, environmental, and regulatory domains, the results demonstrate that e-scooter use is shaped by multiple, interrelated structures rather than by isolated respondent factors.

Motivation for e-scooter use is structured around distinct dimensions reflecting efficiency and convenience, safety and health considerations, and cost- and sustainability-oriented values. Riding behaviour is characterised by differentiated behavioural patterns, separating risk-taking and rule-violating practices from protective safety compliance and from distraction-related behaviours. Perceived safety conditions similarly consist of two conceptually distinct but related dimensions, capturing exposure to traffic conflicts and the quality of the physical riding environment. Finally, attitudes towards compliance-enhancing measures cluster into clearly differentiated orientations towards enforcement-based approaches, regulatory and licensing requirements, and informational or awareness-raising strategies.

The observed correlations among several of the extracted factors indicate that these dimensions are linked in systematic ways while remaining analytically distinct. This underscores the usefulness of a multidimensional perspective when analysing e-scooter use, as behavioural tendencies, safety perceptions, and regulatory attitudes interact but do not collapse into a single underlying construct. By reducing complex sets of observed variables to interpretable latent factors and by constructing reliable composite measures, the factor analyses provide a robust analytical foundation for the subsequent sections of the report, in which associations between these dimensions and socio-demographic characteristics, travel behaviour, and safety-related outcomes are examined in greater detail.

Discrepancies between perceived legality of riding areas and reported riding areas

Understanding e-scooter safety and compliance requires not only examining where riders actually ride, but also how well they understand the legal framework governing e-scooter use. Differences between perceived legality and self-reported riding behaviour can reveal whether non-compliant practices stem primarily from deliberate rule violations or from uncertainty and misinterpretation of traffic regulations.

This section, therefore, compares respondents' reported riding environments with their perceptions of where e-scooter use is legally permitted. By examining overlaps, mismatches, and patterns of under- and over-use across different traffic environments, the analysis provides insight into the extent and nature of regulatory misunderstanding and its potential implications for riding behaviour.

Table 24 summarises the comparison between the perceived legality of different riding environments and respondents' self-reported use of those environments. The results reveal substantial discrepancies between legal perceptions and actual riding behaviour across several types of traffic spaces.

The highest level of accurate legal understanding is observed for infrastructure explicitly designed for cycling. Dedicated cycle paths or tracks show the highest proportion of correct responses (85.19%), followed by marked cycling lanes on the roadway (72.59%). These environments are also characterised by relatively low levels of self-reported riding in areas perceived as prohibited, indicating a comparatively high alignment between perceived legality and actual behaviour.

In contrast, pedestrian-oriented environments exhibit the greatest degree of misunderstanding. Pedestrian zones show the lowest legal perception accuracy (21.48%), with most respondents incorrectly identifying them as permissible for e-scooter use. Sidewalks similarly display a notable mismatch, with more than a quarter of respondents reporting riding in areas they themselves classify as prohibited. These findings suggest that shared or ambiguous spaces represent critical points of regulatory confusion.

Roads without designated cycling infrastructure within built-up areas present a mixed pattern. While over half of respondents correctly perceive these roads as permissible, a considerable proportion either misinterpret their legal status or underuse these environments despite perceiving them as allowed. This underutilisation may reflect concerns related to safety or comfort rather than legal uncertainty alone.

Finally, non-public traffic surfaces, such as private yards or playgrounds, are frequently perceived as permissible, yet are relatively rarely used in practice. This pattern suggests that respondents distinguish between formal traffic regulation and private or informal riding spaces, even if legal boundaries are not clearly understood.

Table 25: Comparison of perceived legality and self-reported riding behaviour across different areas

Riding area	Accurate perception of legality	Incorrect perception of legality	Self-reported riding in perceived prohibited areas	Underutilization of allowed infrastructure
In a pedestrian zone	21.48%	78.52%	16.30%	6.67%
On the sidewalk	71.11%	28.47%	27.74%	/
On a dedicated cycle path or track	85.19%	14.81%	2.96%	12.59%
On a marked cycling lane on the roadway	72.59%	27.41%	3.70%	22.96%
On a road within a built-up area without a designated cycling facility	57.78%	42.22%	9.63%	19.26%
On a road outside a built-up area	67.41%	32.12%	6.57%	/
On areas that are not public traffic surfaces (e.g., private yard, playground)	38.52%	61.48%	4.44%	12.59%

Building on the descriptive findings and factors identified in the previous sections, the next chapters examine associations between socio-demographic characteristics, travel-related variables, and the composite factors derived from the factor analyses. The aim is to explore whether specific groups of e-scooter users differ systematically in their motivations, riding behaviour, perceived safety conditions, and attitudes towards regulatory measures.

Given the exploratory nature of the study and the diversity of the examined variables, a combination of nonparametric statistical tests was applied, depending on the level of measurement and the distributional properties of each variable. These analyses allow for the identification of both statistically significant and non-significant associations, which are equally informative in assessing the extent to which e-scooter use patterns vary across the population.

Importantly, the absence of statistically significant associations in several cases should not be interpreted as a limitation, but rather as an empirical finding indicating relative homogeneity across user groups. The results, therefore, highlight not only where meaningful differences exist but also where e-scooter use appears consistent across socio-demographic categories. Together, the findings in this section provide context for understanding which user characteristics are most relevant for safety, policy, and infrastructure considerations, and which appear to play a minor role.

Associations between socio-demographic characteristics, factors and use of substitute transport modes

Gender differences in substitute transport mode choice

No statistically significant association was found between gender and the choice of substitute transport mode if an e-scooter were unavailable, $\chi^2(6, N = 133) = 2.76$, $p = 0.838$. Given the small expected cell counts, the result was additionally verified using a Monte Carlo simulation, which confirmed the absence of statistical significance (Monte Carlo $p = 0.777$; 95% CI: 0.769–0.785). The effect size was negligible (Cramer's $V \approx 0.08$).

The distribution of substitute transport modes—private motorised transport, public transport, active mobility, and electric micromobility—was highly similar across genders. None of the standardised residuals exceeded the conventional threshold of $|2|$, indicating no meaningful deviations between observed and expected frequencies.

Table 26. Statistical test for associations between gender and substitute transport modes (1)

		Gender			Total
		Man	Woman	3	
Substitute_Groups Private motorized transport	Count	36	24	0	60
	Expected Count	34,7	24,4	,9	60,0
	% within Substitute_Groups	60,0%	40,0%	0,0%	100,0%
	Standardized Residual	,2	-,1	-,9	
Public transport	Count	2	1	0	3
	Expected Count	1,7	1,2	,0	3,0
	% within Substitute_Groups	66,7%	33,3%	0,0%	100,0%
	Standardized Residual	,2	-,2	-,2	
Active mobility	Count	33	24	2	59
	Expected Count	34,2	24,0	,9	59,0
	% within Substitute_Groups	55,9%	40,7%	3,4%	100,0%
	Standardized Residual	-,2	,0	1,2	
Micromobility (electric)	Count	6	5	0	11
	Expected Count	6,4	4,5	,2	11,0

	% within Substitute_Groups	54,5%	45,5%	0,0%	100,0%
	Standardized Residual	-,1	,3	-,4	
Total	Count	77	54	2	133
	Expected Count	77,0	54,0	2,0	133,0
	% within Substitute_Groups	57,9%	40,6%	1,5%	100,0%

Table 27. Statistical test for associations between gender and substitute transport modes (2)

Chi-Square Tests								
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		Monte Carlo Sig. (1-sided)		
				Significance	95% Confidence Interval		Significance	95% Confidence Interval
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
Pearson Chi-Square	2,763 ^a	6	,838	,777 ^b	,769	,785		
Likelihood Ratio	3,505	6	,743	,771 ^b	,763	,779		
Fisher-Freeman-Halton Exact Test	4,039			,833 ^b	,826	,840		
Linear-by-Linear Association	,528 ^c	1	,467	,501 ^b	,491	,510	,259 ^b	,251 ,268
N of Valid Cases	133							

a. 7 cells (58,3%) have expected count less than 5. The minimum expected count is ,05.

b. Based on 10000 sampled tables with starting seed 1090229469.

c. The standardized statistic is ,727.

Age differences in substitute transport mode choice

No statistically significant differences were found in age across groups defined by substitute transport mode choice, Kruskal–Wallis $H(3, N = 133) = 4.69, p = 0.196$ (test statistic adjusted for ties). The estimated effect size was small ($\epsilon^2 \approx 0.036$), indicating that age explains only a very limited proportion of variance in substitute mode selection.

Post-hoc pairwise comparisons with Bonferroni adjustment revealed no statistically significant differences between any pairs of substitute transport groups (all adjusted p-values ≥ 0.468). The largest unadjusted divergence was observed between respondents selecting active mobility and those selecting public transport as a substitute ($z \approx 1.76, p = 0.078$), but this difference did not remain significant after correction for multiple comparisons.

Table 28. Statistical test for associations between age and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Active mobility-Private motorized transport	4,742	7,063	,671	,502	1,000
Active mobility-Micromobility (electric)	-17,790	12,651	-1,406	,160	,958
Active mobility-Public transport	40,184	22,799	1,762	,078	,468
Private motorized transport--Micromobility (electric)	-13,048	12,635	-1,033	,302	1,000
Private motorized transport-Public transport	-35,442	22,790	-1,555	,120	,719
Micromobility (electric)-Public transport	22,394	25,091	,893	,372	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 29. Statistical test for associations between age and substitute transport modes

Independent-Samples Kruskal-Wallis Test Summary	
Total N	133
Test Statistic	4,691 ^a
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	,196

a. The test statistic is adjusted for ties.

Motorcycle licence status and substitute transport mode choice

No statistically significant association was found between holding a motorcycle driving licence and the choice of substitute transport mode, $\chi^2(3, N = 131) = 3.86$, $p = 0.277$. Given the presence of small, expected cell counts, the result was additionally verified using Monte Carlo simulation, which confirmed the absence of statistical significance (Monte Carlo $p = 0.321$; 95% CI: 0.312–0.330). The corresponding effect size was small (Cramer's $V \approx 0.17$).

Although the overall association was not statistically significant, minor descriptive tendencies can be observed. Respondents holding a motorcycle licence were slightly more likely than expected to select public transport as a substitute (standardised residual = +1.4), whereas those without a licence were somewhat less likely to do so (-1.3). For private motorised

transport, active mobility, and electric micromobility, observed frequencies closely matched expected values, indicating no meaningful deviation from independence.

Table 30. Statistical test for associations between motorcycle licence and substitute transport modes (1)

Substitute_Groups * Driving licence status_Motorcycles Crosstabulation				
		Driving licence status_Motorcycles		Total
		No	Yes	
Private motorized transport	Count	33	27	60
	Expected Count	33,0	27,0	60,0
	% within Substitute_Groups	55,0%	45,0%	100,0%
	Standardized Residual	,0	,0	
Public transport	Count	0	3	3
	Expected Count	1,6	1,4	3,0
	% within Substitute_Groups	0,0%	100,0%	100,0%
	Standardized Residual	-1,3	1,4	
Active mobility	Count	33	24	57
	Expected Count	31,3	25,7	57,0
	% within Substitute_Groups	57,9%	42,1%	100,0%
	Standardized Residual	,3	-,3	
Micromobility (electric)	Count	6	5	11
	Expected Count	6,0	5,0	11,0
	% within Substitute_Groups	54,5%	45,5%	100,0%
	Standardized Residual	,0	,0	
Total	Count	72	59	131
	Expected Count	72,0	59,0	131,0
	% within Substitute_Groups	55,0%	45,0%	100,0%

Table 31. Statistical test for associations between motorcycle licence and substitute transport modes (2)

Chi-Square Tests								
Value	df	Asymptotic Significance (2-sided)	Monte Carlo Significance	Monte Carlo Sig. (2-sided)		Monte Carlo Sig. (1-sided)	95% Confidence Interval	
				Lower Bound	Upper Bound		Lower Bound	Upper Bound

Pearson Chi-Square	3,860 ^a	3	,277	,321 ^b	,312	,330			
Likelihood Ratio	4,986	3	,173	,258 ^b	,250	,267			
Fisher-Freeman-Halton Exact Test	3,491			,349 ^b	,339	,358			
Linear-by-Linear Association	,061 ^c	1	,804	,810 ^b	,803	,818	,433 ^b	,423	,442
N of Valid Cases	131								

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,35.

b. Based on 10000 sampled tables with starting seed 1795812538.

c. The standardized statistic is -,248.

Passenger car driving licence status and substitute transport mode choice

No statistically significant association was found between holding a passenger car driving licence and the choice of substitute transport mode, $\chi^2(3, N = 131) = 0.47, p = 0.926$. The result was confirmed using a Monte Carlo simulation (Monte Carlo $p = 0.917$; 95% CI: 0.911–0.922), indicating a very high level of consistency between observed and expected frequencies. The effect size was negligible (Cramer’s $V \approx 0.06$).

Observed distributions of substitute transport modes were nearly identical to those expected under the assumption of independence. Minor descriptive deviations were present—for example, a marginally higher representation of active mobility among respondents without a passenger car licence—but these differences were extremely small and not indicative of any systematic pattern.

Table 32. Statistical test for associations between passenger car licence and substitute transport modes (1)

		Driving licence status_Passenger car			
		No	Yes	Total	
Substitute_Groups * Driving licence status_Passenger car Crosstabulation	Private motorized transport	Count	4	56	60
		Expected Count	4,6	55,4	60,0
		% within Substitute_Groups	6,7%	93,3%	100,0%
		Standardized Residual	-,3	,1	
Public transport	Count	0	3	3	
	Expected Count	,2	2,8	3,0	
	% within Substitute_Groups	0,0%	100,0%	100,0%	
	Standardized Residual	-,5	,1		
Active mobility	Count	5	52	57	
	Expected Count	4,4	52,6	57,0	
	% within Substitute_Groups	8,8%	91,2%	100,0%	
	Standardized Residual	,3	-,1		
Micromobility (electric)	Count	1	10	11	
	Expected Count	,8	10,2	11,0	
	% within Substitute_Groups	9,1%	90,9%	100,0%	
	Standardized Residual	,2	-,1		
Total	Count	10	121	131	
	Expected Count	10,0	121,0	131,0	
	% within Substitute_Groups	7,6%	92,4%	100,0%	

Table 33. Statistical test for associations between passenger car licence and substitute transport modes (2)

Chi-Square Tests								
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)	
				Significance	95% Confidence Interval		Significance	95% Confidence Interval
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
Pearson Chi-Square	,465 ^a	3	,926	,917 ^b	,911	,922		
Likelihood Ratio	,691	3	,875	,917 ^b	,911	,922		
Fisher-Freeman-Halton Exact Test	,789			,837 ^b	,830	,844		
Linear-by-Linear Association	,214 ^c	1	,644	,660 ^b	,650	,669	,371 ^b	,361
N of Valid Cases	131							

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,23.

b. Based on 10000 sampled tables with starting seed 1418382849.

c. The standardized statistic is -,462.

Employment status and substitute transport mode choice

No statistically significant association was found between employment status and the choice of substitute transport mode, $\chi^2(18, N = 132) = 13.33, p = 0.772$. Due to the large number of categories and the presence of small expected cell counts, the result was additionally verified using Monte Carlo simulation, which confirmed the absence of statistical significance (Monte Carlo $p = 0.617$; 95% CI: 0.608–0.627). The associated effect size was negligible (Cramer's $V \approx 0.10$).

Across employment categories—including students, employed and self-employed respondents, retired respondents, and other employment statuses—the distribution of substitute transport modes was largely uniform. None of the standardised residuals exceeded the threshold indicative of meaningful deviations, suggesting that observed frequencies closely matched those expected under independence.

Table 34. Statistical test for associations between passenger car licence and substitute transport modes (1)

		Employment status							Total
		Student	Employed (in an employment relationship)	Self-employed	Farmer status or independent cultural worker or similar	Retired	Unemployed	Other	
Substitute_Groups Private motorized transport	Count	11	41	4	0	2	1	1	60
	Expected Count	8,2	42,7	4,1	,9	1,4	2,3	,5	60,0
	% within Substitute_Groups	18,3%	68,3%	6,7%	0,0%	3,3%	1,7%	1,7%	100,0%
	Standardized Residual	1,0	-,3	,0	-1,0	,5	-,8	,8	
Public transport	Count	0	3	0	0	0	0	0	3
	Expected Count	4	2,1	,2	,0	,1	,1	,0	3,0
	% within Substitute_Groups	0,0%	100,0%	0,0%	0,0%	0,0%	0,0%	0,0%	100,0%
	Standardized Residual	-,6	,6	-,5	-,2	-,3	-,3	-,2	
Active mobility	Count	7	42	4	2	0	3	0	58
	Expected Count	7,9	41,3	4,0	,9	1,3	2,2	,4	58,0
	% within Substitute_Groups	12,1%	72,4%	6,9%	3,4%	0,0%	5,2%	0,0%	100,0%
	Standardized Residual	-,3	,1	,0	1,2	-1,1	,5	-,7	
Micromobility (electric)	Count	0	8	1	0	1	1	0	11
	Expected Count	1,5	7,8	,8	,2	,3	,4	,1	11,0
	% within Substitute_Groups	0,0%	72,7%	9,1%	0,0%	9,1%	9,1%	0,0%	100,0%
	Standardized Residual	-1,2	,1	,3	-,4	1,5	,9	-,3	
Total	Count	18	94	9	2	3	5	1	132
	Expected Count	18,0	94,0	9,0	2,0	3,0	5,0	1,0	132,0

% within	13,6%	71,2%	6,8%	1,5%	2,3%	3,8%	0,8%	100,0%
Substitute_Groups								

Table 35. Statistical test for associations between passenger car licence and substitute transport modes (2)

Chi-Square Tests									
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Significance	95% Confidence Interval		Significance	95% Confidence Interval	
				Lower Bound	Upper Bound		Lower Bound	Upper Bound	
Pearson Chi-Square	13,331 ^a	18	,772	,617 ^b	,608	,627			
Likelihood Ratio	16,834	18	,535	,402 ^b	,392	,412			
Fisher-Freeman-Halton Exact Test	18,841			,512 ^b	,502	,522			
Linear-by-Linear Association	1,415 ^c	1	,234	,240 ^b	,232	,249	,131 ^b	,124	
N of Valid Cases	132								

a. 23 cells (82,1%) have expected count less than 5. The minimum expected count is ,02.

b. Based on 10000 sampled tables with starting seed 307647058.

c. The standardized statistic is 1,189.

Education level and substitute transport mode choice

No statistically significant association was found between respondents' highest level of completed education and the choice of substitute transport mode, $\chi^2(21, N = 132) = 20.67, p = 0.479$. Due to a high proportion of cells with low expected frequencies (62.5%; minimum expected count = 0.05), the asymptotic chi-square test should be interpreted with caution. However, both Monte Carlo simulation and exact tests confirmed the non-significant result (Monte Carlo $p = 0.446$; 95% CI: 0.436–0.456). The estimated effect size was small to moderate (Cramer's $V \approx 0.23$).

Across education levels—from primary and vocational education to university and postgraduate degrees—the distribution of substitute transport modes showed no systematic pattern. Although one isolated cell (electric micromobility among respondents with a Master's degree) exhibited a standardised residual close to the conventional threshold, this deviation is not robust given sparse cell counts and the large number of comparisons.

Table 36. Statistical test for associations between education level and substitute transport modes (1)

		Highest level of education completed								Total	
		Primary school	Vocational secondary school	General secondary school or grammar school	Post-secondary vocational education (ali Higher education)	College (ali Higher education)	University education	Master's degree	Doctorate (PhD)		
Substitute_Groups	Private motorized transport	Count	1	11	14	8	9	9	7	1	60
		Expected Count	1,4	10,0	14,5	7,3	10,0	10,5	5,5	,9	60,0
		% within Substitute_Groups	1,7%	18,3%	23,3%	13,3%	15,0%	15,0%	11,7%	1,7%	100,0%
		Standardized Residual	-,3	,3	-,1	,3	-,3	-,4	,7	,1	
Public transport		Count	0	0	0	1	1	1	0	0	3
		Expected Count	,1	,5	,7	,4	,5	,5	,3	,0	3,0
		% within Substitute_Groups	0,0%	0,0%	0,0%	33,3%	33,3%	33,3%	0,0%	0,0%	100,0%
		Standardized Residual	-,3	-,7	-,9	1,1	,7	,7	-,5	-,2	
Active mobility		Count	1	11	16	7	8	12	2	1	58
		Expected Count	1,3	9,7	14,1	7,0	9,7	10,1	5,3	,9	58,0
		% within Substitute_Groups	1,7%	19,0%	27,6%	12,1%	13,8%	20,7%	3,4%	1,7%	100,0%
		Standardized Residual	-,3	,4	,5	,0	-,5	,6	-,1,4	,1	
Micromobility (electric)		Count	1	0	2	0	4	1	3	0	11
		Expected Count	,3	1,8	2,7	1,3	1,8	1,9	1,0	,2	11,0
		% within Substitute_Groups	9,1%	0,0%	18,2%	0,0%	36,4%	9,1%	27,3%	0,0%	100,0%
		Standardized Residual	1,5	-,1,4	-,4	-,1,2	1,6	-,7	2,0	-,4	
Total		Count	3	22	32	16	22	23	12	2	132
		Expected Count	3,0	22,0	32,0	16,0	22,0	23,0	12,0	2,0	132,0

% within	2,3%	16,7%	24,2%	12,1%	16,7%	17,4%	9,1%	1,5%	100,0%
Substitute_Groups									

Table 37. Statistical test for associations between education level and substitute transport modes (2)

Chi-Square Tests									
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Significance	95% Interval Lower Bound	Confidence Upper Bound	Significance	95% Confidence Interval Lower Bound	Upper Bound
Pearson Chi-Square	20,670 ^a	21	,479	,446 ^b	,436	,456			
Likelihood Ratio	22,722	21	,359	,378 ^b	,368	,388			
Fisher-Freeman-Halton Exact Test	22,386			,293 ^b	,284	,302			
Linear-by-Linear Association	,013 ^c	1	,909	,918 ^b	,913	,924	,468 ^b	,459	,478
N of Valid Cases	132								

a. 20 cells (62,5%) have expected count less than 5. The minimum expected count is ,05.

b. Based on 10000 sampled tables with starting seed 1724717747.

c. The standardized statistic is ,114.

Place of residence and substitute transport mode choice

A statistically significant association was found between respondents' place of residence and the choice of substitute transport mode, $\chi^2(6, N = 132) = 14.07, p = 0.029$. The result was confirmed using a Monte Carlo simulation (Monte Carlo $p = 0.023$; 95% CI: 0.020–0.026). The effect size was medium (Cramer's $V \approx 0.33$), indicating a substantively meaningful relationship.

The distribution of substitute transport modes differed systematically across residential contexts. Respondents living in cities were more likely than expected to select private motorised transport as a substitute for e-scooter trips (standardised residual = +1.7). In contrast, respondents residing in rural areas showed an overrepresentation in selecting electric micromobility (+1.5) and public transport (+1.2). Suburban residents exhibited distributions close to those expected under independence, suggesting a more balanced substitution pattern.

Table 38. Statistical test for associations between please of residence and substitute transport modes (1)

		Place of residence			Total	
		In the city	In the suburbs	In the countryside		
Substitute_Groups	Private motorized transport	Count	35	11	14	60
		Expected Count	26,4	15,9	17,7	60,0
		% within Substitute_Groups	58,3%	18,3%	23,3%	100,0%
		Standardized Residual	1,7	-1,2	-,9	
Public transport		Count	0	1	2	3
		Expected Count	1,3	,8	,9	3,0
		% within Substitute_Groups	0,0%	33,3%	66,7%	100,0%
		Standardized Residual	-1,1	,2	1,2	
Active mobility		Count	21	20	17	58
		Expected Count	25,5	15,4	17,1	58,0
		% within Substitute_Groups	36,2%	34,5%	29,3%	100,0%
		Standardized Residual	-,9	1,2	,0	
Micromobility (electric)		Count	2	3	6	11
		Expected Count	4,8	2,9	3,3	11,0
		% within Substitute_Groups	18,2%	27,3%	54,5%	100,0%
		Standardized Residual	-1,3	,0	1,5	
Total		Count	58	35	39	132
		Expected Count	58,0	35,0	39,0	132,0
		% within Substitute_Groups	43,9%	26,5%	29,5%	100,0%

Table 39. Statistical test for associations between place of residence and substitute transport modes (3)

Chi-Square Tests				
	Value	df	Monte Carlo Sig. (2-sided)	Monte Carlo Sig. (1-sided)

			Asymptotic Significance (2-Sided)	Significance	95% Interval Lower Bound	Confidence Interval Upper Bound	Significance	95% Interval Lower Bound	Confidence Interval Upper Bound
Pearson Chi-Square	14,067 ^a	6	,029	,023 ^b	,020	,026			
Likelihood Ratio	14,926	6	,021	,027 ^b	,024	,030			
Fisher-Freeman-Halton Exact Test	13,735			,016 ^b	,013	,018			
Linear-by-Linear Association	6,794 ^c	1	,009	,010 ^b	,008	,011	,005 ^b	,004	,007
N of Valid Cases	132								

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,80.

b. Based on 10000 sampled tables with starting seed 263739791.

c. The standardized statistic is 2,607.

Household income and substitute transport mode choice

No statistically significant association was found between net disposable household income per household member and the choice of substitute transport mode, $\chi^2(9, N = 132) = 6.41$, $p = 0.698$. The estimated effect size was small (Cramer's $V \approx 0.16$), indicating a limited relationship between income level and substitute mode selection.

The distribution of substitute transport modes was broadly similar across income categories. Respondents with below-average income showed a slightly higher than expected tendency to select private motorised transport as a substitute, while respondents with approximately average income were marginally more represented in public transport and active mobility categories. Respondents with above-average income showed a minor inclination toward electric micromobility. However, these deviations were small, inconsistent, and did not form a systematic pattern.

Table 40. Statistical test for associations between income of household and substitute transport modes (1)

Substitute_Groups * Net disposable income per household member Crosstabulation						
		Net disposable income per household member				Total
		Below average	Approximatel y average (+/- 10% of that amount)	Above average	Prefer not to answer	
Substitut e_Groups	Count	22	18	11	9	60
	Expected Count	18,2	20,9	12,7	8,2	60,0

Private motorized transport	% within	36,7%	30,0%	18,3%	15,0%	100,0%
	Substitute_Groups					
	Standardized Residual	,9	-,6	-,5	,3	
Public transport	Count	1	2	0	0	3
	Expected Count	,9	1,0	,6	,4	3,0
	% within	33,3%	66,7%	0,0%	0,0%	100,0%
	Substitute_Groups					
	Standardized Residual	,1	,9	-,8	-,6	
Active mobility	Count	14	22	14	8	58
	Expected Count	17,6	20,2	12,3	7,9	58,0
	% within	24,1%	37,9%	24,1%	13,8%	100,0%
	Substitute_Groups					
	Standardized Residual	-,9	,4	,5	,0	
Micromobility (electric)	Count	3	4	3	1	11
	Expected Count	3,3	3,8	2,3	1,5	11,0
	% within	27,3%	36,4%	27,3%	9,1%	100,0%
	Substitute_Groups					
	Standardized Residual	-,2	,1	,4	-,4	
Total	Count	40	46	28	18	132
	Expected Count	40,0	46,0	28,0	18,0	132,0
	% within	30,3%	34,8%	21,2%	13,6%	100,0%
	Substitute_Groups					

Table 41. Statistical test for associations between income of household and substitute transport modes (2)

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		Monte Carlo Sig. (1-sided)		
				Significance	95% Confidence Interval	Significance	95% Confidence Interval	Confidence Interval
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
Pearson Chi-Square	4,967 ^a	9	,837	,870 ^b	,864	,877		
Likelihood Ratio	5,853	9	,755	,861 ^b	,854	,868		
Fisher-Freeman-Halton Exact Test	4,602			,899 ^b	,893	,905		

Linear-by-Linear Association	,533 ^c	1	,465	,489 ^b	,479	,498	,245 ^b	,237	,254
N of Valid Cases	132								

a. 8 cells (50,0%) have expected count less than 5. The minimum expected count is ,41.

b. Based on 10000 sampled tables with starting seed 1216981036.

c. The standardized statistic is ,730.

Traffic accident involvement and substitute transport mode choice

A chi-square test of independence indicated no statistically significant association between respondents' involvement in traffic accidents and their choice of substitute transport mode, $\chi^2(3, N = 131) = 1.30, p = 0.728$. The absence of an association was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.756$) as well as the Fisher–Freeman–Halton exact test ($p = 0.894$), due to small expected cell counts. The effect size was negligible, indicating very limited practical relevance.

Across substitute transport groups, the proportion of respondents reporting traffic accident involvement was relatively similar. Although the active mobility group showed a slightly higher proportion of respondents with accident experience, and the public transport group showed no reported accidents, these differences were small and not statistically meaningful, largely reflecting low subgroup sizes rather than systematic behavioural differences.

Table 42. Statistical test for associations between traffic accidents and substitute transport modes (1)

Substitute_Groups * Accident Crosstabulation					
		Accident		Total	
		No	Yes		
Substitute_Groups	Private motorized transport	Count	49	10	59
		Expected Count	47,7	11,3	59,0
		% within Substitute_Groups	83,1%	16,9%	100,0%
		Standardized Residual	,2	-,4	
Public transport		Count	3	0	3
		Expected Count	2,4	,6	3,0
		% within Substitute_Groups	100,0%	0,0%	100,0%
		Standardized Residual	,4	-,8	
Active mobility		Count	45	13	58
		Expected Count	46,9	11,1	58,0

	% within Substitute_Groups	77,6%	22,4%	100,0%
	Standardized Residual	-,3	,6	
Micromobility (electric)	Count	9	2	11
	Expected Count	8,9	2,1	11,0
	% within Substitute_Groups	81,8%	18,2%	100,0%
	Standardized Residual	,0	-,1	
	Total	Count	106	25
	Expected Count	106,0	25,0	131,0
	% within Substitute_Groups	80,9%	19,1%	100,0%

Table 43. Statistical test for associations between traffic accidents and substitute transport modes (2)

Chi-Square Tests									
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Significance	95% Interval Lower Bound	Confidence Upper Bound	Significance	95% Interval Lower Bound	Confidence Upper Bound
Pearson Chi-Square	1,304 ^a	3	,728	,756 ^b	,747	,764			
Likelihood Ratio	1,855	3	,603	,690 ^b	,681	,699			
Fisher-Freeman-Halton Exact Test	,886			,894 ^b	,888	,900			
Linear-by-Linear Association	,365 ^c	1	,546	,619 ^b	,609	,628	,312 ^b	,303	,321
N of Valid Cases	131								

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,57.

b. Based on 10000 sampled tables with starting seed 805840992.

c. The standardized statistic is ,604.

Typical e-scooter travel distance and substitute transport mode choice

Differences in typical e-scooter travel distance across substitute transport mode groups were examined using the Kruskal–Wallis test. The analysis did not reveal statistically significant differences between groups after adjustment for multiple comparisons (all Bonferroni-adjusted p-values > 0.05).

Post-hoc pairwise comparisons similarly indicated no statistically significant differences between any pairs of substitute transport modes. However, descriptive inspection of the distribution of travel distances, as illustrated in Figure 7, suggests a meaningful trend. Respondents who would substitute e-scooter trips with public transport typically reported shorter e-scooter trip distances, whereas those who would substitute with private motorised transport or electric micromobility tended to report longer travel distances, including several extreme values exceeding 20 km.

Users selecting active mobility as a substitute generally reported shorter typical e-scooter trip distances compared to those selecting motorised alternatives. Although these differences did not reach statistical significance, the observed pattern is consistent with expected behavioural logic, whereby longer trip distances increase the attractiveness of motorised and electric alternatives, while shorter trips remain compatible with walking and cycling.

Overall, the findings suggest that while typical travel distance does not statistically differentiate substitute transport mode choice, it may still play a contextual role in shaping substitution decisions. These tendencies provide useful interpretative context for understanding modal substitution behaviour, even in the absence of formally significant group differences.

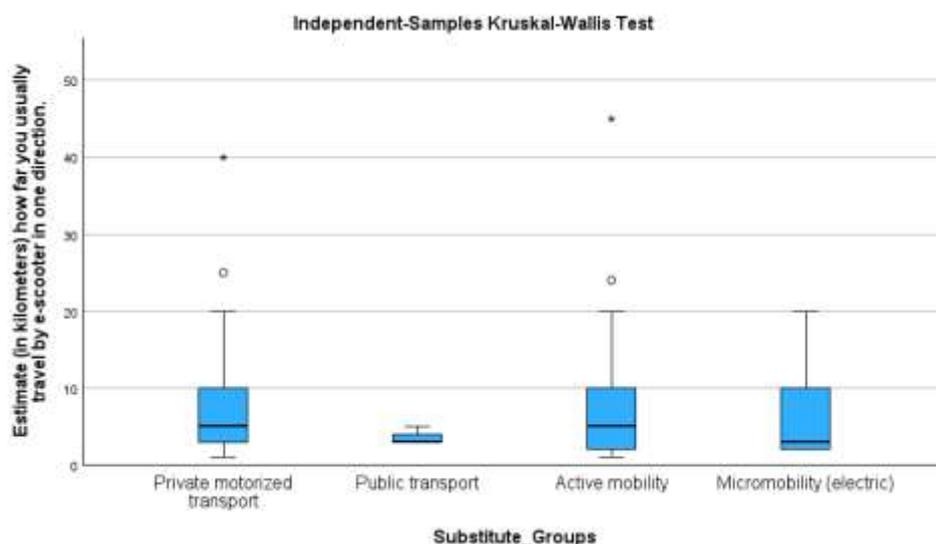


Figure 7. Typical e-scooter trip distance by substitute transport mode

Table 44. Statistical test for associations between travel distance travelled and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Public transport-Micromobility (electric)	-9,515	23,535	-,404	,686	1,000

Public transport-Active mobility	-9,771	21,413	-,456	,648	1,000
Public transport-Private motorized transport	14,985	21,413	,700	,484	1,000
Micromobility (electric)-Active mobility	,256	11,917	,021	,983	1,000
Micromobility (electric)-Private motorized transport	5,470	11,917	,459	,646	1,000
Active mobility-Private motorized transport	5,214	6,829	,764	,445	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Travel purpose and substitute transport modes

This section examines associations between respondent e-scooter trip purposes and the choice of substitute transport modes. Each trip purpose was analysed separately to assess whether users who report using e-scooters for a given purpose differ systematically in their preferred substitute modes compared to those who do not report that purpose.

Commute to work

A statistically significant association was found between the use of e-scooters for commuting to work and the choice of substitute transport mode, $\chi^2(3, N = 134) = 9.66, p = 0.022$. The result was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.019$; 95% CI: 0.016–0.021). The effect size was small to medium (Cramer's $V = 0.27$), indicating a meaningful but moderate relationship.

Inspection of cell frequencies revealed that respondents who use e-scooters for commuting to work were more likely than expected to select public transport as a substitute (standardised residual = +2.0). In contrast, active mobility was slightly underrepresented among work commuters, suggesting lower propensity to substitute commuting trips with walking or cycling when e-scooter use is unavailable.

Table 45. Statistical test for associations between "Commute to work" and substitute transport modes

		Purpose of e-scooter use_Commute to work		
		No	Yes	Total
Substitute_Groups	Private motorized transport	Count 38	23	61
		Expected Count 40,5	20,5	61,0
		% within Substitute_Groups 62,3%	37,7%	100,0%
		Standardized Residual -,4	,6	
Public transport	Count	0	3	3
	Expected Count	2,0	1,0	3,0
	% within Substitute_Groups	0,0%	100,0%	100,0%
	Standardized Residual	-1,4	2,0	
Active mobility	Count	45	14	59
	Expected Count	39,2	19,8	59,0
	% within Substitute_Groups	76,3%	23,7%	100,0%
	Standardized Residual	,9	-1,3	
Micromobility (electric)	Count	6	5	11
	Expected Count	7,3	3,7	11,0
	% within Substitute_Groups	54,5%	45,5%	100,0%
	Standardized Residual	-,5	,7	
Total	Count	89	45	134
	Expected Count	89,0	45,0	134,0
	% within Substitute_Groups	66,4%	33,6%	100,0%

Commute to school

No statistically significant association was found between the use of e-scooters for commuting to school and the choice of substitute transport mode, $\chi^2(3, N = 134) = 1.30, p = 0.729$. The result was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.675$; 95% CI: 0.665–0.684). The effect size was very small (Cramer’s $V \approx 0.10$).

The distribution of substitute transport modes was highly similar between respondents who reported using e-scooters for commuting to school and those who did not. None of the standardised residuals indicated meaningful deviations from expected frequencies, suggesting no systematic differences in substitute mode preferences across groups.

Table 46. Statistical test for associations between “Commute to school” and substitute transport modes

		Purpose of e-scooter use_Commute to school		
		No	Yes	Total
Substitute_Groups Private motorized transport	Count	57	4	61
	Expected Count	56,9	4,1	61,0
	% within Substitute_Groups	93,4%	6,6%	100,0%
	Standardized Residual	,0	,0	
Public transport	Count	3	0	3
	Expected Count	2,8	,2	3,0
	% within Substitute_Groups	100,0%	0,0%	100,0%
	Standardized Residual	,1	-,4	
Active mobility	Count	54	5	59
	Expected Count	55,0	4,0	59,0
	% within Substitute_Groups	91,5%	8,5%	100,0%
	Standardized Residual	-,1	,5	
Micromobility (electric)	Count	11	0	11
	Expected Count	10,3	,7	11,0
	% within Substitute_Groups	100,0%	0,0%	100,0%
	Standardized Residual	,2	-,9	
Total	Count	125	9	134
	Expected Count	125,0	9,0	134,0

% within Substitute_Groups	93,3%	6,7%	100,0%
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Trips for errands or daily tasks

No statistically significant association was found between the use of e-scooters for trips related to errands or daily tasks and the choice of substitute transport mode, $\chi^2(3, N = 134) = 5.29, p = 0.152$. The non-significant result was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.158$; 95% CI: 0.151–0.165). The effect size was small (Cramer’s $V \approx 0.20$), indicating limited practical relevance.

The distribution of substitute transport modes showed no systematic differences between respondents who reported using e-scooters for errands or daily tasks and those who did not. While minor deviations from expected frequencies were observed, none of the standardised residuals reached levels indicative of meaningful group differences.

Table 47. Statistical test for associations between “Errands or daily tasks” and substitute transport modes

		Purpose of e-scooter use_Trips for errands or daily tasks			
		No	Yes	Total	
Substitute_Groups	Private motorized transport	Count	24	37	61
		Expected Count	24,1	36,9	61,0
		% within Substitute_Groups	39,3%	60,7%	100,0%
		Standardized Residual	,0	,0	
Public transport		Count	3	0	3
		Expected Count	1,2	1,8	3,0
		% within Substitute_Groups	100,0%	0,0%	100,0%
		Standardized Residual	1,7	-1,3	
Active mobility		Count	23	36	59
		Expected Count	23,3	35,7	59,0
		% within Substitute_Groups	39,0%	61,0%	100,0%
		Standardized Residual	-,1	,1	
Micromobility (electric)		Count	3	8	11
		Expected Count	4,4	6,6	11,0
		% within Substitute_Groups	27,3%	72,7%	100,0%

	Standardized Residual	-,6	,5	
Total	Count	53	81	134
	Expected Count	53,0	81,0	134,0
	% within Substitute_Groups	39,6%	60,4%	100,0%

Leisure activities

No statistically significant association was found between the use of e-scooters for leisure activities and the choice of substitute transport mode, $\chi^2(3, N = 134) = 4.04, p = 0.257$. The non-significant result was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.269$; 95% CI: 0.261–0.277). The effect size was small (Cramer’s $V \approx 0.17$), indicating limited practical relevance.

The distribution of substitute transport modes was broadly similar between respondents who reported using e-scooters for leisure activities and those who did not. No standardised residuals exceeded thresholds indicative of meaningful deviations from expected frequencies, suggesting that substitute mode preferences remain largely consistent regardless of whether e-scooter use is leisure-oriented.

Table 48. Statistical test for associations between “Leisure activities” and substitute transport modes

		Purpose of e-scooter use_Leisure activities		
		No	Yes	Total
Substitute_Groups Private motorized transport	Count	22	39	61
	Expected Count	23,2	37,8	61,0
	% within Substitute_Groups	36,1%	63,9%	100,0%
	Standardized Residual	-,3	,2	
Public transport	Count	3	0	3
	Expected Count	1,1	1,9	3,0
	% within Substitute_Groups	100,0%	0,0%	100,0%
	Standardized Residual	1,7	-1,4	
Active mobility	Count	20	39	59
	Expected Count	22,5	36,5	59,0
	% within Substitute_Groups	33,9%	66,1%	100,0%

	Standardized Residual	-,5	,4	
Micromobility (electric)	Count	6	5	11
	Expected Count	4,2	6,8	11,0
	% within Substitute_Groups	54,5%	45,5%	100,0%
	Standardized Residual	,9	-,7	
Total	Count	51	83	134
	Expected Count	51,0	83,0	134,0
	% within Substitute_Groups	38,1%	61,9%	100,0%

Tourism purposes

No statistically significant association was found between the use of e-scooters for tourism purposes and the choice of substitute transport mode, $\chi^2(3, N = 134) = 4.71, p = 0.194$. The non-significant result was confirmed using Monte Carlo simulation (Monte Carlo $p = 0.201$; 95% CI: 0.194–0.208). The effect size was small (Cramer’s $V \approx 0.19$), indicating limited practical relevance.

The distribution of substitute transport modes did not differ substantially between respondents who reported using e-scooters for tourism purposes and those who did not. While minor descriptive deviations were observed—suggesting a slightly greater diversity of substitute modes among tourism-oriented users—none of the standardised residuals indicated meaningful departures from expected frequencies.

Table 49. Statistical test for associations between “Tourism purposes” and substitute transport modes

		Purpose of e-scooter use_Tourism purposes		
		No	Yes	Total
Substitute_Groups Private motorized transport	Count	46	15	61
	Expected Count	42,8	18,2	61,0
	% within Substitute_Groups	75,4%	24,6%	100,0%
	Standardized Residual	,5	-,8	
Public transport	Count	3	0	3
	Expected Count	2,1	,9	3,0
	% within Substitute_Groups	100,0%	0,0%	100,0%

	Standardized Residual	,6	-,9	
Active mobility	Count	36	23	59
	Expected Count	41,4	17,6	59,0
	% within Substitute_Groups	61,0%	39,0%	100,0%
	Standardized Residual	-,8	1,3	
Micromobility (electric)	Count	9	2	11
	Expected Count	7,7	3,3	11,0
	% within Substitute_Groups	81,8%	18,2%	100,0%
	Standardized Residual	,5	-,7	
Total	Count	94	40	134
	Expected Count	94,0	40,0	134,0
	% within Substitute_Groups	70,1%	29,9%	100,0%

Associations between motivational, riding behavioural, and perceptual factors across substitute transport mode groups

Efficiency and convenience

Pairwise comparisons with Bonferroni correction indicate no statistically significant differences in perceived efficiency and convenience across substitute groups (all adjusted p-values = 1.000). This suggests that attitudes toward efficiency and convenience are consistent across preferred substitute modes.

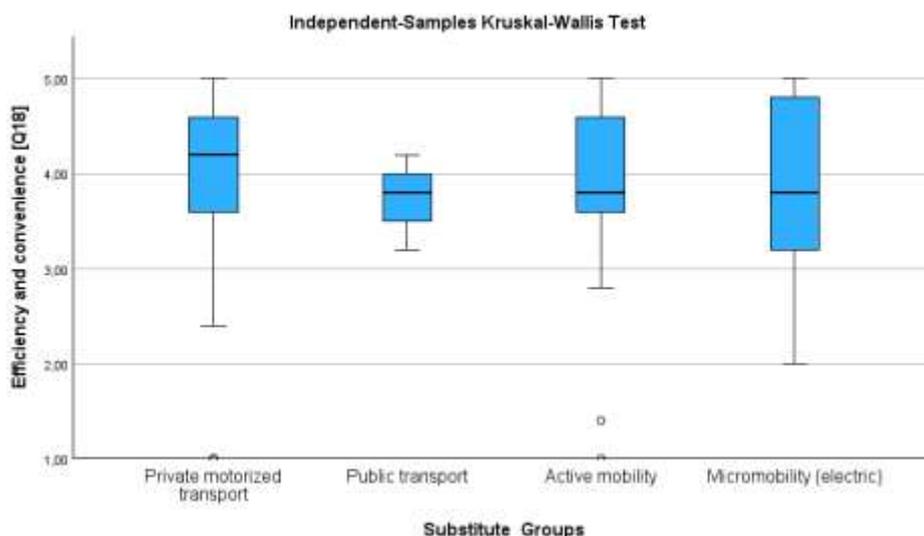


Figure 8. Efficiency and convenience by substitute transport mode

Table 50. Statistical test for associations between “Efficiency and convenience” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Public transport-Active mobility	-12,048	23,055	-,523	,601	1,000
Public transport-Micromobility (electric)	-14,030	25,373	-,553	,580	1,000
Public transport-Private motorized transport	17,981	23,028	,781	,435	1,000
Active mobility-Micromobility (electric)	-1,982	12,793	-,155	,877	1,000
Active mobility-Private motorized transport	5,933	7,085	,837	,402	1,000
Micromobility (electric)-Private motorized transport	3,951	12,745	,310	,757	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Safety and health

Pairwise comparisons with Bonferroni correction indicate no statistically significant differences in perceived safety and health across substitute groups (all adjusted p-values ≥ 0.965). However, descriptive trends suggest that respondents who would substitute e-scooters with public transport rate safety and health higher (median ≈ 4.0), while those preferring active mobility rate it lower (median ≈ 2.5).

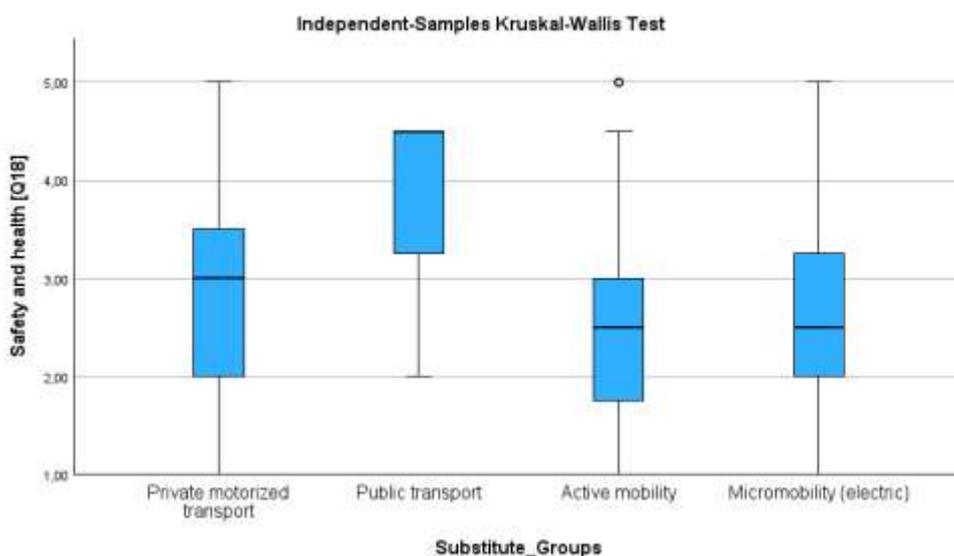


Figure 9. Safety and health by substitute transport mode

Table 51. Statistical test for associations between "Safety and health" and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Active mobility-Micromobility (electric)	-4,675	12,684	-,369	,712	1,000
Active mobility-Private motorized transport	5,720	7,024	,814	,415	1,000
Active mobility-Public transport	32,054	22,858	1,402	,161	,965
Micromobility (electric)-Private motorized transport	1,045	12,636	,083	,934	1,000
Micromobility (electric)-Public transport	27,379	25,156	1,088	,276	1,000
Private motorized transport-Public transport	-26,333	22,832	-1,153	,249	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Cost and sustainability

Pairwise comparisons with Bonferroni adjustment show no statistically significant differences in *Cost and sustainability* across substitute groups (all adjusted p-values ≥ 0.206). The unadjusted difference between *Active mobility* and *Private motorized transport* ($p = 0.034$) does

not remain significant after correction ($p = 0.206$), consistent with similar medians and overlapping interquartile ranges across groups.

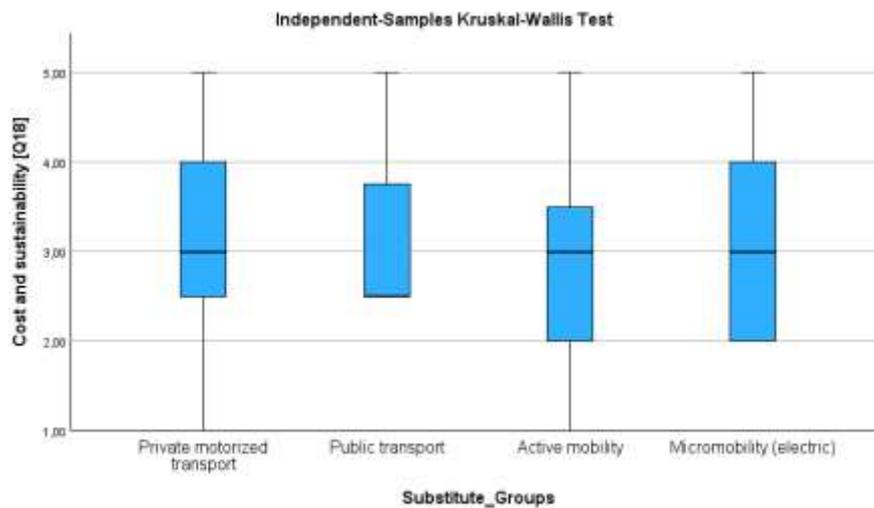


Figure 10. Cost and sustainability by substitute transport mode

Table 52. Statistical test for associations between “Cost and sustainability and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Active mobility-Micromobility (electric)	-8,987	12,724	-,706	,480	1,000
Active mobility-Public transport	10,138	22,930	,442	,658	1,000
Active mobility-Private motorized transport	14,910	7,046	2,116	,034	,206
Micromobility (electric)-Public transport	1,152	25,235	,046	,964	1,000
Micromobility (electric)-Private motorized transport	5,923	12,675	,467	,640	1,000
Public transport-Private motorized transport	4,772	22,903	,208	,835	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Risk and violations

The independent-samples Kruskal-Wallis test indicated no differences in the factor scores across substitute groups, $H(3) = 0.096$, $p = 0.992$. Bonferroni-adjusted pairwise comparisons likewise showed no statistically significant contrasts (all adjusted p -values = 1.000).

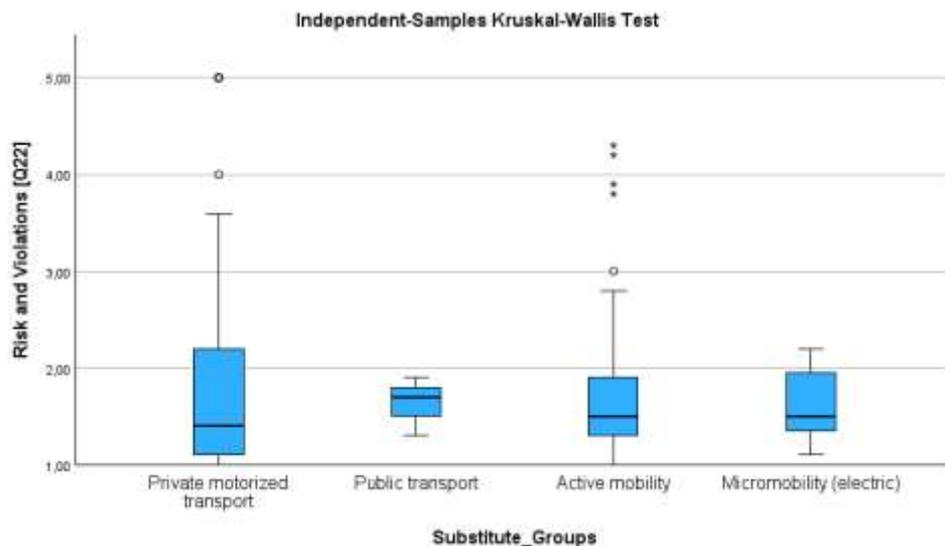


Figure 11. Risk and violations by substitute transport mode

Table 53. Statistical test for associations between "Risk and violations" and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Private motorized transport-Active mobility	-3,719	7,072	-,526	,599	1,000
Private motorized transport-Micromobility (electric)	-4,148	12,666	-,328	,743	1,000
Private motorized transport-Public transport	-10,860	22,886	-,475	,635	1,000
Active mobility-Micromobility (electric)	-,429	12,731	-,034	,973	1,000
Active mobility-Public transport	7,141	22,922	,312	,755	1,000
Micromobility (electric)-Public transport	6,712	25,216	,266	,790	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Safety compliance

Bonferroni-adjusted pairwise comparisons show no statistically significant differences in Safety compliance [Q22] across substitute groups (all adjusted p-values = 1.000). Boxplots indicate similar medians (~3) with overlapping interquartile ranges, consistent with no group differences.

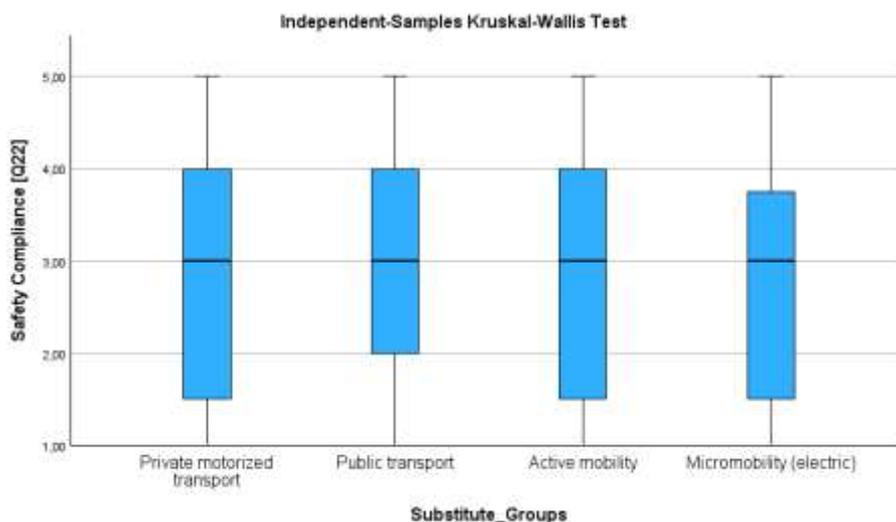


Figure 12. Safety compliance by substitute transport mode

Table 54. Statistical test for associations between “Safety compliance” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Micromobility (electric)-Active mobility	1,516	12,569	,121	,904	1,000
Micromobility (electric)-Private motorized transport	2,951	12,504	,236	,813	1,000
Micromobility (electric)-Public transport	5,136	24,894	,206	,837	1,000
Active mobility-Private motorized transport	1,435	6,982	,206	,837	1,000
Active mobility-Public transport	3,621	22,629	,160	,873	1,000
Private motorized transport-Public transport	2,185	22,593	-,097	,923	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Phone or audio use

Bonferroni-adjusted pairwise comparisons after the Kruskal–Wallis test indicate no statistically significant differences in phone or audio use (Q22) across substitute groups (all adjusted p-values = 1.000). Boxplots show similar medians (~2–2.5) with overlapping IQRs, consistent with no group differences.

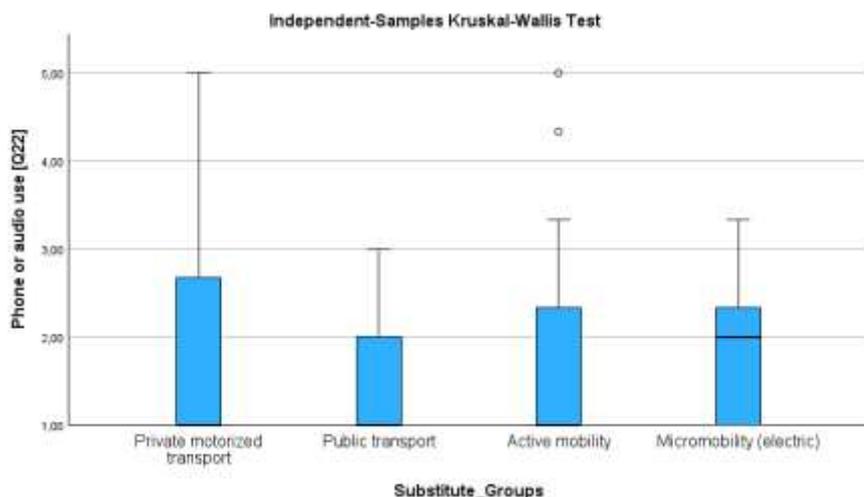


Figure 13. Phone or audio use during e-Scooter drive by substitute transport mode

Table 55. Statistical test for associations between “Phone or audio use” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Public transport-Active mobility	-4,075	21,409	-,190	,849	1,000
Public transport-Private motorized transport	7,333	21,375	,343	,732	1,000
Public transport-Micromobility (electric)	-14,333	23,551	-,609	,543	1,000
Active mobility-Private motorized transport	3,259	6,605	,493	,622	1,000
Active mobility-Micromobility (electric)	-10,259	11,891	-,863	,388	1,000
Private motorized transport-Micromobility (electric)	-7,000	11,830	-,592	,554	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Exposure and conflict

Pairwise comparisons indicated no evidence of differences in Exposure and Conflict scores across substitute groups (all Bonferroni-adjusted p-values $\geq .388$; all adjusted p-values = 1.000). Thus, perceived exposure and conflict appears comparable across the different intended substitute transport modes.

Table 56. Statistical test for associations between “Exposure and conflict” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Public transport-Micromobility (electric)	-7,303	25,052	-,292	,771	1,000
Public transport-Active mobility	-7,563	22,773	-,332	,740	1,000
Public transport-Private motorized transport	13,658	22,746	,600	,548	1,000
Micromobility (electric)-Active mobility	,260	12,649	,021	,984	1,000
Micromobility (electric)-Private motorized transport	6,355	12,599	,504	,614	1,000
Active mobility-Private motorized transport	6,095	7,054	,864	,388	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Infrastructure quality

Pairwise comparisons indicated no statistically significant differences in Infrastructure Quality scores across e-scooter substitute transport mode groups after Bonferroni adjustment (all adjusted p-values $\geq .424$). Although two contrasts showed trend-level unadjusted significance (Private motorized transport vs. Public transport: $p = .071$; Micromobility (electric) vs. Public transport: $p = .085$), these differences were not significant after correction for multiple comparisons.

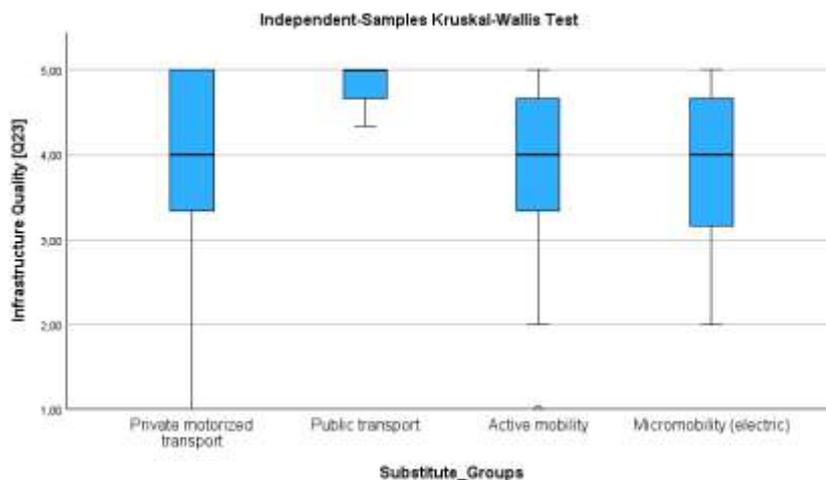


Figure 14. Infrastructure quality by substitute transport mode

Table 57. Statistical test for associations between “Infrastructure quality” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Micromobility (electric)-Private motorized transport	1,958	12,444	,157	,875	1,000
Micromobility (electric)-Active mobility	6,995	12,493	,560	,576	1,000
Micromobility (electric)-Public transport	42,576	24,743	1,721	,085	,512
Private motorized transport-Active mobility	5,037	6,967	-,723	,470	1,000
Private motorized transport-Public transport	40,617	22,465	-1,808	,071	,424
Active mobility-Public transport	35,580	22,492	1,582	,114	,682

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Punishment and enforcement

Pairwise comparisons showed no statistically significant differences in Punishment and Enforcement scores across e-scooter substitute transport mode groups (all Bonferroni-adjusted p-values = 1.000). This indicates that support for enforcement- and fine-based measures is broadly similar regardless of respondents’ intended substitute mode.

Table 58. Statistical test for associations between "Punishment and enforcement" and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Public transport-Private motorized transport	1,984	22,449	,088	,930	1,000
Public transport-Micromobility (electric)	-7,545	24,725	-,305	,760	1,000
Public transport-Active mobility	-10,241	22,476	-,456	,649	1,000
Private motorized transport-Micromobility (electric)	-5,562	12,435	-,447	,655	1,000
Private motorized transport-Active mobility	-8,258	6,962	-1,186	,236	1,000
Micromobility (electric)-Active mobility	2,696	12,484	,216	,829	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Licensing and obligatory measures

Pairwise comparisons indicated that Licensing and obligatory scores were comparable across all substitute transport mode groups. None of the contrasts reached statistical significance (all unadjusted p-values $\geq .325$), and all Bonferroni-adjusted p-values were 1.000, confirming the absence of robust group differences.

Table 59. Statistical test for associations between "Licensing and obligatory measures" and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Micromobility (electric)-Private motorized transport	411	12,479	,033	,974	1,000
Micromobility (electric)-Active mobility	7,289	12,529	,582	,561	1,000
Micromobility (electric)-Public transport	9,924	24,814	,400	,689	1,000
Private motorized transport-Active mobility	-6,879	6,987	-,985	,325	1,000
Private motorized transport-Public transport	-9,514	22,530	-,422	,673	1,000
Active mobility-Public transport	2,635	22,557	,117	,907	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Public awareness

Pairwise comparisons indicated that *Public Awareness* ratings were comparable across all substitute transport mode groups. None of the contrasts reached statistical significance (all unadjusted p-values $\geq .359$), and all Bonferroni-adjusted p-values were 1.000, confirming the absence of robust group differences.

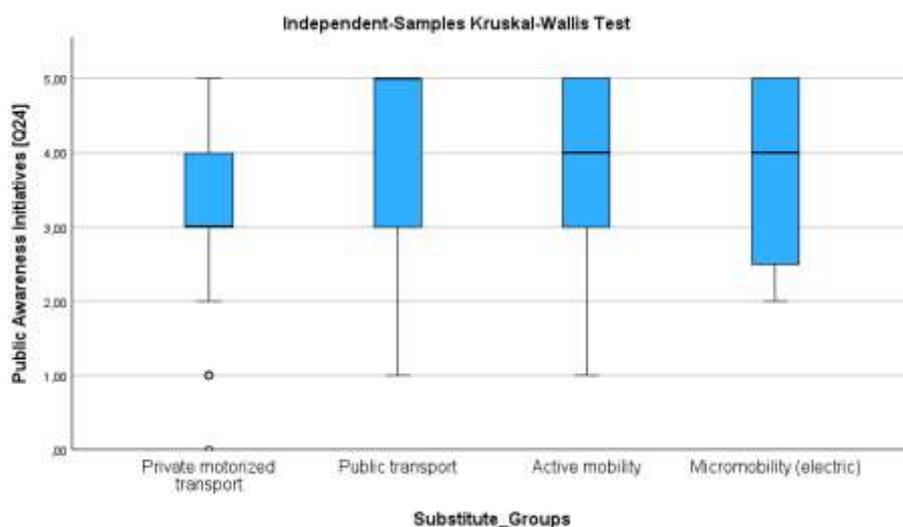


Figure 15. Public awareness by substitute transport mode

Table 60. Statistical test for associations between “Public awareness” and substitute transport modes

Pairwise Comparisons of Substitute_Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Private motorized transport-Active mobility	-5,091	6,908	-,737	,461	1,000
Private motorized transport-Micromobility (electric)	-11,404	12,426	-,918	,359	1,000
Private motorized transport-Public transport	-17,374	22,452	-,774	,439	1,000
Active mobility-Micromobility (electric)	-6,313	12,473	-,506	,613	1,000
Active mobility-Public transport	12,282	22,478	,546	,585	1,000
Micromobility (electric)-Public transport	5,970	24,738	,241	,809	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Associations between socio-demographic characteristics, factors and safety-related characteristics

This section presents the results of statistical analyses examining the relationships between selected safety-related factors and other study variables. Specifically, three factors derived from the factor analyses—Safety and health, Risky and violative riding behaviour, and Safety compliance (protective practices)—were analysed in relation to a range of demographic characteristics, travel behaviour variables, and e-scooter use patterns.

Gender and safety-related characteristics

No statistically significant gender differences were found for any of the examined safety-related factors (all p-values > 0.05). Effect sizes were small, indicating that gender explains little variance in safety-related motivations, self-reported risky or violative riding behaviour, or compliance-oriented safety practices among e-scooter users.

Descriptive comparisons revealed largely overlapping distributions of factor scores for men and women across all safety-related dimensions. Although minor differences in median scores were observed for respondent factors, none of these deviations reached statistical significance or demonstrated a consistent pattern favouring one gender over the other.

Table 61. Statistical test for associations between gender and e-Scooter riding safety

Hypothesis Test Summary						
	Null Hypothesis	Test	Sig. ^{a,b}	Decision		
1	The distribution of Safety and health [Q18] is the same across Gender categories.	Independent-Samples Mann-Whitney U Test	,527	Retain the null hypothesis.		
2	The distribution of Risk and Violations [Q22] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,079	Retain the null hypothesis.		
1	The distribution of Safety Compliance [Q22] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,235	Retain the null hypothesis.	Test	,235

a. The significance level is ,050.

b. Asymptotic significance is displayed.

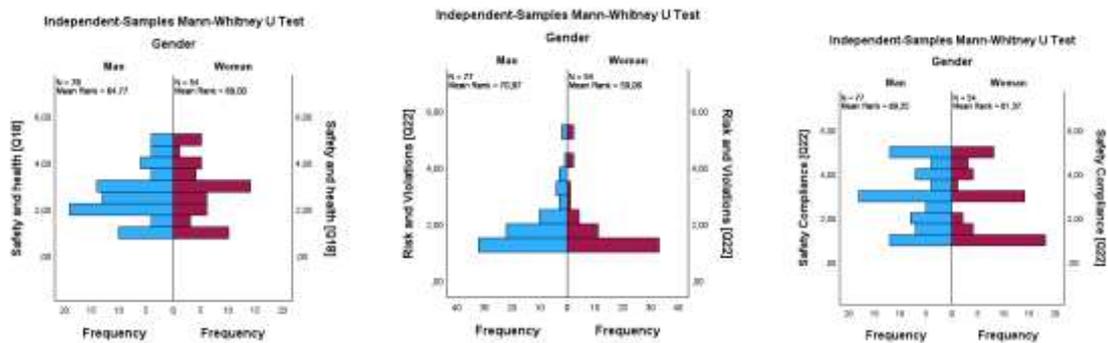


Figure 16. e-Scooter riding safety scores by gender

Age and safety-related characteristics

A statistically significant negative association was found between age and Risky and Violative riding behaviour ($p < 0, p < 0.01$), indicating that older respondents reported lower levels of risky and violative riding behaviour. The strength of the association was small to moderate, suggesting a gradual decline in self-reported risk-taking behaviour with increasing age.

No statistically significant associations were found between age and the Safety and health or Safety compliance (all p -values > 0.05), indicating that age does not meaningfully differentiate safety-related motivations or compliance-oriented safety practices.

Table 62. Statistical test for associations between age and e-Scooter riding safety

		Correlations			
		Age	Safety and health [Q18]	Risk and Violations [Q22]	Safety Compliance [Q22]
Spearman's rho	Age	1,000	,053	-,244**	,072
	Correlation Coefficient				
	Sig. (2-tailed)	.	,542	,005	,412
	N	134	134	133	133
Safety and health [Q18]	Correlation Coefficient	,053	1,000	,065	,421**
	Sig. (2-tailed)	,542	.	,455	<,001
	N	134	136	135	135
Risk and Violations [Q22]	Correlation Coefficient	-,244**	,065	1,000	,055
	Sig. (2-tailed)	,005	,455	.	,527
	N	133	135	135	135
Safety Compliance [Q22]	Correlation Coefficient	,072	,421**	,055	1,000
	Sig. (2-tailed)	,412	<,001	,527	.
	N	133	135	135	135

** . Correlation is significant at the 0.01 level (2-tailed).

Motorcycles driving status and safety-related characteristics

Statistically significant differences were observed for two of the three safety-related factors. Respondents holding a motorcycle driving licence reported significantly higher scores on the Safety compliance factor ($p < 0.01$), indicating more frequent engagement in protective and compliance-oriented safety practices. In addition, licence holders scored significantly higher on the Safety and health factor ($p < 0.05$), suggesting a stronger orientation towards safety- and health-related considerations when using an e-scooter. Effect sizes for both associations were small to moderate, indicating meaningful but not large differences between groups.

No statistically significant difference was found between groups for the Risky and Violative riding behaviour factor ($p > 0.05$), indicating that possession of a motorcycle driving licence is not associated with lower self-reported involvement in risky or violative riding behaviours.

Table 63. Statistical test for associations between motorcycle driving licence and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,002	Reject the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,020	Reject the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,772	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

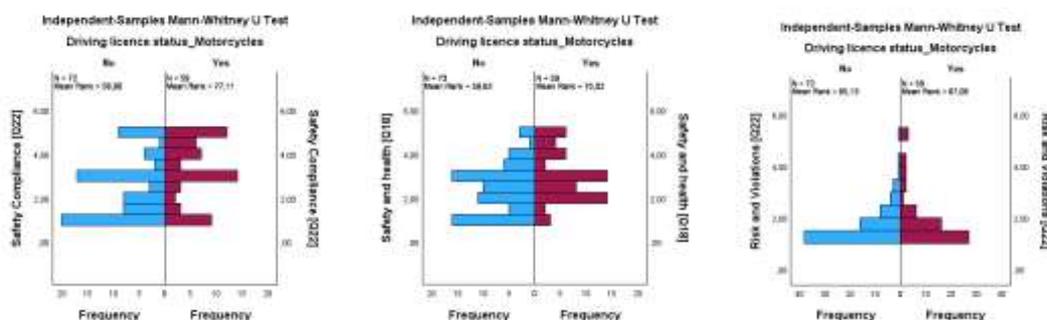


Figure 17. e-Scooter riding safety scores by motorcycle driving status

Passenger car driving status and safety-related characteristics

No statistically significant differences were found between licence holders and non-holders for any of the examined safety-related factors (all p -values > 0.05). Effect sizes were small, indicating that possession of a passenger car driving licence explains little variance in safety-related motivations, risk-taking or violative behaviours, or compliance-oriented safety practices when using an e-scooter.

Descriptive comparisons showed largely overlapping distributions of factor scores across all three safety-related dimensions. Although minor variations in median values were observed,

these differences were inconsistent and did not suggest a systematic pattern associated with passenger car driving licence status.

Table 64. Statistical test for associations between passenger car driving licence and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,441	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,215	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,019	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

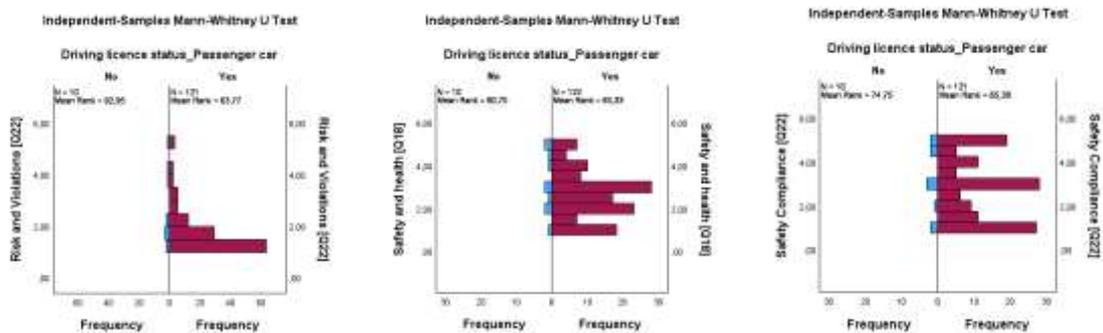


Figure 18 e-Scooter riding safety scores by passenger car driving licence

Employment status and safety-related characteristics

No statistically significant differences in factor scores were found across employment status groups for any of the examined safety-related dimensions (all p-values > 0.05). Effect sizes were small, indicating that employment status accounts for little variance in safety-related attitudes, self-reported risky or violative behaviours, or compliance-oriented safety practices among e-scooter users.

Descriptive comparisons revealed largely overlapping distributions of factor scores across employment categories, including students, employed and self-employed respondents, and

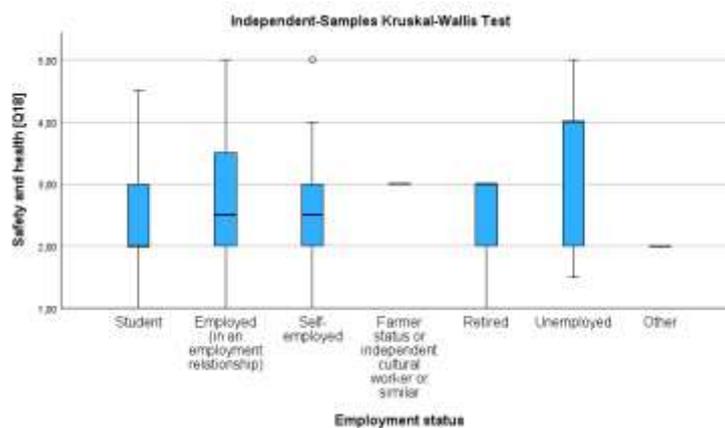
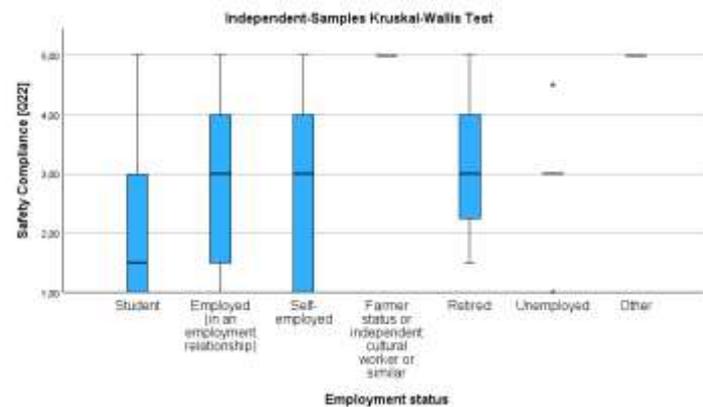
retired respondents. Although minor variations in median values were observed for some factors, these deviations did not form a consistent pattern and were not statistically robust.

Table 65. Statistical test for associations between employment status and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,107	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,814	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,161	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.



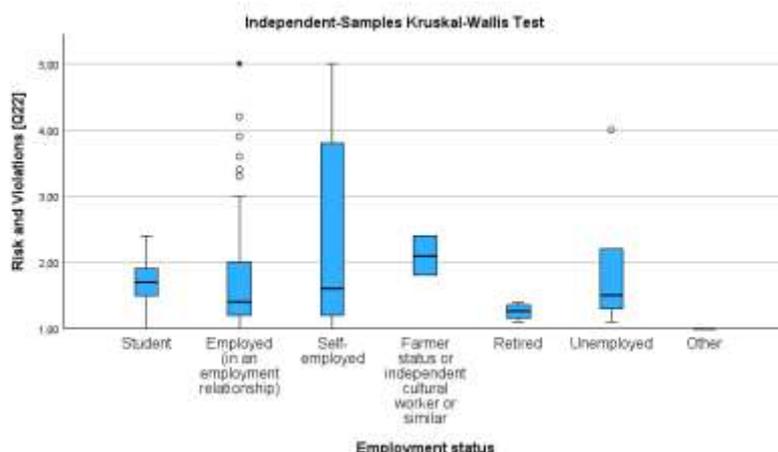


Figure 19. e-Scooter riding safety scores by employment status

Education and safety-related characteristics

No statistically significant differences in factor scores were found across education levels for any of the examined safety-related dimensions (all p-values > 0.05). Given the number of education categories and uneven group sizes, these results indicate that educational attainment explains little variance in safety-related attitudes, self-reported risky or violative riding behaviour, or compliance-oriented safety practices among e-scooter users.

Descriptive inspection of factor scores distributions showed overlapping patterns across all education groups. Although minor variations in median scores were observed for respondent factors, these deviations were neither consistent nor statistically robust and therefore do not suggest meaningful differentiation between education levels.

Table 66. Statistical test for associations between education level and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,779	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,663	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,173	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

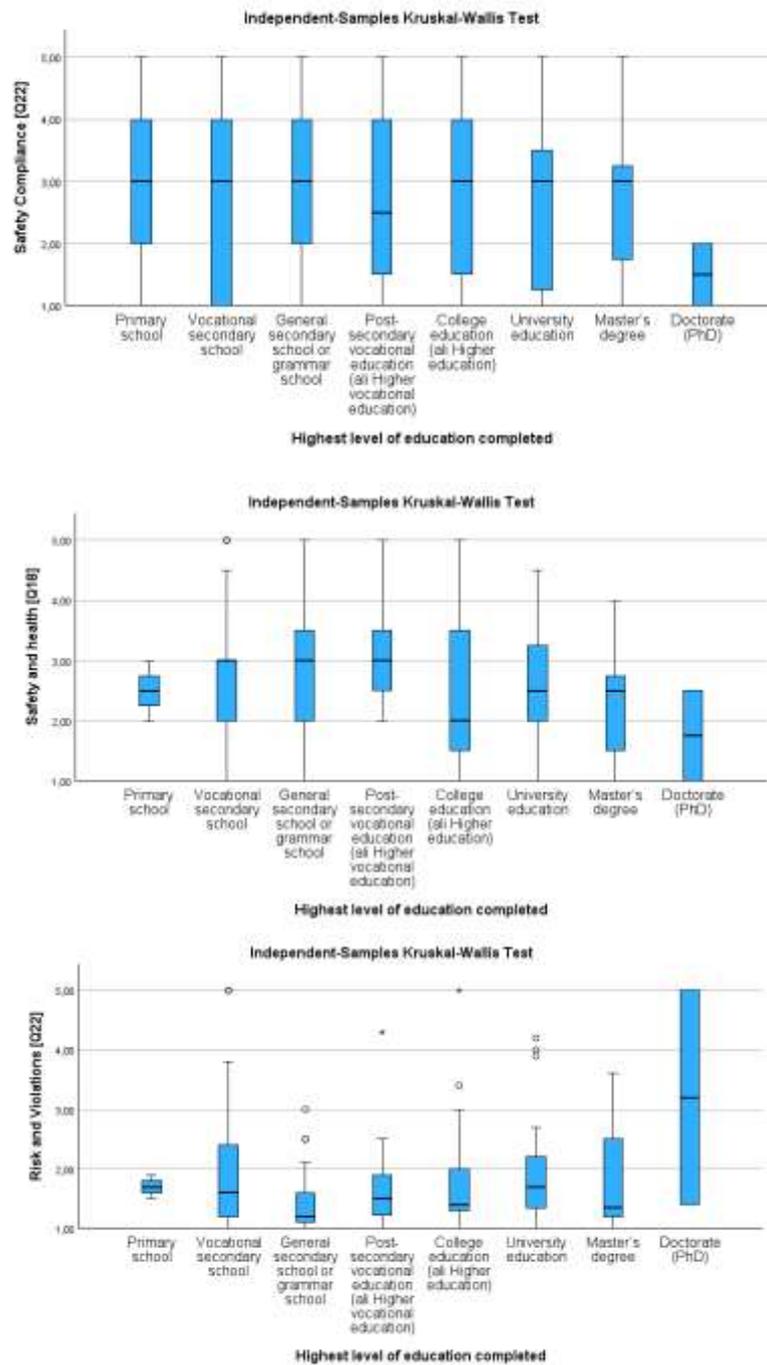


Figure 20. e-Scooter riding safety scores by education level

Place of residence and safety-related characteristics

No statistically significant differences in factor scores were found across residential contexts for any of the examined safety-related factors (all p-values > 0.05). Effect sizes were small, indicating that place of residence explains little variance in safety-oriented motivations,

self-reported risky or violative riding behaviours, or compliance-related safety practices among e-scooter users.

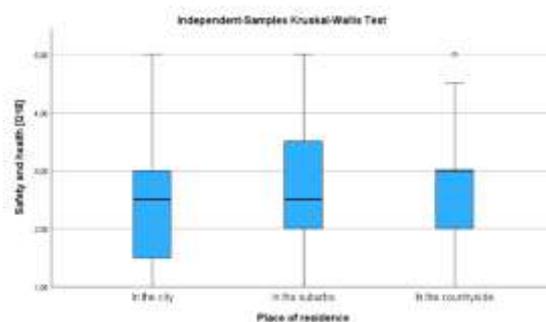
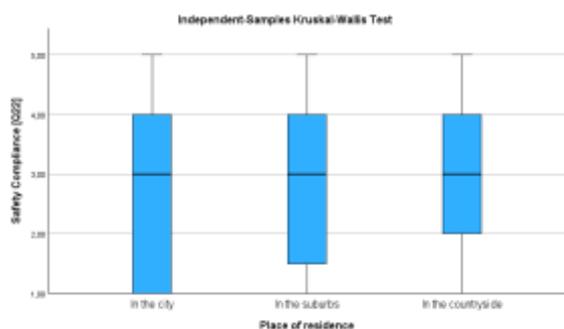
Descriptive inspection of factor scores distributions revealed broadly overlapping patterns across urban, suburban, and rural respondents. While minor variations in median values were observed—for example, slightly higher Safety compliance scores among urban residents and marginally higher Risk and violative riding behaviour scores among rural respondents—these differences were not statistically robust and did not form consistent or systematic patterns.

Table 67. Statistical test for associations between place of residence and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,560	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,450	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,839	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.



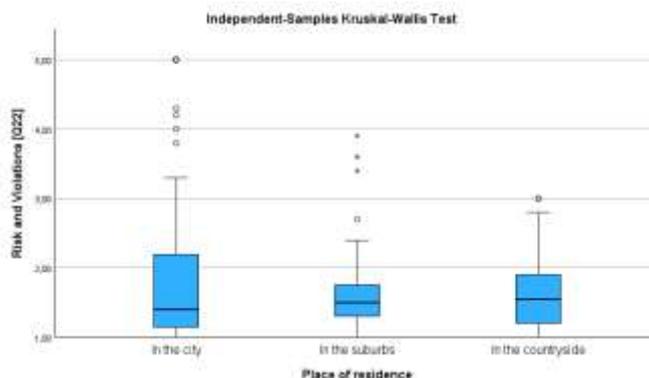


Figure 21. e-Scooter riding safety scores by place of residence

Household income and safety-related characteristics

No statistically significant differences in factor scores were found across income groups for any of the examined safety-related dimensions (all p-values > 0.05). Effect sizes were small, indicating that household income explains little variance in safety-oriented motivations, self-reported risky or violative riding behaviour, or compliance-related safety practices among e-scooter users.

Descriptive inspection of factor scores distributions revealed largely overlapping patterns across income categories. Although minor variations in median values were observed—for example, slightly higher Safety compliance scores among respondents with above-average income—these differences were neither consistent nor statistically robust and therefore do not suggest meaningful income-related differentiation.

Table 68. Statistical test for associations between the income of household and e-Scooter riding safety

Hypothesis Test Summary			
	Null Hypothesis	Test	Sig. ^{a,b} Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,372 Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,056 Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,431 Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

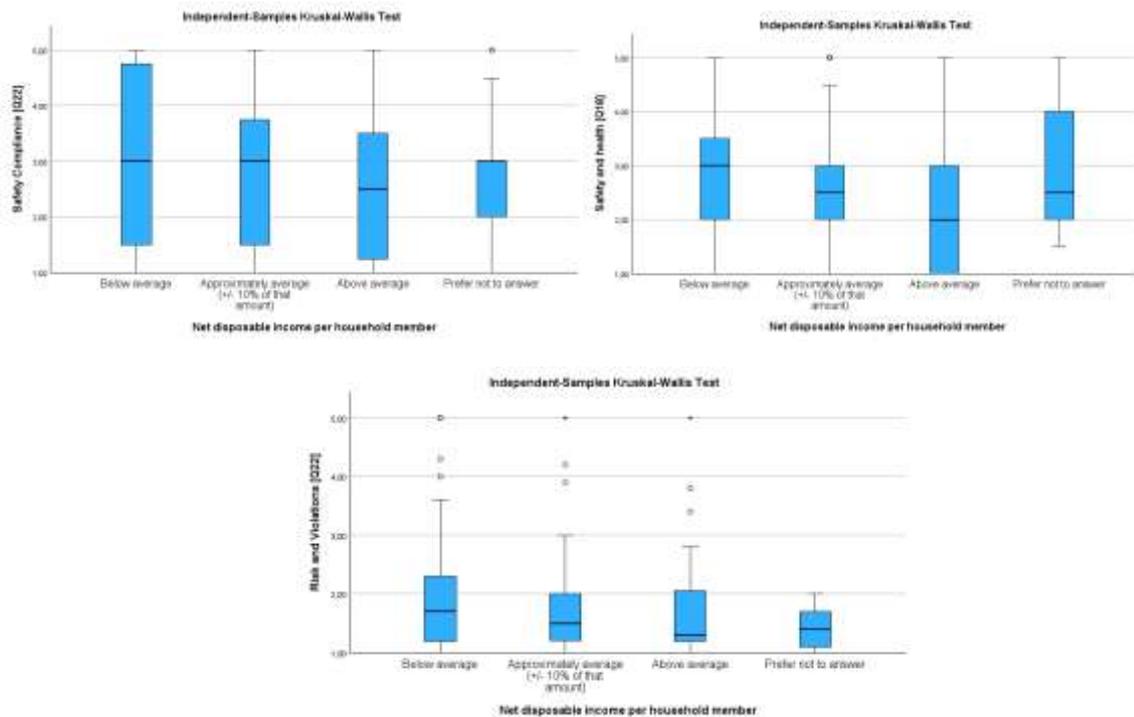


Figure 22. e-Scooter riding safety scores by household income

Traffic accident involvement and safety-related characteristics

Statistically significant differences were observed for two of the three safety-related factors. Respondents with prior accident involvement reported significantly higher scores on the Risky and Violative riding behaviour factor ($p < 0.01$), indicating more frequent engagement in risky or violative riding behaviours. In addition, this group also scored significantly higher on the Safety compliance factor ($p < 0.01$), suggesting greater use of protective and compliance-oriented safety practices. Effect sizes for both associations were small to moderate, indicating meaningful differences in safety-related behavioural profiles.

No statistically significant difference was found between groups for the Safety and health factor ($p > 0.05$), indicating that accident involvement is not associated with stronger safety- or health-oriented motivations for e-scooter use.

Table 69. Statistical test for associations between accidents in traffic and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,005	Reject the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,381	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,002	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

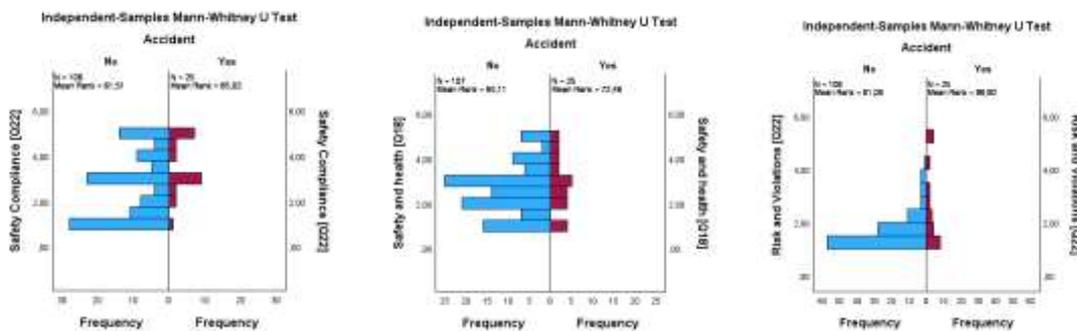


Figure 23. e-Scooter riding safety scores by incidents in traffic

Typical e-scooter travel distance and safety-related characteristics

Statistically significant positive associations were observed between typical e-scooter travel distance and all three safety-related factors. Longer travel distances were associated with higher scores on the Risky and Violative riding behaviour factor ($p = .272$, $p = .002$), indicating more frequent engagement in risky or violative riding behaviours. In addition, respondents who reported longer trips also demonstrated higher levels of Safety compliance ($p = .279$, $p = .002$), suggesting more frequent use of protective and compliance-oriented safety practices.

A similarly positive association was observed for the Safety and health factor ($p = .279$, $p = .002$), indicating that respondents travelling longer distances tend to place greater emphasis on safety- and health-related considerations when using e-scooters. The effect sizes were moderate, suggesting that travel distance is meaningfully associated with both increased safety awareness and higher exposure to risk-related riding situations.

Table 70. Statistical test for associations between travelled distance with e-Scooter and e-Scooter riding safety

Correlations					
		Risk and Violations [Q22]	Safety Compliance [Q22]	Safety and health	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.
Spearman's rho	Correlation Coefficient	1,000	,055	,108	,272**
	Sig. (2-tailed)	.	,527	,220	,002
	N	135	135	131	126
Safety Compliance [Q22]	Correlation Coefficient	,055	1,000	,414**	,279**
	Sig. (2-tailed)	,527	.	<,001	,002
	N	135	135	131	126
Safety health	Correlation Coefficient	,108	,414**	1,000	,279**
	Sig. (2-tailed)	,220	<,001	.	,002
	N	131	131	132	124
Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	Correlation Coefficient	,272**	,279**	,279**	1,000
	Sig. (2-tailed)	,002	,002	,002	.
	N	126	126	124	127

** . Correlation is significant at the 0.01 level (2-tailed).

Travel purpose and safety-related characteristics

This subsection examines whether the purpose of travel is associated with differences in safety-related factors among e-scooter users. Specifically, we assess whether the factors Safety and health, Risky and violative riding behaviour, and Safety compliance vary depending on the type of trip for which an e-scooter is used (e.g. commuting, leisure, errands, or tourism).

The analyses aim to identify potential differences in safety perceptions and self-reported riding behaviour across travel purposes, providing insight into whether specific usage contexts are associated with distinct safety-related patterns.

Commute to work

No statistically significant differences were found between respondents who use an e-scooter to commute to work and those who do not across any of the three safety-related outcomes (all $p > .05$). For Safety compliance, the commuting group showed higher mean ranks than the non-commuting group (MR = 75.62 vs. 63.39), but the difference did not reach statistical significance ($p = .080$). A similar non-significant pattern was observed for Safety and health, where commuters again reported higher mean ranks (MR = 76.06 vs. 63.97), but the result remained non-significant ($p = .086$).

For Risky and violative riding behaviour, there was likewise no evidence of a difference between commuters and non-commuters ($p = .201$). After accounting for multiple testing across the three outcomes using a Holm–Bonferroni procedure, all results remained non-significant. Taken together, these findings indicate that commuting to work is not reliably associated with differences in safety compliance, safety- and health-oriented motivations, or risky/violative riding behaviour in this sample.

Table 71. Statistical test for associations between “Commute to work” and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,080	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,086	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,201	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

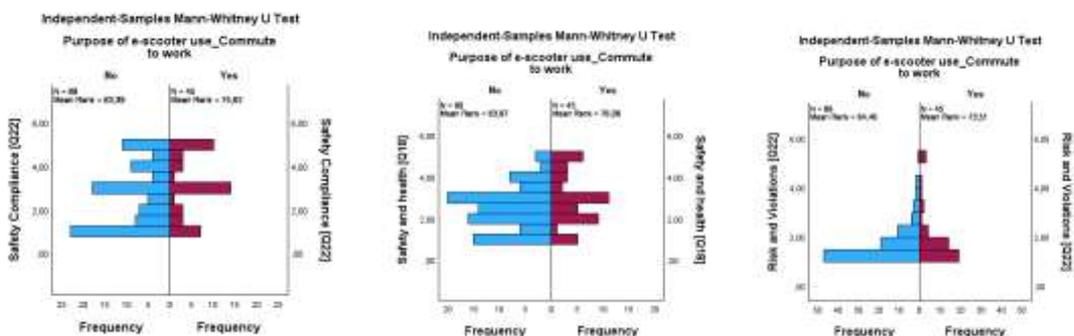


Figure 24. e-Scooter riding safety scores by purpose “Commute to work”

Commute to school

Statistically significant differences were observed for one of the three safety-related factors. Respondents who use an e-scooter to commute to school reported significantly higher scores on the Risky and violative riding behaviour factor compared to non-commuters ($p = .001$), indicating more frequent engagement in risky or violative riding behaviours among this group. This result remained statistically significant after applying the Holm–Bonferroni correction for multiple testing ($p = .001 \leq .0167$).

In contrast, no statistically significant differences were found between school commuters and non-commuters for Safety compliance ($p = .481$) or Safety and health ($p = .665$). Although school commuters showed slightly higher mean ranks on both factors, these differences were small and not statistically meaningful. Taken together, the findings suggest that commuting to school by e-scooter is specifically associated with higher levels of risk- and violation-related behaviour, but not with increased safety compliance or stronger safety- and health-oriented motivations.

Table 72. Statistical test for associations between “Commute to school” and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,481	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,665	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,001	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

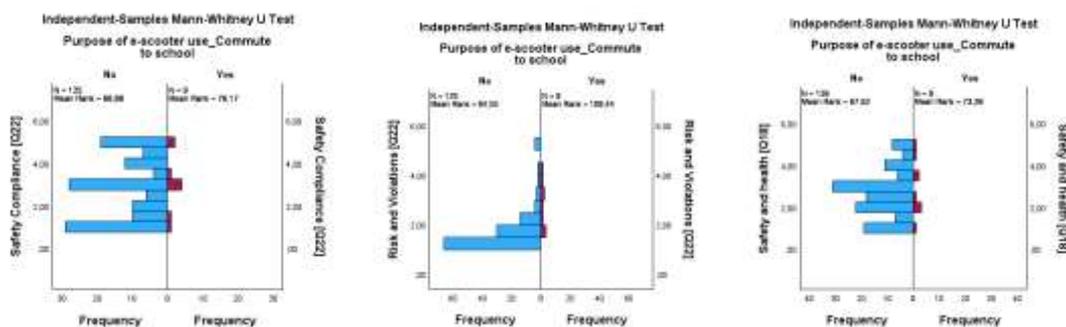


Figure 25. e-Scooter riding safety scores by purpose "Commute to school"

Trips for errands or daily tasks

No statistically significant differences were found between respondents who use an e-scooter for errands or daily tasks and those who do not across any of the three safety-related factors (all $p > .05$). For Safety compliance, mean ranks suggested slightly higher compliance among respondents who do not use e-scooters for errands (MR = 72.64) compared to those who do (MR = 64.24), but this difference was not statistically significant ($p = .215$).

Similarly, no significant differences were observed for Safety and health ($p = .373$) or for Risky and violative riding behaviour, where mean ranks were nearly identical between the two groups (MR = 67.68 vs. 67.38; $p = .965$). After accounting for multiple testing using the Holm-Bonferroni procedure, all results remained non-significant. Overall, these findings indicate that using an e-scooter for routine errands or daily tasks is not systematically associated with differences in safety compliance, safety- and health-oriented attitudes, or self-reported risk and violation behaviours in this sample.

Table 73. Statistical test for associations between "Trips for errands or daily tasks" and e-Scooter riding safety

Hypothesis Test Summary						
	Null Hypothesis	Test	Sig. ^{a,b}	Decision		
1	The distribution of Safety Compliance [Q22] is the same across categories of Purpose of e-scooter use_Trips for errands or daily tasks.	Independent-Samples Mann-Whitney U Test	,215	Retain the null hypothesis.		null
2	The distribution of Safety and health [Q18] is the same across categories of Purpose of e-scooter use_Trips for errands or daily tasks.	Independent-Samples Mann-Whitney U Test	,373	Retain the null hypothesis.		null

3	The distribution of Risk and Violations [Q22] is the same across categories of Purpose of e-scooter use_Trips for errands ar daily tasks.	Independent-Samples Mann-Whitney U Test	,965	Retain the null hypothesis.
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a. The significance level is ,050.

b. Asymptotic significance is displayed.

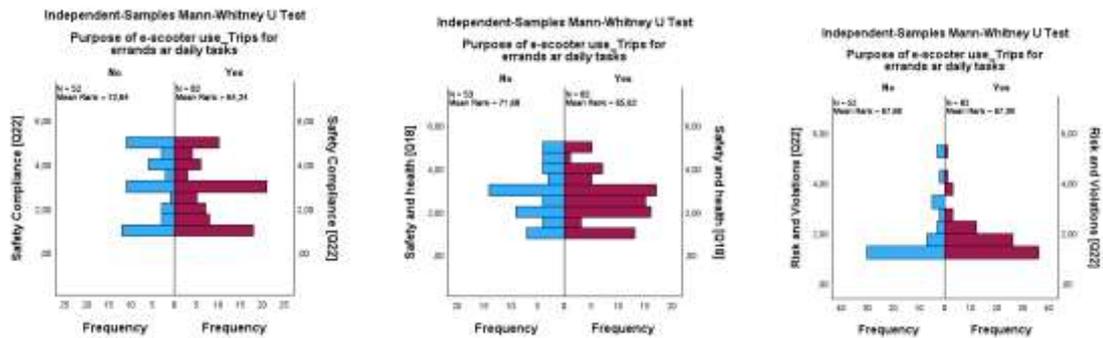


Figure 26. e-Scooter riding safety scores by purpose “Trips for errands or daily tasks”

Leisure activities

No statistically significant differences were found between respondents who use an e-scooter for leisure activities and those who do not across any of the three safety-related factors (all $p > .05$). For Safety compliance, leisure users showed slightly lower mean ranks compared to non-leisure users (MR = 64.43 vs. 72.50), but this difference did not reach statistical significance ($p = .235$).

For Safety and health, mean ranks were somewhat higher among leisure users (MR = 70.49) than among non-leisure users (MR = 63.90), although this difference was likewise not statistically significant ($p = .337$). Risky and violative riding behaviour also showed no evidence of a difference between leisure and non-leisure users ($p = .428$). After applying the Holm-Bonferroni correction for multiple testing, all results remained non-significant. Overall, these findings indicate that using an e-scooter for leisure activities is not reliably associated with differences in safety compliance, safety- and health-oriented attitudes, or self-reported risk and violation behaviours in this sample.

Table 74. Statistical test for associations between “Leisure activities” and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,235	Retain the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,337	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,428	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

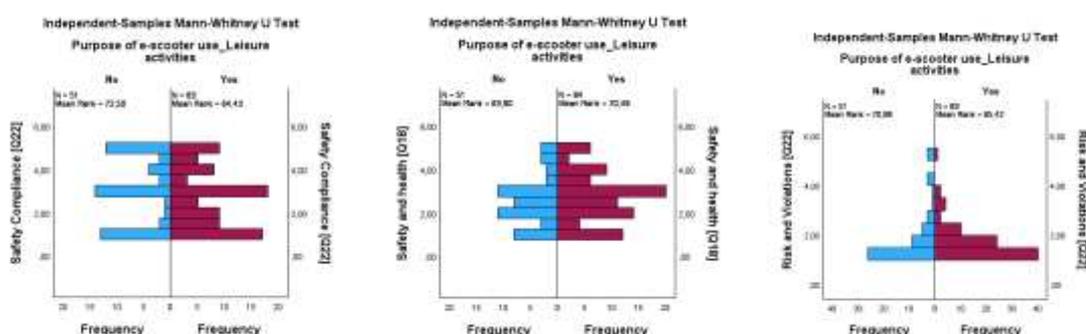


Figure 27. e-Scooter riding safety scores by purpose “Leisure activities”

Tourism purpose

Statistically significant differences were observed for one of the three safety-related factors. Respondents who use an e-scooter for tourism purposes reported significantly higher scores on the Safety compliance factor compared to non-tourism users ($p = .021$), indicating greater engagement in protective and compliance-oriented safety practices among this group. This result remained statistically significant after applying the Holm–Bonferroni correction for multiple testing ($p = .021 \leq .025$).

In contrast, no statistically significant differences were found for Safety and Health [Q18] ($p = .135$) or for Risk and violative riding behaviour ($p = .116$). Although tourism users showed higher mean ranks on the Safety and health factor, these differences were not statistically meaningful. Taken together, the findings suggest that using an e-scooter for tourism purposes is specifically associated with higher safety compliance, but not with stronger safety- and health-oriented motivations or differences in risky or violative riding behaviour.

Table 75. Statistical test for associations between “Tourism purpose” and e-Scooter riding safety

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Safety Compliance [Q22] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,021	Reject the null hypothesis.
2	The distribution of Safety and health [Q18] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,135	Retain the null hypothesis.
3	The distribution of Risk and Violations [Q22] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,116	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

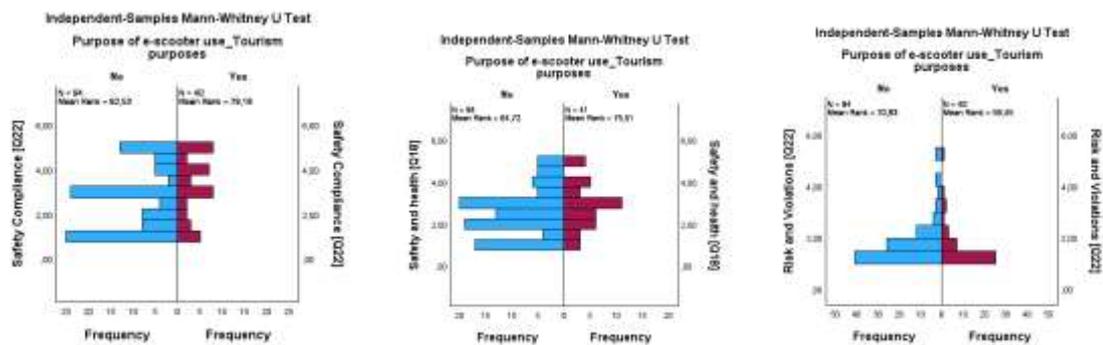


Figure 28. e-Scooter riding safety scores by purpose “Tourism purposes”

Associations between efficiency, safety and sustainability and e-Scooter riding safety

Several strong and statistically significant associations were observed among the safety-related factors. Safety and health was highly positively correlated with Cost and sustainability ($\rho = .706, p < .001$), indicating that respondents who place greater emphasis on safety and health also tend to value cost-effective and sustainable solutions. Strong interrelationships were also found among enforcement-related measures, with Punishment and enforcement showing a robust positive association with Licensing and mandatory requirements ($\rho = .630, p < .001$).

A moderate positive correlation was observed between Infrastructure quality and Traffic exposure and conflict ($\rho = .491, p < .001$), suggesting that poorer perceived infrastructure

conditions are aligned with higher perceived levels of traffic conflict. In contrast, Risky and violative riding behaviour showed weak associations with most factors, except for a moderate positive correlation with Phone and audio use while riding ($\rho = .432$, $p < .001$), indicating that risky and violative behaviours tend to co-occur with distraction-related practices. Public awareness initiatives were moderately correlated with enforcement-oriented measures, highlighting a perceived complementarity between educational approaches and regulatory interventions.

Table 76. Spearman correlations between safety-related factors and other variables

Correlations			Safety and health [Q18]	Risk and Violations [Q22]	Safety Compliance [Q22]	Efficiency and convenience [Q18]	Cost and sustainability [Q18]	Phone or audio use [Q22]	Traffic or Exposure Conflict [Q23]	& Infrastructure Quality [Q23]	Punishment & Enforcement [Q24]	Licensing & Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]
Spearman's rho	Safety and health [Q18]	Correlation Coefficient	1,000	,065	,421**	,341**	,706**	,235**	,262**	,050	,075	,166	,226**
		Sig. (2-tailed)	.	,455	<,001	<,001	<,001	,006	,002	,565	,387	,055	,008
		N	136	135	135	136	136	135	134	134	134	134	136
Risk and Violations [Q22]		Correlation Coefficient	,065	1,000	,055	-,020	,088	,432**	,133	-,080	,008	,052	-,127
		Sig. (2-tailed)	,455	.	,527	,817	,312	<,001	,124	,359	,927	,547	,141
		N	135	135	135	135	135	135	134	134	134	134	135
Safety Compliance [Q22]		Correlation Coefficient	,421**	,055	1,000	,171*	,397**	,185*	,302**	,068	,036	,137	,220*
		Sig. (2-tailed)	<,001	,527	.	,048	<,001	,031	<,001	,433	,677	,114	,010
		N	135	135	135	135	135	135	134	134	134	134	135
Efficiency and convenience [Q18]		Correlation Coefficient	,341**	-,020	,171*	1,000	,473**	-,025	,051	,027	,043	-,063	,078
		Sig. (2-tailed)	<,001	,817	,048	.	<,001	,773	,557	,757	,621	,467	,366
		N	136	135	135	136	136	135	134	134	134	134	136
Cost and sustainability [Q18]		Correlation Coefficient	,706**	,088	,397**	,473**	1,000	,191*	,289**	,046	-,023	,044	,245**
		Sig. (2-tailed)	<,001	,312	<,001	<,001	.	,027	<,001	,596	,794	,616	,004

	N	136	135	135	136	136	135	134	134	134	134	136
Phone use [Q22]	Correlation Coefficient	,235**	,432**	,185*	-,025	,191*	1,000	,157	-,141	,070	,090	-,034
	Sig. (2-tailed)	,006	<,001	,031	,773	,027	.	,070	,105	,422	,303	,692
	N	135	135	135	135	135	135	134	134	134	134	135
Traffic Exposure & Conflict [Q23]	Correlation Coefficient	,262**	,133	,302**	,051	,289**	,157	1,000	,491**	,226**	,287**	,260**
	Sig. (2-tailed)	,002	,124	<,001	,557	<,001	,070	.	<,001	,009	<,001	,002
	N	134	134	134	134	134	134	134	134	134	134	134
Infrastructure Quality [Q23]	Correlation Coefficient	,050	-,080	,068	,027	,046	-,141	,491**	1,000	,314**	,280**	,313**
	Sig. (2-tailed)	,565	,359	,433	,757	,596	,105	<,001	.	<,001	,001	<,001
	N	134	134	134	134	134	134	134	134	134	134	134
Punishment Enforcement [Q24]	Correlation Coefficient	,075	,008	,036	,043	-,023	,070	,226**	,314**	1,000	,630**	,404**
	Sig. (2-tailed)	,387	,927	,677	,621	,794	,422	,009	<,001	.	<,001	<,001
	N	134	134	134	134	134	134	134	134	134	134	134
Licensing Obligatory Measures [Q24]	Correlation Coefficient	,166	,052	,137	-,063	,044	,090	,287**	,280**	,630**	1,000	,381**
	Sig. (2-tailed)	,055	,547	,114	,467	,616	,303	<,001	,001	<,001	.	<,001
	N	134	134	134	134	134	134	134	134	134	134	134
Public Awareness	Correlation Coefficient	,226**	-,127	,220*	,078	,245**	-,034	,260**	,313**	,404**	,381**	1,000
	Sig. (2-tailed)	,008	,141	,010	,366	,004	,692	,002	<,001	<,001	<,001	.

Initiatives N [Q24]	136	135	135	136	136	135	134	134	134	134	136
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** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Associations between demographic variables, factors, and phone and audio use while riding e-Scooter

This section presents the results of statistical analyses examining phone and audio use while riding an e-scooter in relation to other study variables. The factor Phone and audio use was analysed across the same set of demographics, behavioural, and contextual variables as the safety-related factors presented in the previous sections.

Gender difference in phone and audio use

No statistically significant differences were found between men and women in Phone and audio use while riding ($p = .326$). Although men showed slightly higher mean ranks than women (MR = 68.55 vs. 62.37), this difference did not reach statistical significance. These findings indicate that self-reported phone or audio use while riding an e-scooter does not differ meaningfully by gender in the present sample.

Table 77. Statistical test for associations between gender and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,326	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

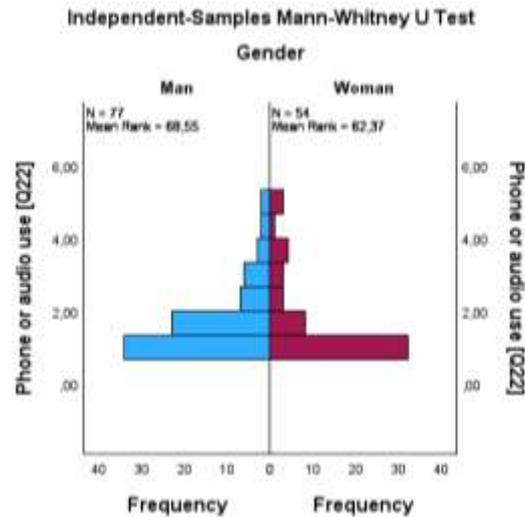


Figure 29. Phone and audio use score by gender

Age difference in phone and audio use

A statistically significant negative association was observed between age and Phone and audio use while riding ($p = -.221$, $p = .011$), indicating that younger respondents report more frequent phone or audio use while riding an e-scooter. Although the strength of the association was weak, the direction of the relationship was consistent, suggesting age-related differences in distraction-related riding behaviours within the sample.

Table 78. Statistical test for associations between age difference and phone and audio use

Correlations		Phone or audio use [Q22]	Age
Spearman's rho	Phone or audio use [Q22]	1,000	-,221*
	Sig. (2-tailed)	.	,011
	N	135	133
Age	Correlation Coefficient	-,221*	1,000
	Sig. (2-tailed)	,011	.
	N	133	134

*. Correlation is significant at the 0.05 level (2-tailed).

Motorcycles driving status in phone and audio use

No statistically significant differences were found in Phone or audio use while riding between respondents with and without a motorcycle driving licence ($p = .721$). Mean ranks were highly similar across groups (No licence: MR = 65.00; Licence: MR = 67.22), indicating comparable levels of distraction-related behaviour regardless of motorcycle licence status. These findings suggest that holding a motorcycle licence does not meaningfully influence self-reported phone or audio use while riding an e-scooter in the present sample.

Table 79. Statistical test for associations between motorcycle driving licence and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	.721	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

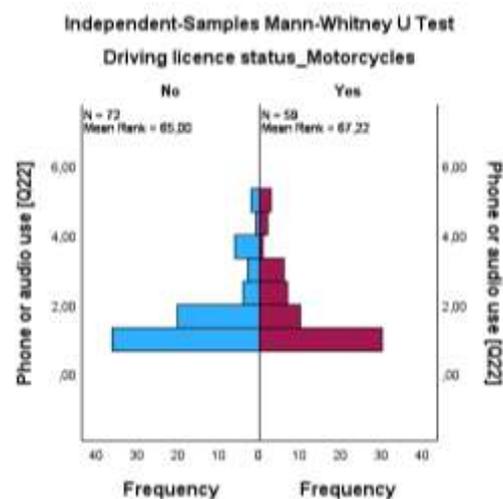


Figure 30. Phone and audio use score by driving licence status

Passenger car driving status in phone and audio use

Statistically significant differences were observed in Phone and audio use while riding between respondents with and without a passenger car driving licence ($p = .016$). Participants without a car licence reported substantially higher mean ranks (MR = 91.85) compared to

those holding a licence (MR = 63.86), indicating more frequent engagement in phone or audio use while riding an e-scooter among non-licensed riders.

However, this finding should be interpreted with caution, as the group of respondents without a passenger car driving licence was very small. While the result suggests a potential association between the absence of a car licence and higher distraction-related behaviour, the limited group size restricts the robustness and generalisability of this conclusion.

Table 80. Statistical test for associations between passenger car driving licence and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,016	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

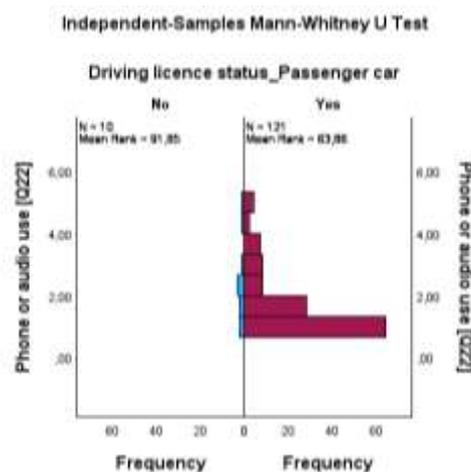


Figure 31. Phone and audio use score by passenger car driving licence

Employment status and phone and audio use

No statistically significant differences in Phone and audio use while riding were found across employment status categories ($p = .105$). The distributions of self-reported phone or audio use were largely comparable between groups, with only minor variability and a small number of outliers.

These findings indicate that employment status is not meaningfully associated with distraction-related behaviours while riding an e-scooter in this sample. However, given the

relatively small sizes of some employment categories, the results should be interpreted with appropriate caution.

Table 81. Statistical test for associations between employment status and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,105	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

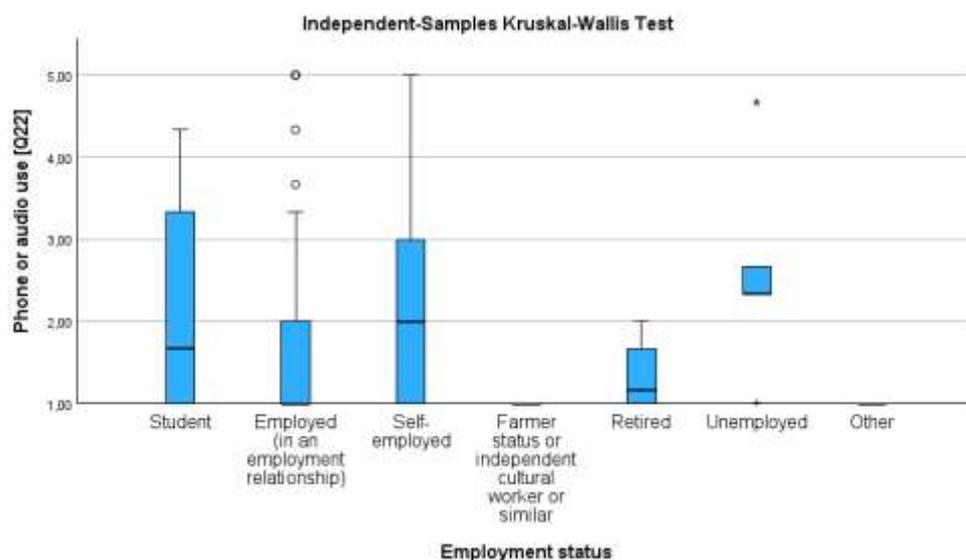


Figure 32. Phone and audio use score by employment status

Education level and phone and audio use

No statistically significant differences were found in Phone and audio use while riding across different education levels ($p = .550$), indicating largely similar distributions of self-reported phone or audio use among respondents with varying educational backgrounds. Although some variability and a small number of outliers were observed within respondent education categories, particularly among groups with smaller sample sizes, these differences were not systematic and did not reach statistical significance.

Overall, the findings suggest that the highest level of completed education does not meaningfully influence distraction-related behaviours while riding an e-scooter in this sample.

Table 82. Statistical test for associations between education level and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,550	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

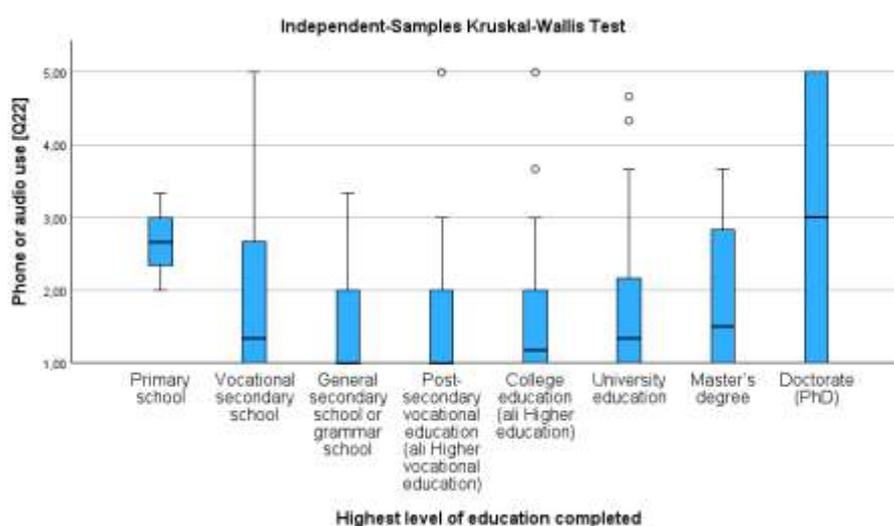


Figure 33. Phone and audio use score by education level

Place of residence and phone and audio use

No statistically significant differences in Phone and audio use while riding were found across place of residence categories ($p = .324$). Respondents living in the city, suburban areas, and the countryside reported broadly similar levels of phone or audio use while riding an e-scooter, with overlapping distributions across groups.

Table 83. Statistical test for associations between place of residence and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,324	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

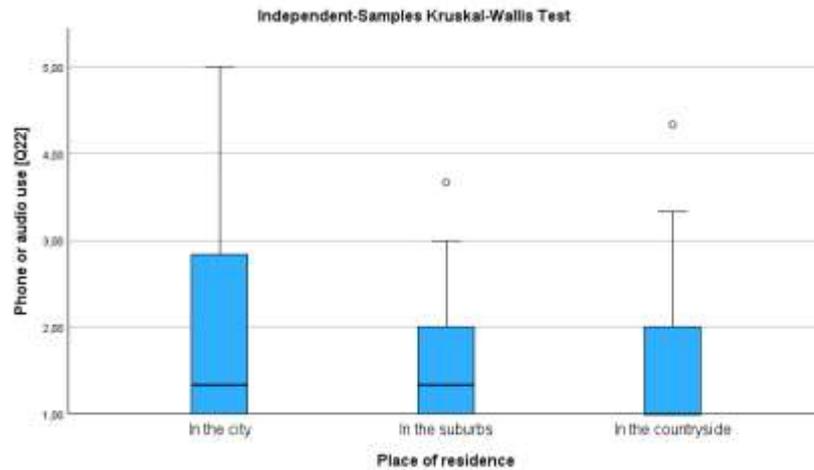


Figure 34. Phone and audio use score by place of residence

Household income and phone and audio use

No statistically significant differences in Phone and audio use while riding were found across categories of net disposable income per household member ($p = .542$), indicating largely similar distributions of self-reported phone or audio use among respondents with different income levels. Although some variability and isolated outliers were observed, particularly in smaller or less clearly defined income groups, these differences were not systematic and did not reach statistical significance.

Table 84. Statistical test for associations between household income and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,542	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

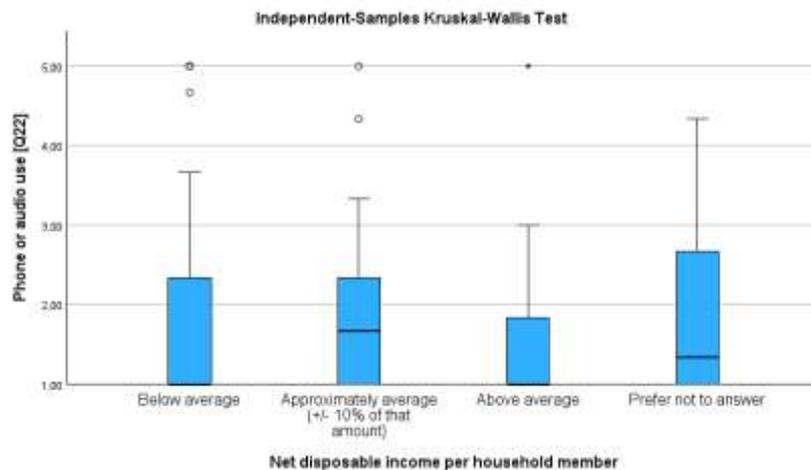


Figure 35. Phone and audio use score by household income

Traffic accidents involvement and phone and audio use

Statistically significant differences in Phone and audio use while riding were observed between respondents with and without prior accident involvement ($p = .007$). Participants who reported having been involved in an accident showed higher mean ranks (MR = 83.16) compared to those without accident experience (MR = 61.95), indicating more frequent engagement in phone or audio use while riding an e-scooter among the accident-involved group.

These findings suggest an association between distraction-related behaviours and accident involvement. However, due to the cross-sectional design and reliance on self-reported data, no causal conclusions can be drawn regarding the direction of this relationship.

Table 85. Statistical test for associations between traffic accidents involvement and phone and audio use

Hypothesis Test Summary			
	Null Hypothesis	Test	Sig. ^{a,b} Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	.007 Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

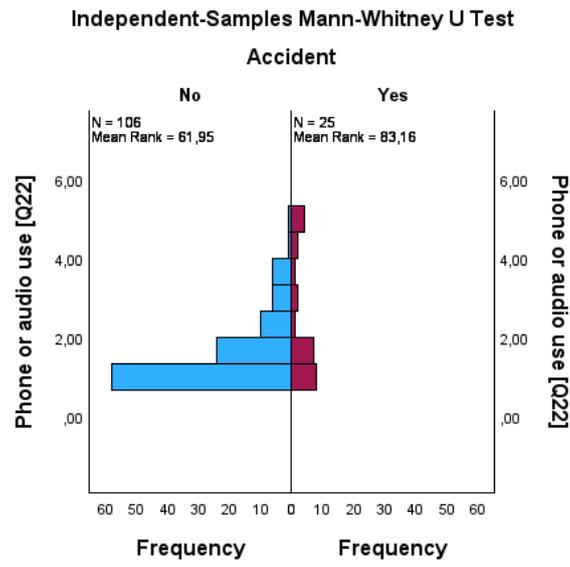


Figure 36. Phone and audio use score by traffic accidents involvement

Typical e-scooter travel distance and phone and audio use

A statistically significant positive association was observed between typical one-way e-scooter travel distance and Phone or audio use while riding ($\rho = .284$, $p = .001$), indicating that respondents who usually ride longer distances report more frequent engagement in phone or audio use while riding an e-scooter.

Although the strength of the association was modest, the relationship was consistent, suggesting that travel distance represents a relevant contextual factor associated with distraction-related behaviour among e-scooter riders.

Table 86. Statistical test for associations between typical e-scooter travel distance and phone and audio use

Correlations			
	Phone or audio use [Q22]	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	
Spearman's rho	Phone or audio use [Q22]	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	Correlation Coefficient
			1,000
			,284**
			Sig. (2-tailed)
			.
			N
			135
			126
	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	Phone or audio use [Q22]	Correlation Coefficient
			,284**
			1,000
			Sig. (2-tailed)
			,001
			.
			N
			126
			127

** . Correlation is significant at the 0.01 level (2-tailed).

Travel purpose and phone and audio use

This subsection examines whether the purpose of travel is associated with differences in phone or audio use while riding among e-scooter users. Specifically, the analysis assesses whether the frequency of self-reported phone or audio use varies depending on the type of trip for which an e-scooter is used (e.g. commuting, leisure activities, errands or daily tasks, and tourism).

The analyses aim to identify whether specific usage contexts are associated with higher levels of distraction-related behaviour, thereby providing insight into how different travel purposes may shape riders' engagement in phone or audio use while riding an e-scooter.

Commute to work

No statistically significant differences were found in Phone and audio use while riding between respondents who reported using an e-scooter to commute to work and those who did not ($p = .900$). Mean ranks were nearly identical across the two groups (MR = 67.78 vs. 66.94), indicating no meaningful differences in self-reported phone or audio use associated with commuting-related e-scooter use.

Table 87. Statistical test for associations between “Commute to work” and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	.900	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

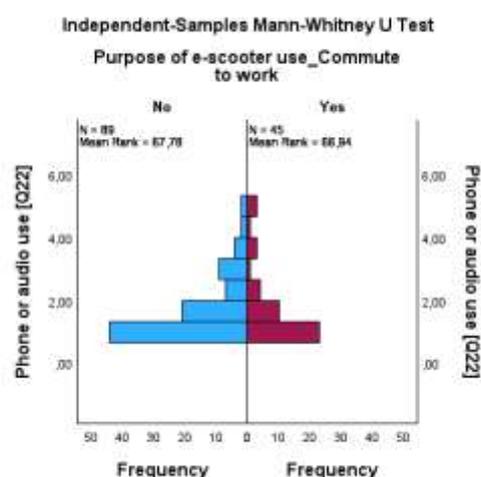


Figure 37. Phone or audio use by purpose “Commute to work”

Commute to school

No statistically significant differences were found in Phone and audio use while riding between respondents who reported using an e-scooter to commute to school and those who did not ($p = .254$). Although the mean rank was higher among school commuters (MR = 80.83) compared to non-commuters (MR = 66.54), this difference did not reach statistical significance.

The small number of respondents in the school-commuting group limits the interpretability of this observed pattern, and the findings therefore do not support a meaningful association between commuting to school by e-scooter and phone or audio use while riding in the present sample.

Table 88. Statistical test for associations between "Commute to school" and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Whitney U Test	Mann-.254	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

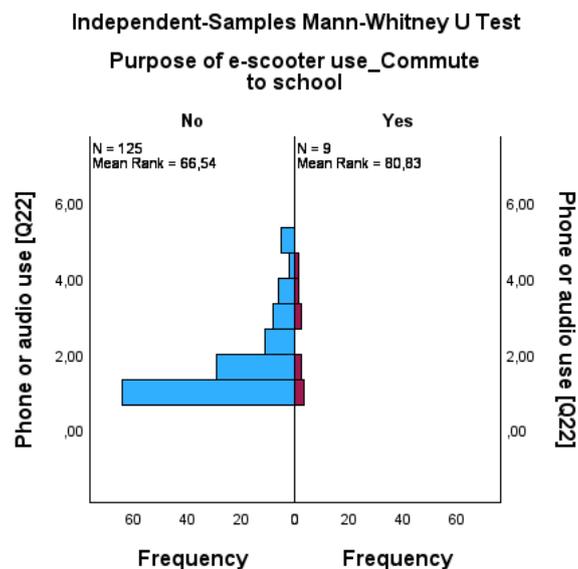


Figure 38. Phone or audio use by purpose "Commute to school"

Trips for errands or daily tasks

No statistically significant differences were found in Phone or Audio Use while riding [Q22] between respondents who reported using an e-scooter for errands or daily tasks and those who did not ($p = .889$). Mean ranks were nearly identical across groups (MR = 67.85 for users of e-scooters for errands vs. MR = 66.95 for non-users), indicating highly similar distributions of self-reported phone or audio use.

Table 89. Statistical test for associations between “Errands or daily tasks” and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Purpose of e-scooter use_Trips for errands or daily tasks.	Independent-Samples Mann-Whitney U Test	,889	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

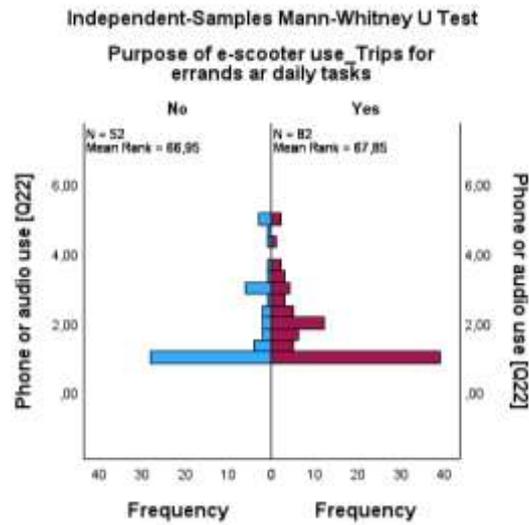


Figure 39. Phone or audio use by purpose “Trips for errands or daily tasks”

Leisure activities

A statistically significant difference was found in Phone and audio use while riding between respondents who reported using an e-scooter for leisure activities and those who did not ($p = .043$). Mean ranks were higher among leisure-related e-scooter users ($MR = 82.52$) than among non-leisure users ($MR = 75.60$), indicating greater self-reported engagement in phone or audio use during leisure-oriented rides.

Table 90. Statistical test for associations between "Leisure activities" and phone and audio use

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Phone or audio use [Q22] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	.043	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

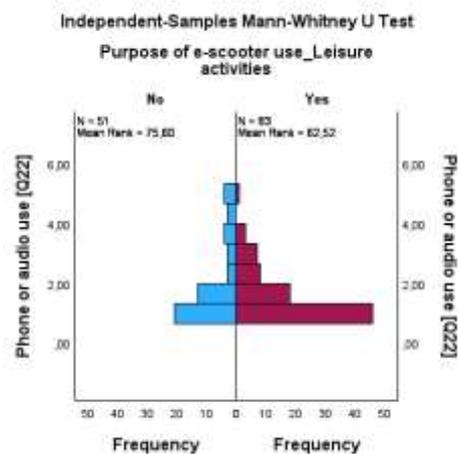


Figure 40. Phone or audio use by purpose "Leisure activities"

Tourism purposes

No statistically significant differences were found in Phone or Audio Use while riding [Q22] between respondents who reported using an e-scooter for tourism purposes and those who did not ($p = .745$). Mean ranks were nearly identical across groups, indicating highly similar distributions of self-reported phone or audio use associated with tourism-oriented riding..

Table 91. Statistical test for associations between "Tourism purposes" and phone and audio use

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision
1 The distribution of Phone or audio use [Q22] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,745	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

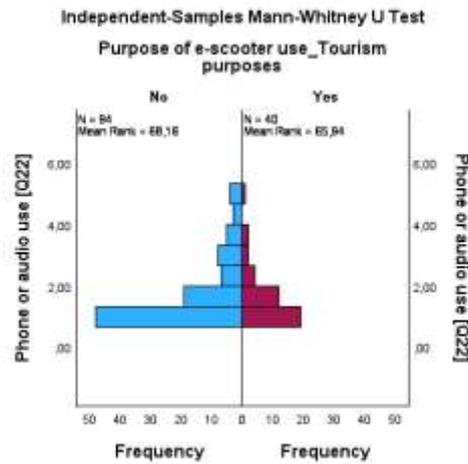


Figure 41. Phone or audio use by purpose "Tourism purposes"

Associations between demographic variables, factors, and the perception of efficiency and convenience

This section presents the results of statistical analyses examining the perception of efficiency and convenience in relation to other study variables. The factor Efficiency and convenience was analysed across the same set of demographics, behavioural, and contextual variables as the safety-related factors presented in the previous sections.

Gender difference and perception of efficiency and convenience

No statistically significant differences were found between men and women in their perception of Efficiency and convenience ($p = .935$). Mean ranks were nearly identical for both groups (MR = 66.28 for men vs. 66.82 for women), indicating a virtually complete overlap in the distribution of responses. These findings suggest that gender does not meaningfully influence how users evaluate the efficiency and convenience of e-scooter travel in the present sample.

Table 92. Statistical test for associations between gender and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	.935	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

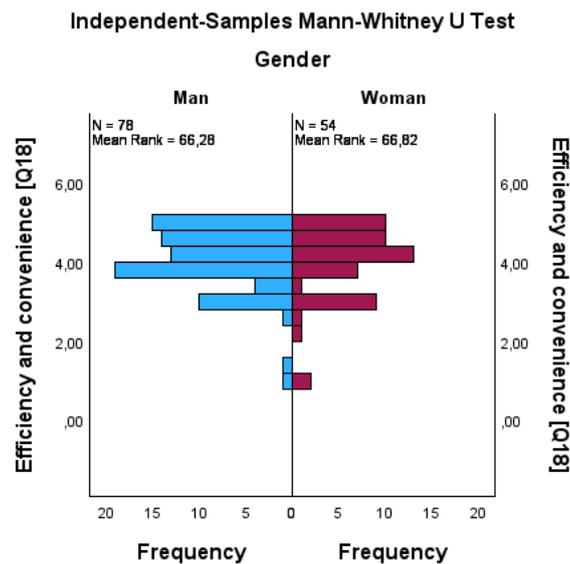


Figure 42. Efficiency and convenience by gender

Age difference and perception of efficiency and convenience

No statistically significant association was found between age and the perception of Efficiency and convenience ($r = .039$, $p = .655$). The correlation was extremely weak and close to zero, indicating that respondents of different ages evaluate the efficiency- and convenience-related aspects of e-scooter use in a highly similar manner. These results suggest that age does not meaningfully influence users' perceptions of the practical benefits of e-scooter travel in the present sample.

Table 93. Statistical test for associations between age difference and perception of efficiency and convenience

Correlations			
		Age	Efficiency and convenience [Q18]
Age	Pearson Correlation	1	,039
	Sig. (2-tailed)		,655
	N	134	134
Efficiency and convenience [Q18]	Pearson Correlation	,039	1
	Sig. (2-tailed)	,655	
	N	134	136

Motorcycles driving status and perception of efficiency and convenience

No statistically significant differences were found in Phone or audio use while riding between respondents with and without a motorcycle driving licence ($p = .721$). Mean ranks were highly similar across groups (No licence: MR = 65.00; Licence: MR = 67.22), indicating comparable levels of distraction-related behaviour regardless of motorcycle licence status. These findings suggest that holding a motorcycle licence does not meaningfully influence self-reported phone or audio use while riding an e-scooter in the present sample.

Table 94. Statistical test for associations between motorcycle driving licence and perception of efficiency and convenience

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision
1 The distribution of Efficiency and convenience [Q18] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	.713	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

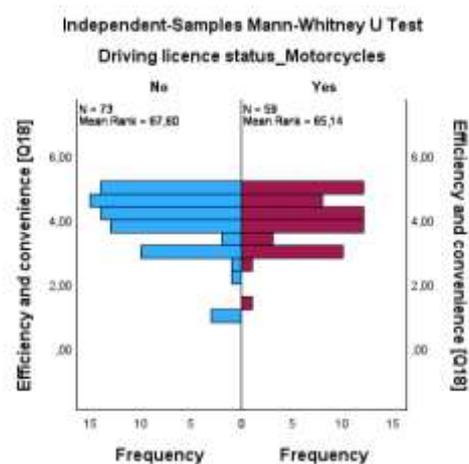


Figure 43. Efficiency and convenience score by driving licence status

Passenger car driving status and perception of efficiency and convenience

No statistically significant differences were found between respondents with and without a passenger car driving licence in their perception of Efficiency and convenience ($p = .065$). Although users with a car licence had higher mean ranks (MR = 68.25) than those without

(MR = 45.15), this difference did not reach statistical significance at the 0.05 level. These findings indicate that holding a passenger car licence does not meaningfully influence how users evaluate the efficiency and convenience of e-scooter travel in the present sample.

Table 95. Statistical test for associations between passenger car driving licence and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,065	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

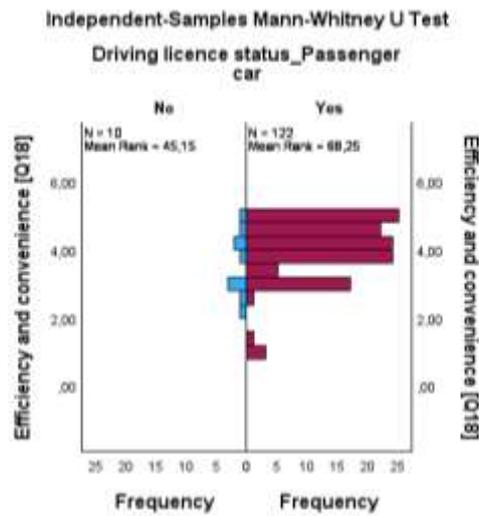


Figure 44. Efficiency and convenience score by passenger car driving licence

Employment status and perception of efficiency and convenience

No statistically significant differences were found between employment groups in their perception of Efficiency and convenience ($p = .406$). Although the boxplot suggests minor variation in response distributions across categories, these differences were not statistically meaningful. The results indicate that respondents with different employment statuses evaluate the efficiency and convenience of e-scooter use similarly, suggesting that occupational context does not play a notable role in shaping perceptions of this motivational factor in the present sample.

Table 96. Statistical test for associations between employment status and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,406	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

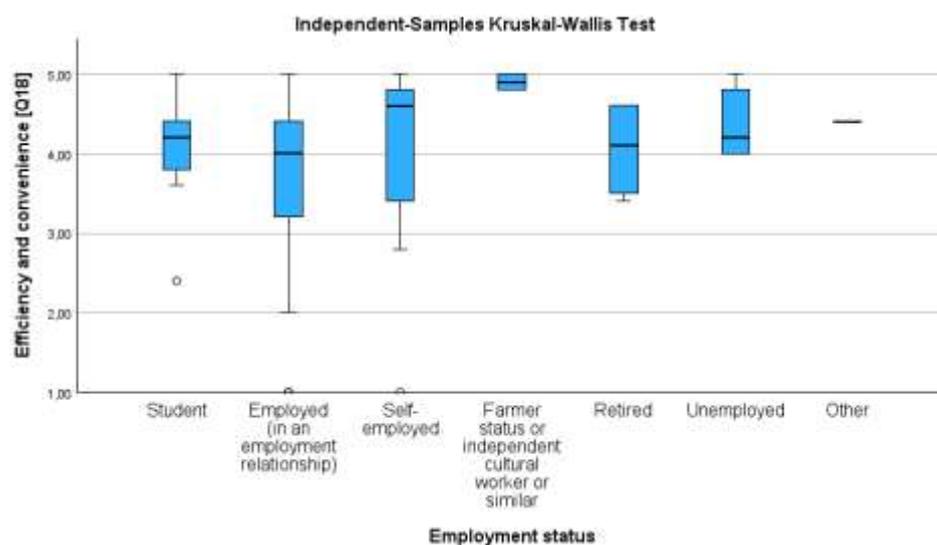


Figure 45. Efficiency and convenience score by employment status

Education level and perception of efficiency and convenience

No statistically significant differences were found between education groups in their perception of Efficiency and convenience ($p = .840$). Although minor variations in response distributions are visible in the boxplot, these differences were not statistically significant. The results suggest that users with varying levels of formal education evaluate the efficiency and convenience of e-scooter use similarly. In the present sample, educational attainment does not appear to influence how strongly respondents perceive the practical benefits of e-scooter travel.

Table 97. Statistical test for associations between education level and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,840	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

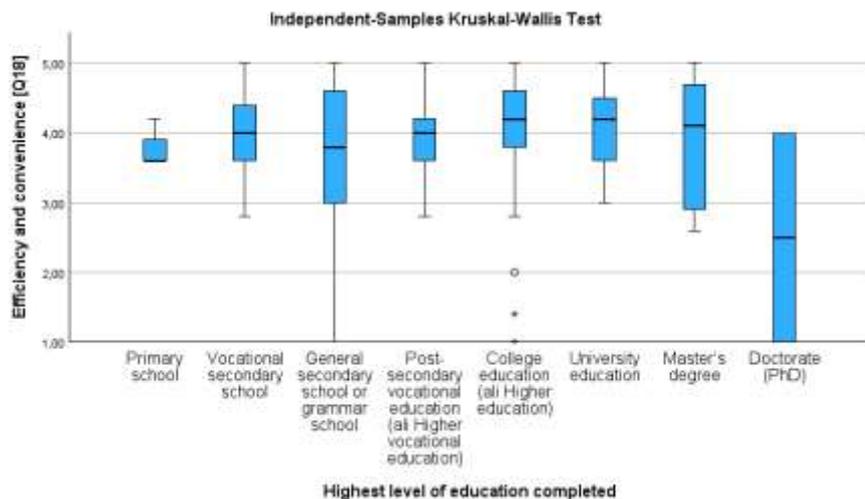


Figure 46. Efficiency and convenience score by education level

Place of residence and perception of efficiency and convenience

No statistically significant differences were found between residential groups in their perception of Efficiency and convenience ($p = .943$). Although the boxplot shows small variations in the distribution of responses across urban, suburban and rural areas, these differences were negligible and not statistically meaningful. The results indicate that users living in cities, suburbs or the countryside perceive the efficiency- and convenience-related advantages of e-scooter use in a highly similar way. In this sample, place of residence does not appear to influence how strongly respondents value the practical benefits of e-scooter travel.

Table 98. Statistical test for associations between place of residence and perception of efficiency and convenience

Hypothesis Test Summary

	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	.943	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

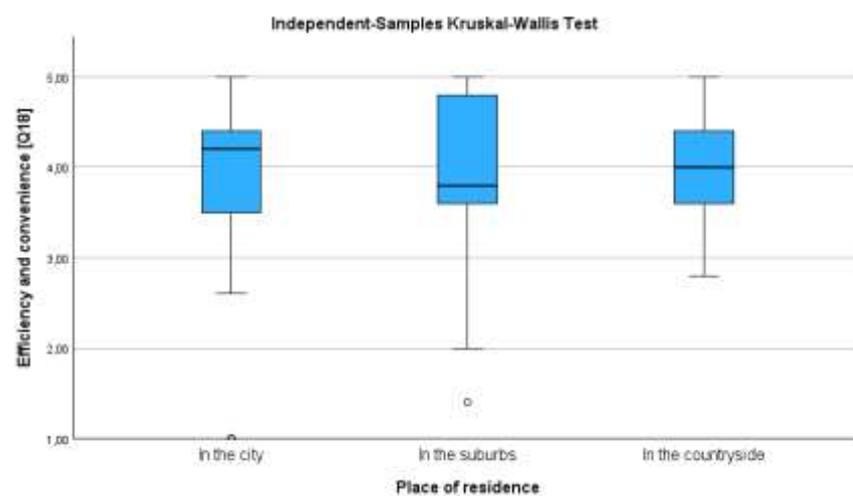


Figure 47. Efficiency and convenience score by place of residence

Household income and perception of efficiency and convenience

No statistically significant differences were found between income groups in their perception of Efficiency and convenience ($p = .307$). Although the boxplot suggests some minor variability across household income categories, these differences were not statistically meaningful. The results indicate that respondents with lower, average, or above-average incomes – as well as those who preferred not to disclose their income – evaluate the efficiency and convenience of e-scooter use in a broadly similar way. In this sample, disposable household income does not appear to influence how strongly users perceive the practical benefits of e-scooter travel.

Table 99. Statistical test for associations between household income and perceptions of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,307	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

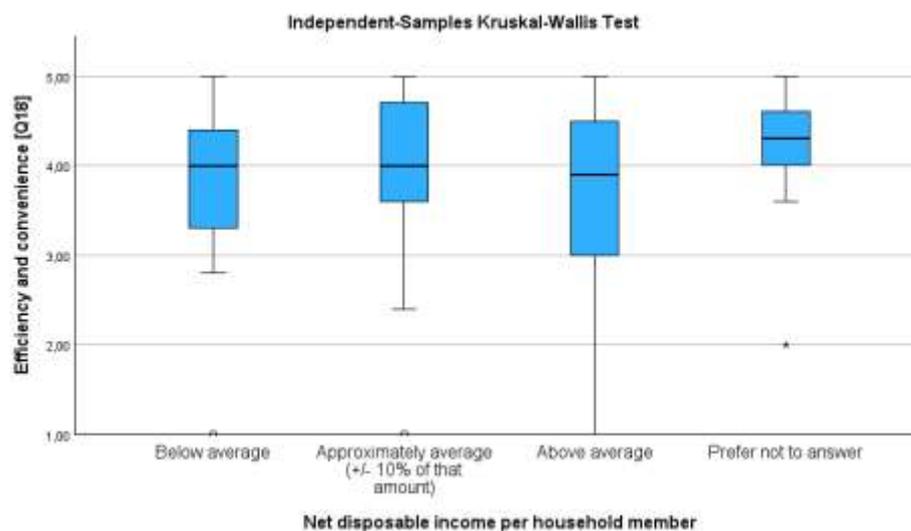


Figure 48. Efficiency and convenience score by household income

Traffic accidents involvement and perception of efficiency and convenience

No statistically significant differences were found between respondents with and without prior accident involvement in their perception of Efficiency and convenience ($p = .733$). Mean ranks were highly similar between the two groups (MR = 67.05 for those without an accident vs. 64.16 for those with accident experience), indicating minimal variation in how users evaluate the practical benefits of e-scooter travel. These findings suggest that having been involved in an e-scooter-related accident does not meaningfully influence riders' perceptions of efficiency and convenience in the present sample.

Table 100. Statistical test for associations between traffic accidents involvement and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	.733	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

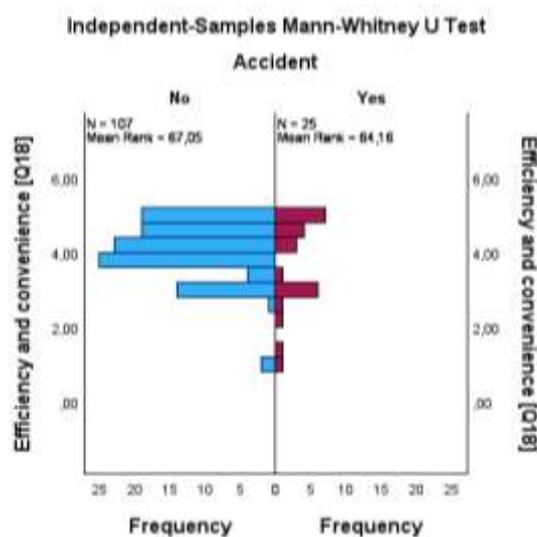


Figure 49. Efficiency and convenience score by traffic accident involvement

Typical e-scooter travel distance and perception of efficiency and convenience

No statistically significant association was found between Efficiency and convenience and respondents' typical one-way e-scooter travel distance ($r = -.102$, $p = .253$). The correlation was weak and negative, suggesting only a slight tendency for respondents reporting longer trips to rate efficiency and convenience marginally lower; however, this relationship was not statistically meaningful. Overall, these findings indicate that perceived efficiency and convenience are largely independent of typical trip distance in the present sample.

Table 101. Statistical test for associations between typical e-scooter travel distance and perception of efficiency and convenience

Correlations			
		Efficiency and convenience [Q18]	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.
Efficiency and convenience [Q18]	Pearson Correlation	1	-,102
	Sig. (2-tailed)		,253
	N	136	127
Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	Pearson Correlation	-,102	1
	Sig. (2-tailed)	,253	
	N	127	127

Travel purpose and perception of efficiency and convenience

This subsection examines whether the purpose of travel is associated with differences in perception of efficiency and convenience among e-scooter users.

Commute to work

No statistically significant differences were found between respondents who use an e-scooter for commuting to work and those who do not in their perception of Efficiency and Convenience ($p = .068$). Although work commuters showed higher mean ranks than non-commuters (MR = 76.64 vs. 63.68), this difference did not reach statistical significance at the 0.05 level. These findings suggest that perceiving e-scooter use as efficient and convenient is broadly similar regardless of whether riders use it for commuting to work, although the observed trend may indicate slightly stronger efficiency- and convenience-related evaluations among commuters in the present sample.

Table 102. Statistical test for associations between "Commute to work" and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,068	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

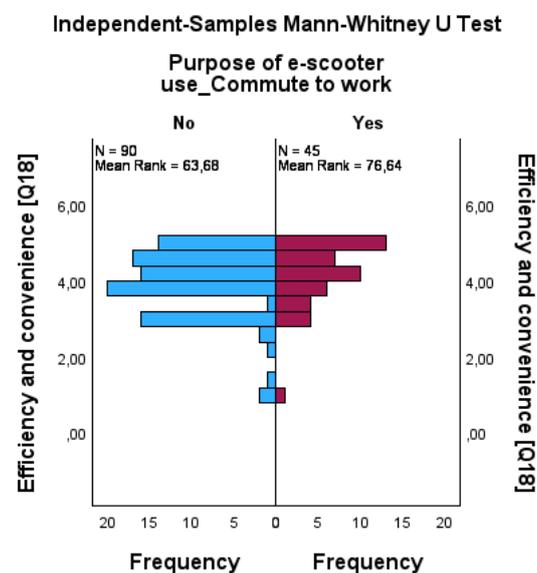


Figure 50. Efficiency and convenience score by purpose "Commute to work"

Commute to school

No statistically significant differences were found between respondents who use an e-scooter for commuting to school and those who do not in their perception of Efficiency

and Convenience ($p = .804$). Mean ranks were very similar for both groups (MR = 71.11 for school commuters vs. 67.78 for non-commuters), indicating a strong overlap in response distributions. These findings suggest that using an e-scooter for commuting to school does not meaningfully influence how users evaluate the efficiency and convenience of e-scooter travel in the present sample.

Table 103. Statistical test for associations between “Commute to school” and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	.804	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

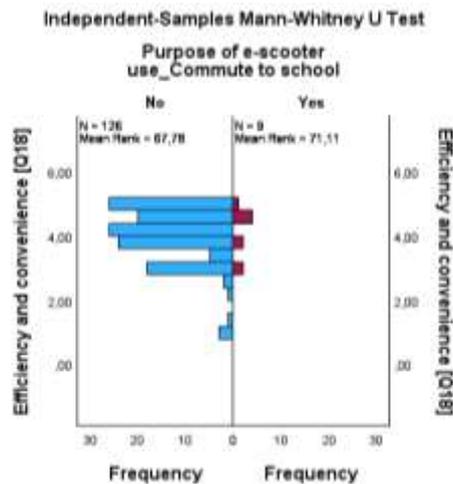


Figure 51. Efficiency and convenience score by purpose “Commute to school”

Trips for errands or daily tasks

A statistically significant difference was found in Efficiency and Convenience between respondents who use an e-scooter for errands or daily tasks and those who do not ($p = .014$). Respondents reporting this trip purpose showed substantially higher mean ranks than those who did not ($MR = 74.60$ vs. 57.78), indicating higher perceived efficiency and convenience among users who rely on e-scooters for everyday practical trips. These findings suggest that using an e-scooter for errands or daily tasks is meaningfully associated with stronger evaluations of the e-scooter’s practical benefits in the present sample.

Table 104. Statistical test for associations between “Errands or daily tasks” and perception of efficiency and convenience

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision
1 The distribution of Efficiency and convenience [Q18] is the same across categories of Purpose of e-scooter use_Trips for errands ar daily tasks.	Independent-Samples Mann-Whitney U Test	,014	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

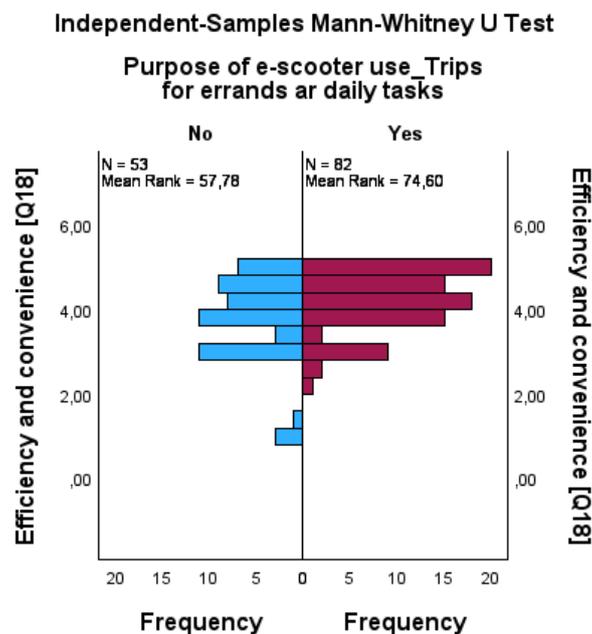


Figure 52. Efficiency and convenience score by purpose “Trips for errands or daily tasks”

Leisure activities

No statistically significant differences were found between respondents who use an e-scooter for leisure activities and those who do not in their perception of Efficiency and Convenience ($p = .185$). Although leisure users showed slightly higher mean ranks (MR = 71.46 vs. 62.29), the difference did not reach statistical significance. These findings suggest that using an e-scooter for leisure purposes does not meaningfully influence how users evaluate the efficiency and convenience of e-scooter travel in the present sample.

Table 105. Statistical test for associations between "Leisure activities" and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Efficiency and convenience [Q18] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,185	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

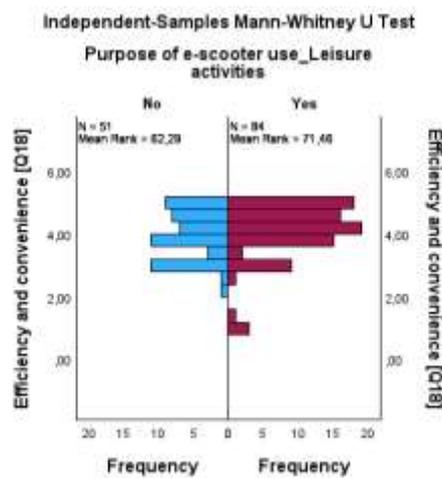


Figure 53. Efficiency and convenience score by purpose "Leisure activities"

Tourism purposes

No statistically significant differences were found between respondents who use an e-scooter for tourism purposes and those who do not in their perception of Efficiency and convenience ($p = .081$). Although tourism users showed higher mean ranks (MR = 76.87 vs. 64.13), the difference did not reach statistical significance at the 0.05 level. These findings suggest that using an e-scooter for tourism purposes does not meaningfully influence how strongly users perceive the efficiency and convenience of e-scooter travel in the present sample, despite the small descriptive tendency toward higher ratings among tourism users.

Table 106. Statistical test for associations between "Tourism purposes" and perception of efficiency and convenience

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision
1 The distribution of Efficiency and convenience [Q18] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,081	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

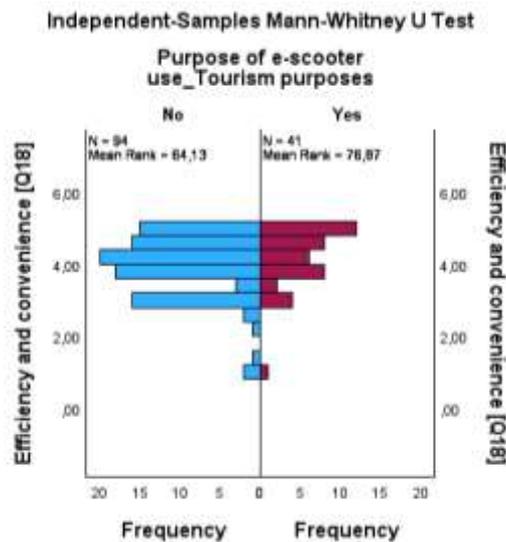


Figure 54. Efficiency and convenience scores by purpose "Tourism purposes"

Correlations between perceptions of efficiency and convenience and other factors

A strong, statistically significant positive association was found between Efficiency and convenience and between Cost and sustainability ($r = .535$, $p < .001$). This indicates that respondents who perceive e-scooters as efficient and convenient also tend to rate them more positively in terms of cost-effectiveness and environmental benefits. The strength of the association suggests that these two motivational dimensions are closely intertwined in riders' evaluations.

No statistically significant correlations were observed between Efficiency and convenience, and either Traffic exposure and conflict ($r = -.019$, $p = .828$) or Infrastructure quality ($r = .008$, $p = .926$). These negligible correlation coefficients indicate that riders' perceptions of efficiency and convenience are largely independent of their experiences with traffic conditions or the physical condition of the infrastructure.

Table 107. Statistical test for associations between other factors and perception of efficiency and convenience

Correlations		Efficiency and convenience [Q18]	Cost and sustainability [Q18]	Traffic Exposure & Conflict [Q23]	Infrastructure Quality [Q23]
Efficiency and convenience [Q18]	Pearson Correlation	1	,535**	-,019	,008
	Sig. (2-tailed)		<,001	,828	,926
	N	136	136	134	134
Cost and sustainability [Q18]	Pearson Correlation	,535**	1	,278**	,063
	Sig. (2-tailed)	<,001		,001	,468
	N	136	136	134	134
Traffic Exposure & Conflict [Q23]	Pearson Correlation	-,019	,278**	1	,547**
	Sig. (2-tailed)	,828	,001		<,001
	N	134	134	134	134
Infrastructure Quality [Q23]	Pearson Correlation	,008	,063	,547**	1
	Sig. (2-tailed)	,926	,468	<,001	
	N	134	134	134	134

** . Correlation is significant at the 0.01 level (2-tailed).

Associations between demographic variables, factors, and the compliance measures

This section presents the results of statistical analyses examining the perception of compliance measures in relation to other study variables. The category compliance measures is combined with three factors: Punishment and enforcement, Licensing and mandatory requirements and awareness campaigns. All three were analysed across the same set of demographics, behavioural, and contextual variables as the safety-related factors presented in the previous sections.

Gender difference and compliance measures

No statistically significant differences were found between men and women in their support for Punishment and Enforcement measures ($p = .157$), Licensing and Obligatory Measures ($p = .052$), or Public Awareness Initiatives ($p = .630$). Although small descriptive differences in mean ranks were present, none reached statistical significance at the 0.05 level.

Table 108. Statistical test for associations between gender and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,157	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,052	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	,630	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

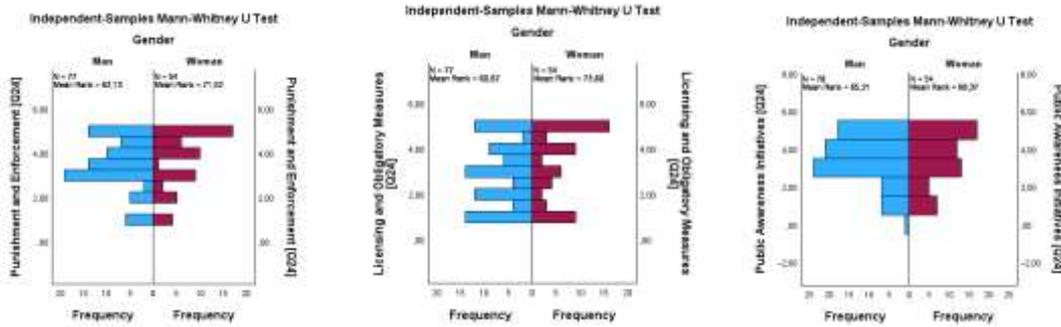


Figure 55. Compliance measures scores by gender

Age difference and compliance measures

Age was not significantly associated with any of the three compliance measure dimensions (all $p > .20$), indicating that support for punishment-based measures, licensing requirements, and awareness initiatives does not vary meaningfully across age groups.

In contrast, the three compliance factors were strongly and positively interrelated. A very strong correlation was observed between Punishment and enforcement and Licensing and obligatory measures ($r = .644, p < .001$), suggesting that respondents who support stricter enforcement also tend to favour administrative or mandatory regulatory measures. Moderate but statistically significant correlations were also found between Punishment and enforcement and Public awareness initiatives ($r = .434, p < .001$), as well as between Licensing and Obligatory Measures and Public Awareness Initiatives ($r = .395, p < .001$).

Table 109. Statistical test for associations between age difference and compliance measures

Correlations					
		Age	Punishment and Enforcement [Q24]	Licensing and Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]
Age	Pearson Correlation	1	-,028	,001	,107
	Sig. (2-tailed)		,752	,990	,220
	N	134	133	133	134
Punishment and Enforcement [Q24]	Pearson Correlation	-,028	1	,644**	,434**
	Sig. (2-tailed)	,752		<,001	<,001
	N	133	134	134	134

Licensing and Obligatory Measures [Q24]	Pearson Correlation	,001	,644**	1	,395**
	Sig. (2-tailed)	,990	<,001		<,001
	N	133	134	134	134
Public Awareness Initiatives [Q24]	Pearson Correlation	,107	,434**	,395**	1
	Sig. (2-tailed)	,220	<,001	<,001	
	N	134	134	134	136

** . Correlation is significant at the 0.01 level (2-tailed).

Motorcycles driving status and compliance measures

Across all three compliance-related dimensions in Punishment and enforcement, Licensing and obligatory measures, and Public awareness initiatives—no statistically significant differences emerged between respondents with and without a motorcycle driving licence (all $p > .05$). Although licence holders consistently showed slightly higher mean ranks (approximately MR = 70–71) than non-holders (MR = 61–63), these differences were not large enough to reach significance.

Table 110. Statistical test for associations between motorcycle driving licence and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,211	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,133	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Driving licence status_Motorcycles.	Independent-Samples Mann-Whitney U Test	,252	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

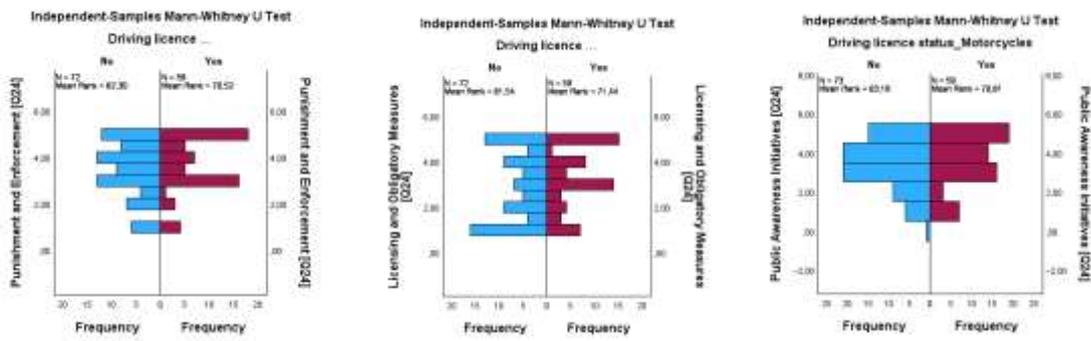


Figure 56. Compliance measures score by driving licence status

Passenger car driving status and compliance measures

Across all three compliance-related dimensions in Punishment and enforcement, Licensing and obligatory measures, and Public awareness initiatives—no statistically significant differences were observed between respondents with and without a passenger-car driving licence (all $p > .05$). Although mean ranks varied somewhat across the groups (e.g., MR \approx 48–71 for non-holders vs. MR \approx 66–68 for licence holders), these differences did not reach statistical significance, indicating that passenger-car licence status does not meaningfully shape respondents’ views on enforcement measures, mandatory requirements, or public awareness initiatives within this sample.

Table 111. Statistical test for associations between passenger car driving licence and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,105	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,587	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Driving licence status_Passenger car.	Independent-Samples Mann-Whitney U Test	,703	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

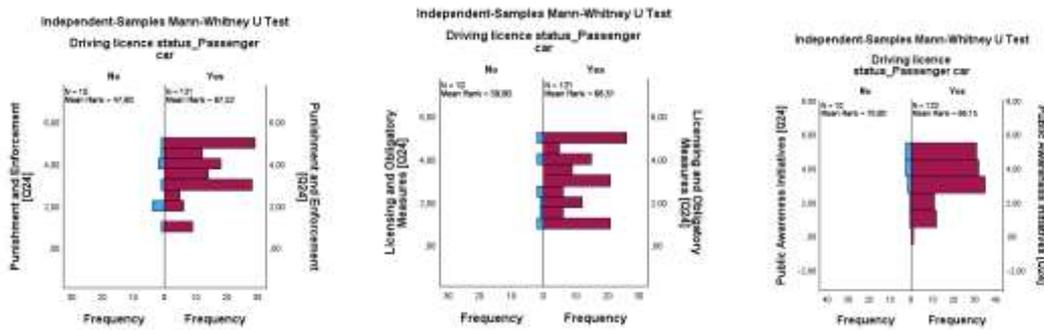


Figure 57. Compliance measures score by passenger car driving licence

Employment status and compliance measures

Across employment status categories, the Kruskal–Wallis tests indicated no statistically significant differences in any of the three compliance-measure dimensions (all $p > .05$): Punishment and enforcement ($p = .786$), Licensing and obligatory measures ($p = .070$), and Public awareness initiatives ($p = .113$). While the boxplots suggest some descriptive variation in central tendency across groups—most notably a non-significant trend toward differences in Licensing and obligatory measures—these patterns did not reach the conventional significance threshold.

Table 112. Statistical test for associations between employment status and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,786	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,070	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Employment status.	Independent-Samples Kruskal-Wallis Test	,113	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

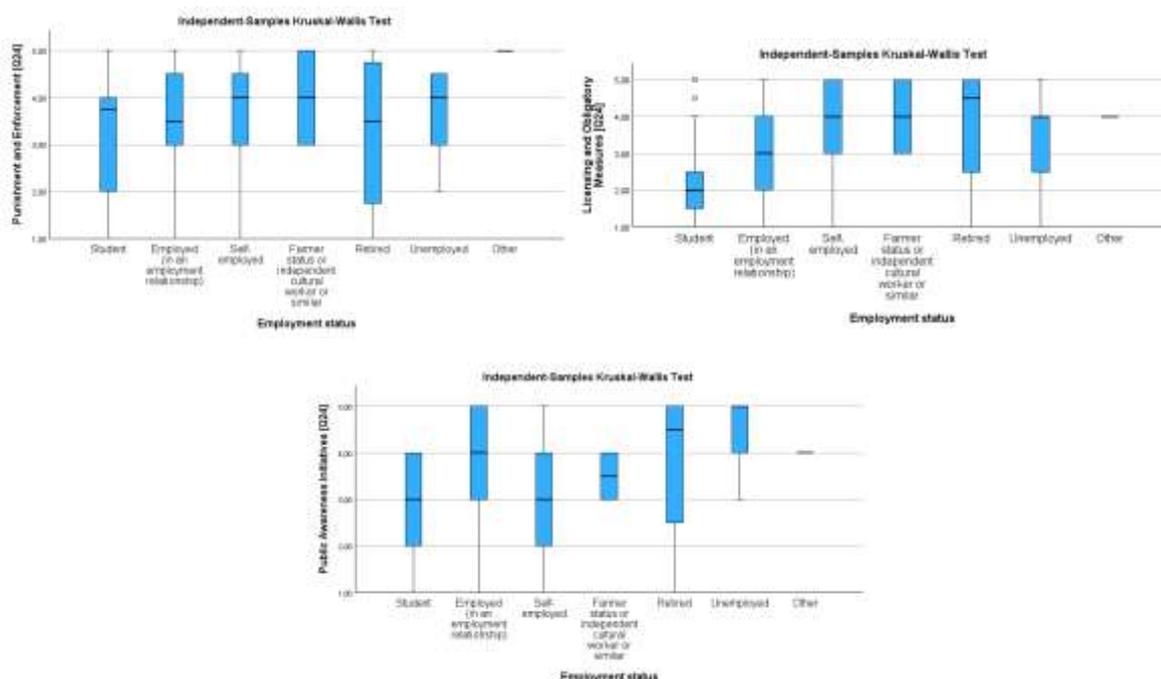


Figure 58. Compliance measures score by employment status

Education level and compliance measures

Across categories of education completed, the Kruskal–Wallis tests showed no statistically significant differences in any of the three compliance-measure dimensions (all $p > .05$): Punishment and enforcement ($p = .647$), Licensing and obligatory measures ($p = .469$), and Public awareness initiatives ($p = .224$). Although the boxplots indicate some descriptive variation in medians and the spread of scores across education groups, these differences did not reach statistical significance.

Table 113. Statistical test for associations between education level and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,647	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,469	Retain the null hypothesis.

3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Highest level of education completed.	Independent-Samples Kruskal-Wallis Test	,224	Retain the null hypothesis.
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a. The significance level is ,050.

b. Asymptotic significance is displayed.

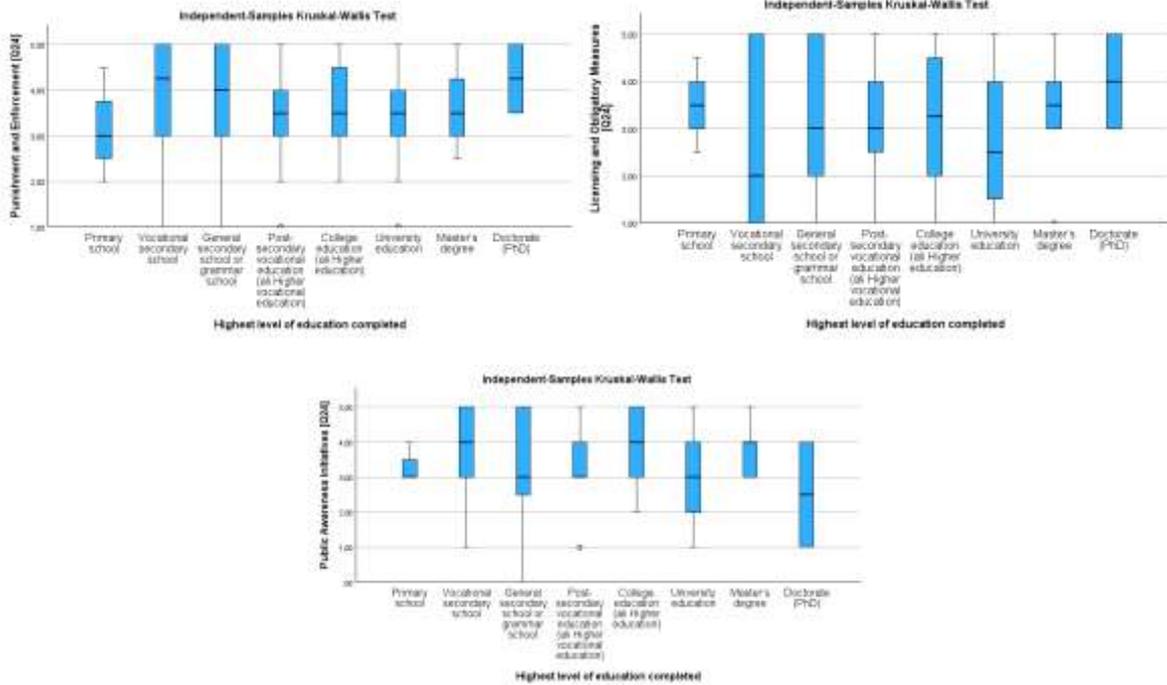


Figure 59. Compliance measures score by education level

Place of residence and compliance measures

Across the three place-of-residence categories (city, suburbs, countryside), the Kruskal–Wallis tests showed no statistically significant differences in any of the compliance-related dimensions: Punishment and enforcement ($p = .634$), Licensing and obligatory measures ($p = .426$), and Public awareness initiatives ($p = .884$). Although the boxplots display some expected variability in medians and distributions across residential environments, these differences were not large enough to reach statistical significance.

Table 114. Statistical test for associations between place of residence and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,634	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,426	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Place of residence.	Independent-Samples Kruskal-Wallis Test	,884	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

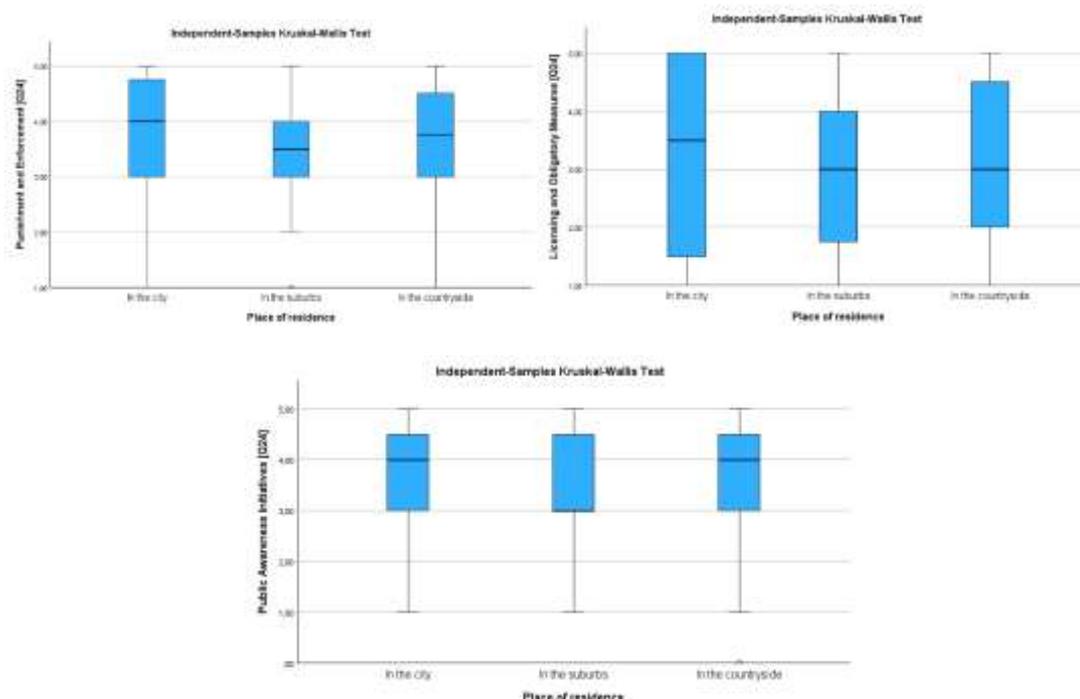


Figure 60. Compliance measures score by place of residence

Household income and compliance measures

Across the different net disposable income groups, the Kruskal–Wallis tests showed no statistically significant differences in any of the three compliance-related dimensions: Punishment and enforcement ($p = .613$), Licensing and obligatory measures ($p = .062$), and Public awareness initiatives ($p = .377$). Although the boxplots suggest some descriptive variation—particularly a non-significant trend for income differences in support for licensing and obligatory measures—the observed patterns did not reach the statistical significance threshold.

Table 115. Statistical test for associations between household income and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,613	Retain the null hypothesis.

2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,062	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Net disposable income per household member.	Independent-Samples Kruskal-Wallis Test	,377	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

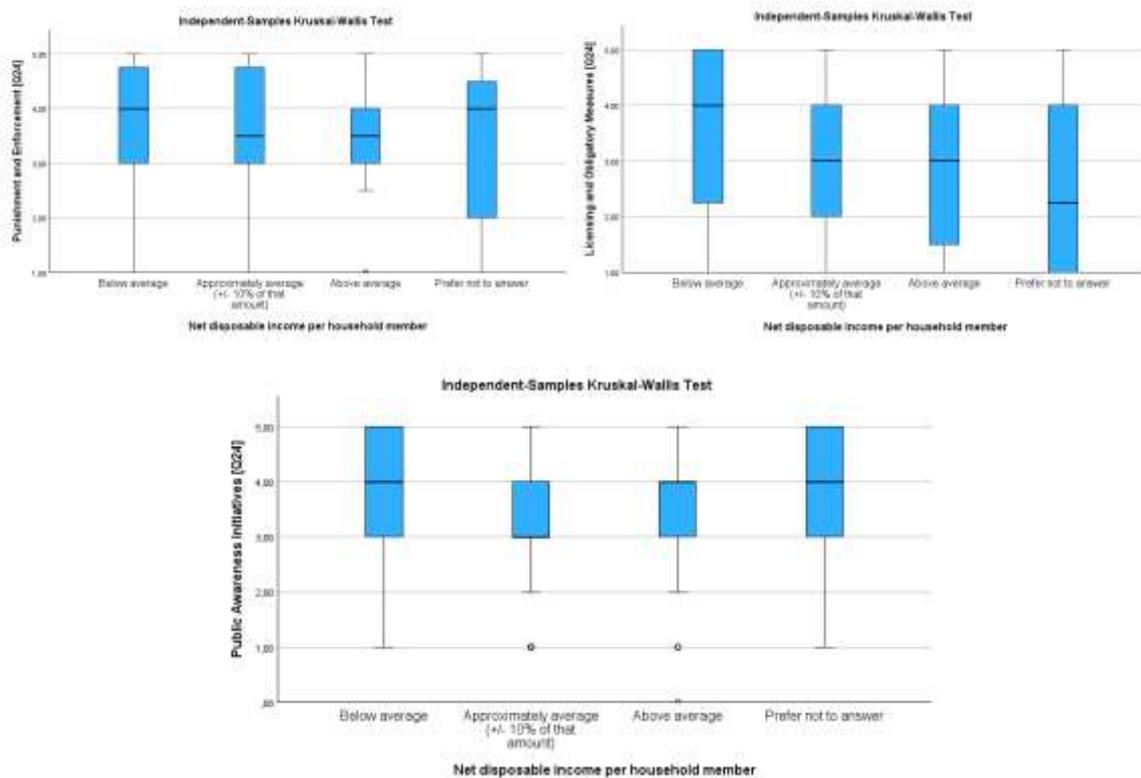


Figure 61. Compliance measures score by household income

Traffic accidents involvement and compliance measures

Across respondents who had versus had not experienced an e-scooter accident, the Mann-Whitney U tests revealed mixed results across the three compliance-related dimensions. For Punishment and enforcement ($p = .798$) and Licensing and obligatory measures ($p = .062$), no statistically significant differences were observed, indicating broadly similar attitudes between those with and without accident experience. In contrast, a significant difference emerged for Public awareness initiatives ($p = .013$), with respondents who had been involved

in an accident showing substantially higher mean ranks (MR = 83.04) than those without accident experience (MR = 62.64).

Table 116. Statistical test for associations between traffic accidents involvement and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,798	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,062	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Accident.	Independent-Samples Mann-Whitney U Test	,013	Reject the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

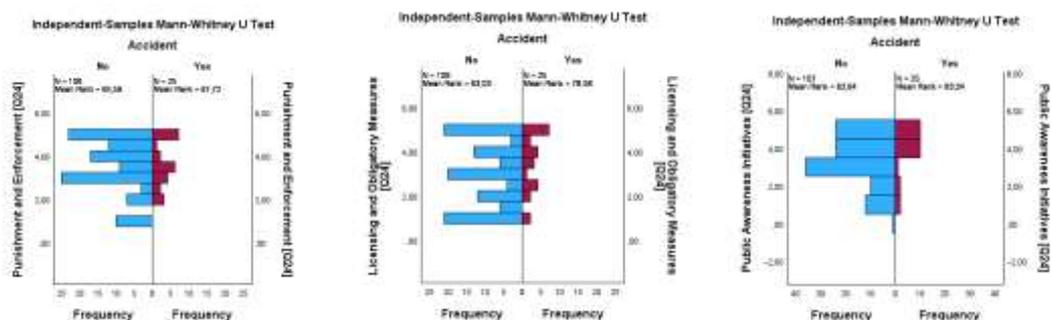


Figure 62. Compliance measures score by traffic accident involvement

Typical e-scooter travel distance and compliance measures

The Pearson correlation analysis showed no statistically significant associations between respondents' typical one-way e-scooter travel distance and any of the three compliance-related dimensions. Travel distance was weakly and non-significantly related to Punishment and enforcement ($r = .128$, $p = .155$) and Licensing and obligatory measures ($r = .126$, $p = .160$). A very small, non-significant negative correlation was observed with Public awareness Initiatives ($r = -.052$, $p = .558$).

Table 117. Statistical test for associations between typical e-scooter travel distance and compliance measures

Correlations					
		Punishment and Enforcement [Q24]	Licensing and Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]	Estimate (in kilometers) how far you usually travel by e-scooter in one direction.
Estimate (in kilometers) how far you usually travel by e-scooter in one direction.	Pearson Correlation	,128	,126	-,052	1
	Sig. (2-tailed)	,155	,160	,558	
	N	126	126	127	127

** Correlation is significant at the 0.01 level (2-tailed).

Travel purpose and compliance measures

This subsection examines whether the compliance measures is associated with differences in perception of efficiency and convenience among e-scooter users.

Commute to work

Across respondents who do and do not use an e-scooter to commute to work, the Mann-Whitney U tests indicated no statistically significant differences in attitudes toward Punishment and enforcement ($p = .683$) or Licensing and obligatory measures ($p = .217$). Mean ranks were only slightly higher among commuters for these two dimensions, suggesting broadly similar views across groups. However, a significant difference emerged for Public awareness initiatives ($p = .009$), with commuters showing notably higher mean ranks (MR = 80.07) than non-commuters (MR = 61.97). This indicates that respondents who rely on e-scooters for commuting place greater importance on awareness-raising and educational initiatives, possibly reflecting their more frequent exposure to traffic conditions and safety risks.

Table 118. Statistical test for associations between "Commute to work" and compliance measures

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision

1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,683	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,217	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Purpose of e-scooter use_Commute to work.	Independent-Samples Mann-Whitney U Test	,009	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

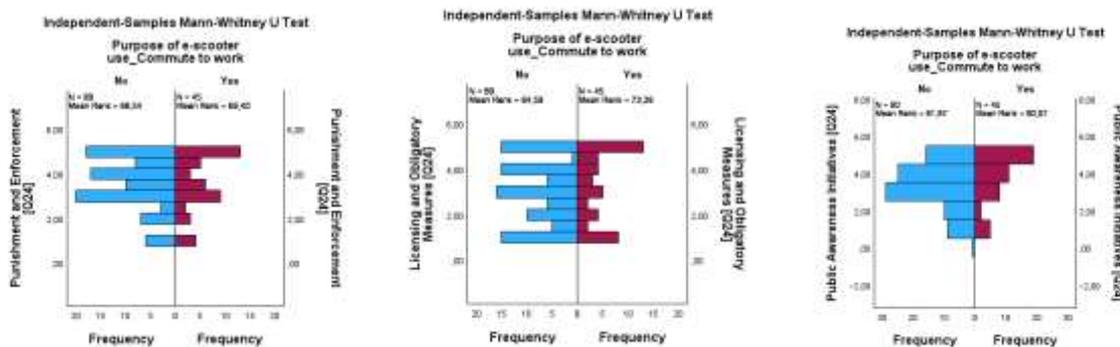


Figure 63. Compliance measures score by purpose “Commute to work”

Commute to school

The Mann–Whitney U tests comparing respondents who do and do not use an e-scooter to commute to school revealed a statistically significant difference for Punishment and enforcement ($p = .034$). Commuters displayed notably lower mean ranks (MR = 41.33) than non-commuters (MR = 69.38), suggesting that those who ride to school tend to place less emphasis on punitive and enforcement-oriented measures. In contrast, no significant differences emerged for Licensing and obligatory measures ($p = .381$) or Public awareness initiatives ($p = .201$), indicating that attitudes were broadly comparable between school commuters and non-commuters on these dimensions.

Table 119. Statistical test for associations between “Commute to school” and compliance measures

Hypothesis Test Summary			
Null Hypothesis	Test	Sig. ^{a,b}	Decision

1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,034	Reject the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,381	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Purpose of e-scooter use_Commute to school.	Independent-Samples Mann-Whitney U Test	,201	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

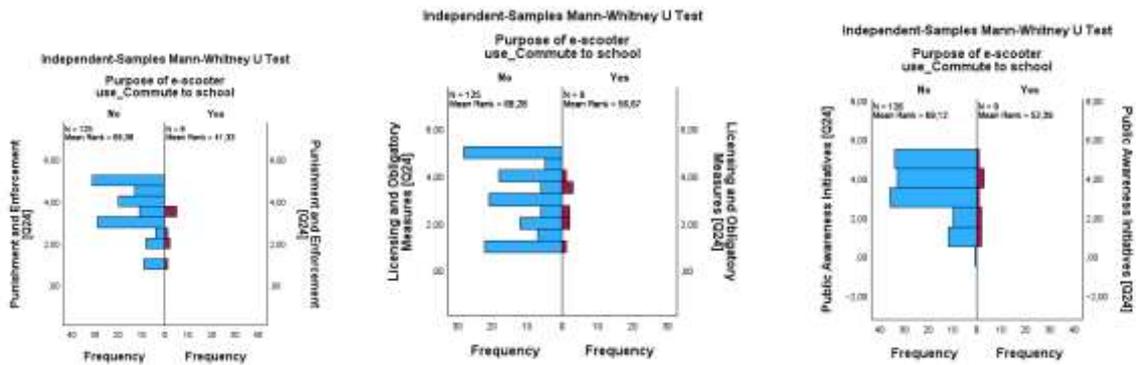


Figure 64. Compliance measures score by purpose "Commute to school"

Trips for errands or daily tasks

Across respondents who do and do not use an e-scooter for errands or daily tasks, the Mann–Whitney U tests indicated no statistically significant differences in any of the three compliance-related dimensions. Attitudes toward Punishment and enforcement ($p = .880$), Licensing and obligatory measures ($p = .094$), and Public awareness initiatives ($p = .944$) were highly comparable across groups, with mean ranks differing only slightly. Although a small, non-significant trend suggested that non-users of e-scooters for errands might rate licensing-related measures somewhat higher (MR = 74.48 vs. 63.07), this pattern did not reach statistical significance.

Table 120. Statistical test for associations between “Errands or daily tasks” and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Purpose of e-scooter use_Trips for errands ar daily tasks.	Independent-Samples Mann-Whitney U Test	,880	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Purpose of e-scooter use_Trips for errands ar daily tasks.	Independent-Samples Mann-Whitney U Test	,094	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Purpose of e-scooter use_Trips for errands ar daily tasks.	Independent-Samples Mann-Whitney U Test	,944	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

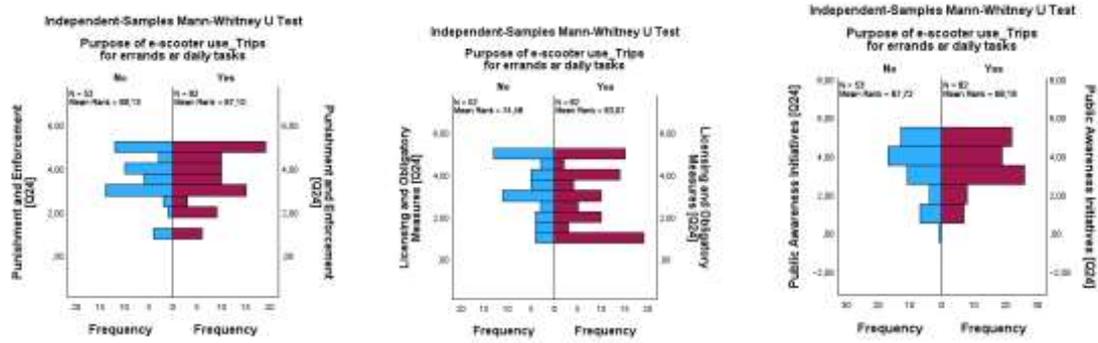


Figure 65. Compliance measures score by purpose "Trips for errands or daily tasks"

Leisure activities

Across respondents who do and do not use an e-scooter for leisure activities, the Mann-Whitney U tests showed no statistically significant differences in any of the three compliance-related Q24 dimensions. Attitudes toward Punishment and Enforcement ($p = .732$), Licensing and Obligatory Measures ($p = .104$), and Public Awareness Initiatives ($p = .256$) were highly similar across both groups, with only small, non-significant differences in mean ranks (e.g., slightly higher ranks among non-leisure users).

Table 121. Statistical test for associations between "Leisure activities" and perception of efficiency and convenience

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,732	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,104	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Purpose of e-scooter use_Leisure activities.	Independent-Samples Mann-Whitney U Test	,256	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

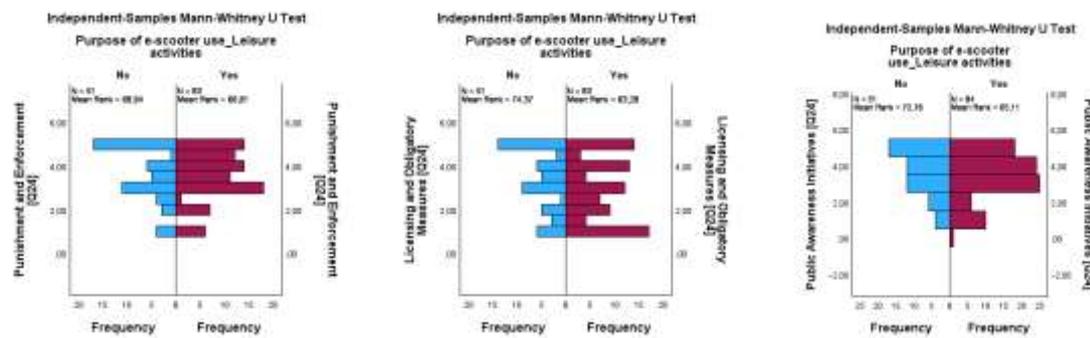


Figure 66. Compliance measures score by purpose "Leisure activities"

Tourism purposes

Across respondents who do versus do not use an e-scooter for tourism purposes, the Mann-Whitney U tests showed no statistically significant differences in any of the three compliance-related Q24 dimensions: Punishment and enforcement ($p = .943$), Licensing and obligatory measures ($p = .996$), and Public awareness initiatives ($p = .719$). Mean ranks were virtually identical for punishment/enforcement (No: MR = 67.35, $n = 94$; Yes: MR = 67.86, $n = 40$) and licensing/obligatory measures (No: MR = 67.49, $n = 94$; Yes: MR = 67.53, $n = 40$), and only slightly different for public awareness (No: MR = 68.78, $n = 94$; Yes: MR = 66.22, $n = 41$).

Table 122. Statistical test for associations between "Tourism purposes" and compliance measures

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distribution of Punishment and Enforcement [Q24] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,943	Retain the null hypothesis.
2	The distribution of Licensing and Obligatory Measures [Q24] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,996	Retain the null hypothesis.
3	The distribution of Public Awareness Initiatives [Q24] is the same across categories of Purpose of e-scooter use_Tourism purposes.	Independent-Samples Mann-Whitney U Test	,719	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

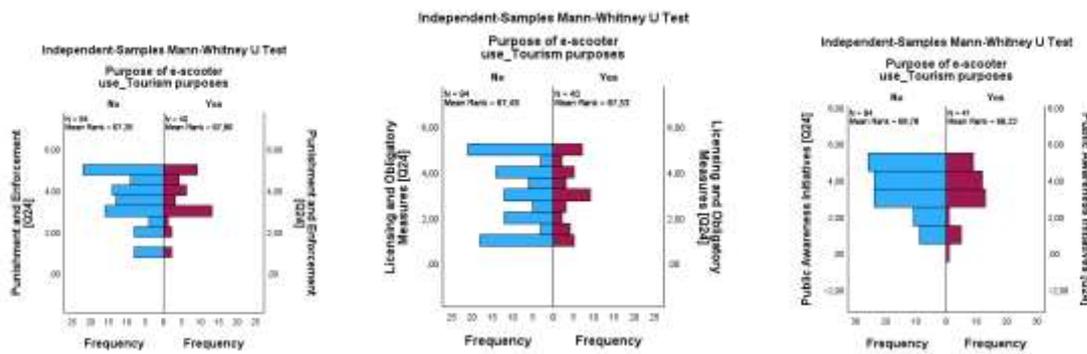


Figure 67. Compliance measures scores by purpose “Tourism purposes”

Correlations between compliance measures and motivation for use

Across all three compliance-related dimensions, the correlations with motivations indicate that respondents’ support for regulatory and educational measures is only selectively associated with their underlying reasons for using e-scooters, and these relationships are generally small in magnitude.

First, Punishment and enforcement showed no meaningful associations with any motivation dimension (all $p > .05$). In contrast, Licensing and obligatory measures demonstrated a weak but statistically significant positive association with Safety and health motivations ($r = .183$, $p = .034$). This indicates that respondents who emphasise safety- or health-related reasons for riding an e-scooter tend to be somewhat more supportive of mandatory or licensing-based requirements, potentially because these respondents place greater value on structured, rule-based approaches to promoting safe mobility. No significant correlations emerged with Efficiency and Convenience ($r = -.106$, $p = .223$) or Cost and Sustainability ($r = .041$, $p = .636$), implying that these motivations do not translate into preferences for stricter formal regulation.

Finally, Public Awareness Initiatives showed the broadest pattern of significant associations with user motivations. This dimension correlated positively with both Safety and Health ($r = .247$, $p = .004$) and Cost and Sustainability ($r = .270$, $p = .001$), indicating that respondents motivated by health/safety considerations or sustainability concerns tend to be more supportive of educational and awareness-raising strategies. These associations, although modest in size, suggest that respondents who value safer or more environmentally responsible mobility may view public awareness campaigns as an important tool for improving e-scooter behaviours and conditions. As with the other Q24 dimensions, Efficiency and Convenience was not significantly related to this domain ($r = .104$, $p = .227$).

Table 123. Statistical test for associations between compliance measures and motivation for use e-scooter

Correlations				
		Punishment and Enforcement [Q24]	Licensing and Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]
Efficiency and convenience [Q18]	Pearson Correlation	,030	-,106	,104
	Sig. (2-tailed)	,729	,223	,227
	N	134	134	136
Safety and health [Q18]	Pearson Correlation	,120	,183*	,247**
	Sig. (2-tailed)	,167	,034	,004
	N	134	134	136
Cost and sustainability [Q18]	Pearson Correlation	,010	,041	,270**
	Sig. (2-tailed)	,908	,636	,001
	N	134	134	136

Correlations between compliance measures and environmental safety conditions

All three compliance-measure dimensions were positively and significantly related to respondents' perceptions of the riding environment, although the relationships were small in magnitude. Specifically, stronger support for Punishment and enforcement was associated with higher reported Traffic exposure & conflict ($r = .231$, $p = .007$) and higher Infrastructure quality scores ($r = .264$, $p = .002$). Similarly, Licensing and obligatory measures showed significant positive links with both Traffic exposure & conflict ($r = .304$, $p < .001$) and Infrastructure quality ($r = .273$, $p = .001$), with the strongest association in this set occurring between licensing/obligatory measures and traffic exposure/conflict. Finally, Public awareness initiatives were also positively correlated with Traffic exposure and conflict ($r = .249$, $p = .004$) and Infrastructure quality ($r = .286$, $p < .001$), with the latter representing the strongest association for this dimension.

Table 124. Statistical test for associations between compliance measures and environmental safety conditions

Correlations				
		Punishment and Enforcement [Q24]	Licensing and Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]
Traffic Exposure & Conflict [Q23]	Pearson Correlation	,231**	,304**	,249**
	Sig. (2-tailed)	,007	<,001	,004

N	134	134	134
Infrastructure Quality [Q23]	Pearson Correlation	,264**	,273**
	Sig. (2-tailed)	,002	<,001
N	134	134	134

Correlations between compliance measures and riding behaviours

Across the three compliance-related dimensions, the correlations with behavioural patterns indicate that support for regulatory and awareness-oriented measures is only selectively associated with respondents' self-reported riding behaviours. Punishment and enforcement showed no statistically significant associations with any riding behaviour (all $p > .05$), with very small correlations for Risk and violations ($r = .097$, $p = .265$) and Safety compliance ($r = .058$, $p = .502$), and a slightly higher but still non-significant correlation with Phone and audio use ($r = .156$, $p = .071$).

Support for Licensing and obligatory measures, however, showed a small but statistically significant positive association with Risky and violative riding behaviour ($r = .186$, $p = .032$). This indicates that respondents who report more frequent risky or rule-breaking behaviour tend to express slightly stronger support for mandatory or licensing-based regulation—perhaps reflecting a recognition of risk in their environment, even if they themselves engage in these behaviours. Although licensing support was also weakly related to Safety compliance ($r = .148$, $p = .088$) and Phone and audio use ($r = .148$, $p = .088$), these associations did not reach significance.

Finally, Public awareness initiatives showed a significant positive correlation with Safety compliance ($r = .216$, $p = .012$), indicating that riders who already engage in safer behaviours tend to be more supportive of educational and awareness-based interventions. In contrast, Public awareness Initiatives were not significantly related to Risky and violative riding behaviour ($r = -.038$, $p = .660$) or Phone and audio use ($r = .017$, $p = .844$), suggesting that support for awareness campaigns is primarily aligned with existing safety-oriented tendencies, rather than with risky or distracted riding behaviours.

Table 125. Statistical test for associations between compliance measures and riding behaviours

Correlations			
	Punishment and Enforcement [Q24]	Licensing and Obligatory Measures [Q24]	Public Awareness Initiatives [Q24]

Risk and [Q22]	Violations	Pearson Correlation	,097	,186*	-,038
		Sig. (2-tailed)	,265	,032	,660
		N	134	134	135
Safety [Q22]	Compliance	Pearson Correlation	,058	,148	,216*
		Sig. (2-tailed)	,502	,088	,012
		N	134	134	135
Phone or audio [Q22]	use	Pearson Correlation	,156	,148	,017
		Sig. (2-tailed)	,071	,088	,844
		N	134	134	135

Discussion

The findings show a clear preference for cycling infrastructure as the main choice for e-scooter travel. When such facilities are missing or interrupted, riders often switch to mixed-traffic roads. This confirms that dedicated lanes are the backbone of safe e-scooter mobility, while other surfaces serve as fallback options.

High use of cycle paths combined with frequent sidewalk riding points to situational switching. Riders use protected lanes when available but turn to sidewalks or other non-compliant areas when the network is congested, fragmented, or feels unsafe. Occasional use of pedestrian zones may reflect tolerance for slow-speed travel or a desire to avoid motor traffic.

Gaps in infrastructure, uneven surfaces, and the absence of dedicated routes hinder daily riding. These are not minor inconveniences but real barriers to safe and comfortable travel. The overall burden is moderate to high (mean score 3.52), highlighting priorities such as smoother surfaces, better curb design, and continuous, high-quality cycling corridors.

E-scooters are primarily used for everyday, non-work trips, but they also serve purposes such as leisure, errands, commuting, and tourism. Patterns suggest they complement existing habits rather than replace them. Intermodal travel is common, making e-scooters a flexible link in multimodal mobility chains rather than a standalone mode. The typical cruising speed is around 20 km/h, although variation across contexts is notable.

Two key issues stand out: first, confusion about the legality of activities in pedestrian zones and sidewalks, which correlates with higher violation rates; second, missed opportunities to utilise safe, permitted infrastructure, especially cycling lanes and tracks. Many riders misinterpret rules or assume it is permissible to enter prohibited areas, revealing a significant knowledge gap.

Safety perceptions depend more on infrastructure and motor traffic than on interactions between riders. Parking is a challenge for some, but not a significant safety concern. Enforcement measures, such as visible monitoring and fines, have a significant impact on compliance. Educational campaigns are helpful but less persuasive. Formal regulations, such as registration or tests, are seen as less effective than direct enforcement and awareness efforts.

Summary and interpretation of statistical findings

This section synthesises the findings of the analyses examining associations between substitute transport mode choice and a wide range of socio-demographic, licensing, experiential, travel-related, and purpose-based variables.

Across respondent socio-demographic characteristics—including gender, age, education level, employment status, and household income—no statistically significant associations with the choice of a substitute transport mode were identified. Likewise, possession of a motorcycle or passenger car driving licence and prior involvement in traffic incidents did not meaningfully differentiate substitution patterns. Overall, substitute transport mode choice appears to be largely independent of respondent background characteristics and personal driving credentials.

In contrast, spatial context emerged as a key differentiating factor. Place of residence was associated with a statistically significant difference in the choice of substitute transport mode. Urban respondents were more likely to substitute e-scooter trips for private motorised transport, whereas rural respondents were more likely to select public transport or electric micromobility options. Substitution patterns among suburban residents were broadly consistent with distributions expected under independence.

Travel-related characteristics exhibited a more nuanced pattern. Typical e-scooter travel distance did not result in statistically significant differences in the choice of a substitute transport mode. Nevertheless, travel distance may still offer contextual insight into substitution behaviour, without constituting a formal differentiating factor.

Regarding trip purpose, statistically significant differences were observed only for e-scooter use related to commuting to school. Respondents who reported using an e-scooter to commute to school exhibited significantly higher scores on the Risky and violative riding behaviour compared to non-commuters. No statistically significant differences were found for other trip purposes.

Across all examined latent factor dimensions, no statistically significant differences were found between groups defined by their preferred substitute transport mode. Users who would substitute e-scooter trips with private motorised transport, public transport, active mobility, or electric micromobility did not differ meaningfully in their motivational orientations, self-reported riding behaviours, safety compliance, perceived infrastructure quality, or attitudes towards enforcement and regulatory measures.

Taken together (Table 91), the findings suggest that substitute transport mode choice among e-scooter users is influenced primarily by contextual factors—most notably place of residence—rather than by socio-demographic characteristics, experiential factors, or underlying psychological and perceptual profiles. Observed differences in substitution

behaviour therefore appear to reflect structural and situational conditions rather than systematic differences in users' attitudes or behavioural dispositions.

Table 126. Summary of statistically significant differences in e-scooter substitute transport mode choice

Variable	Statistical difference	Description of significant difference
Gender	No	
Age	No	
Motorcycle driving licence status	No	
Passenger driving licence status	No	
Employment status	No	
Education	No	
Place of residence	Yes	Place of residence was significantly associated with the choice of a substitute transport mode. Urban respondents were more likely to substitute e-scooter trips with private motorised transport, whereas rural respondents more frequently selected electric micromobility and public transport options.
Household income	No	
Traffic accident involvement	No	
Typical e-scooter travelled distance	No	Typical travel distance does not statistically differentiate substitute transport mode choice; it may still play a contextual role in shaping substitution decisions.
Purpose	Yes	Respondents using an e-scooter for commuting to school reported significantly higher scores on the Risky and violative riding behaviour compared to non-commuters.
Efficiency and convenience	No	
Safety and health	No	
Cost and sustainability	No	
Risk and violations	No	
Safety compliance	No	
Phone and audio use	No	
Traffic exposure and conflict	No	
Infrastructure quality	No	
Punishment and enforcement	No	
Licensing and obligatory measures	No	
Public awareness initiative	No	

The results indicate that safety-related behaviours and perceptions among e-scooter users are only partially shaped by socio-demographic characteristics, with most background variables showing no statistically significant associations. Instead, behavioural differences appear to be more closely linked to experiential factors, travel characteristics, and specific usage contexts (Table 92).

Age emerged as a meaningful differentiator of risky behaviour, with older riders reporting lower levels of risky and violative riding. This pattern is consistent with broader traffic safety research, which associates increasing age with greater risk awareness, accumulated experience, and more conservative riding strategies. In contrast, younger riders may be more prone to exploratory or risk-oriented behaviours in micromobility contexts.

Motorcycle driving licence status was associated with higher safety compliance and stronger safety- and health-related orientations. This suggests that formal riding experience and exposure to traffic regulations may transfer positively to e-scooter use, fostering greater adherence to safety practices and protective behaviours. A similar pattern was observed among respondents with prior traffic accident involvement, who reported both higher risky behaviour and higher safety compliance. This combination may reflect increased exposure to risk together with heightened safety awareness following accident experience.

Travel distance was related to multiple safety dimensions, indicating a complex relationship between exposure and behaviour. Longer e-scooter trips were associated not only with greater engagement in risky and violative behaviours but also with higher levels of safety compliance and safety- and health-oriented attitudes. This suggests that increased exposure may simultaneously elevate risk opportunities and encourage more deliberate safety practices, rather than reflecting a unidirectional effect.

Trip purpose further differentiated safety-related behaviours. Higher levels of risky and violative behaviour among school commuters may reflect time pressure, routine travel patterns, or peer-influenced riding contexts. In contrast, higher safety compliance among tourism-oriented users may be linked to unfamiliar environments, leisure-oriented usage, or greater caution when navigating new surroundings.

Finally, the observed correlations between latent factors highlight coherent attitudinal and perceptual structures underlying e-scooter use. Strong linkages between safety, cost, and sustainability suggest that these considerations form a unified evaluation framework for many users. Likewise, the strong interrelationship between enforcement-related measures indicates that regulatory acceptance is perceived as a consistent domain. The moderate association between risky behaviour and phone or audio use underscores the role of distraction in risk-related riding practices.

Table 127. Summary of statistically significant differences in safety-related characteristics

Variable	Statistical difference	Description of significant difference
Gender	No	
Age	Yes	Older respondents reported significantly lower scores on the Risky and violative riding behaviour , indicating reduced engagement in risky and violative riding behaviours with increasing age.
Motorcycle driving licence status	Yes	Respondents holding a motorcycle driving licence reported significantly higher Safety compliance scores, indicating greater engagement in protective and compliance-oriented safety practices. Licensed motorcycle riders also reported significantly higher Safety and health scores, reflecting a stronger safety- and health-oriented approach to e-scooter use.
Passenger driving licence status	No	
Employment status	No	
Education	No	
Place of residence	No	
Household income	No	

Traffic accident involvement	Yes	Respondents with prior accident involvement reported significantly higher Risky and violative riding behaviour scores, indicating more frequent risky and violative riding behaviours. The same group also reported significantly higher Safety compliance scores, suggesting greater use of protective and compliance-oriented safety practices.
Typical e-scooter travelled distance	Yes	Longer e-scooter travel distances were significantly associated with higher Risky and violative riding behaviour scores. Longer travel distances were also associated with higher Safety compliance scores. In addition, respondents travelling longer distances reported significantly higher Safety and health scores.
Purpose	Yes	Respondents using e-scooters to commute to school reported significantly higher Risky and violative riding behaviour scores compared to non-commuters. Tourism-oriented e-scooter users reported significantly higher Safety compliance scores than non-tourism users.
Efficiency and convenience	Yes	Efficiency and Convenience was strongly positively correlated with Safety and health and with Cost and sustainability. Safety and health was strongly positively correlated with Cost and sustainability. Punishment and Enforcement was strongly positively correlated with Licensing and mandatory requirements. Infrastructure quality was moderately positively correlated with Traffic exposure and conflict. Risk and Violations showed generally weak associations with other factors, except for a moderate positive correlation with Phone and audio use. Public awareness initiatives were moderately positively correlated with enforcement-related measures.

The analysis revealed several meaningful associations between user characteristics and phone or audio use while riding an e-scooter. Age showed a significant effect, with younger respondents reporting more frequent phone and audio use compared to older riders. A similar pattern emerged for licensing status: respondents without a passenger car driving licence exhibited significantly higher levels of phone and audio use than those who hold such a licence, suggesting that driving experience may be linked to safer or more attentive riding practices.

Experience with traffic incidents also played an important role. Respondents who had previously been involved in a traffic accident reported higher levels of phone and audio use than those without such experience, indicating that distraction-related behaviours may contribute to elevated exposure to risk. In addition, longer typical e-scooter travel distances were significantly associated with more frequent phone and audio use, suggesting that riders may be more inclined to engage with devices during extended trips.

Trip purpose further differentiated riders: those who use e-scooters for leisure reported higher levels of phone and audio use, suggesting a more relaxed, less safety-focused riding style in recreational contexts.

No statistically significant differences were found with respect to gender, motorcycle licence status, employment status, education level, place of residence, or household income,

indicating that these characteristics do not meaningfully explain variation in distraction-related behaviours in the present sample.

Table 128. Summary of statistically significant differences in phone and audio use while riding an e-scooter

Variable	Statistical difference	Description of significant difference
Gender	No	
Age	Yes	Younger respondents reported more frequent phone and audio use while riding an e-scooter.
Motorcycles driving licence	No	
Passenger driving licence	Yes	Respondents without a passenger car driving licence reported significantly higher levels of phone and audio use while riding compared to licence holders.
Employment status	No	
Education	No	
Place of residence	No	
Income	No	
Incidents in traffic	Yes	Respondents with prior traffic accident involvement reported significantly higher levels of phone and audio use while riding than those without such experience.
Travelled distance with eScooter	Yes	Longer typical e-scooter travel distances were significantly associated with more frequent phone and audio use while riding.
Purpose	Yes	Leisure-oriented e-scooter use was associated with higher levels of phone and audio use while riding.

The results summarised in the table indicate that, within the examined set of user characteristics and contextual factors, Efficiency and convenience is a relatively stable motivational dimension that does not vary meaningfully across most demographic or behavioural subgroups. This suggests that the perceived practical benefits of e-scooter use—such as speed, comfort, and ease of travel—are broadly shared and widely recognised among users regardless of their socio-demographic background or riding experience.

Despite this overall stability, two variables demonstrated statistically significant associations, offering important insight into the contexts in which efficiency-related perceptions become more pronounced. The first is the trip purpose. Respondents who reported using e-scooters for errands or daily tasks evaluated them as significantly more efficient and convenient than those who did not use them for these practical purposes. This finding aligns with the intuitive expectation that regular, task-oriented users may be more attuned to the time-saving and flexible nature of e-scooter travel, as these benefits are directly relevant to routine mobility needs. The result, therefore, highlights that everyday functional use—rather than occasional or recreational use—is closely tied to a stronger appreciation of the practical advantages offered by e-scooters.

The second significant association was observed between Efficiency and Convenience and the Cost and Sustainability dimension. A strong positive correlation indicates that riders who perceive e-scooters as efficient and convenient also tend to evaluate them more favourably in terms of cost-effectiveness and environmental impact. These two motivational aspects

appear to reinforce one another, suggesting that users who value e-scooters for their practical benefits also see them as economically and environmentally advantageous. This convergence highlights the multidimensional nature of users' positive attitudes toward e-scooter use and suggests that efficiency, affordability, and sustainability are intertwined components of a broader favourable perception of micromobility.

Taken together, these findings indicate that perceptions of efficiency and convenience are largely universal but become especially salient among riders who use e-scooters for routine everyday tasks and among those who also prioritise economic and environmental considerations. These patterns support the view that e-scooters are not only seen as a recreational or situational mode of transport, but also as a practical, increasingly integrated component of daily mobility for some users.

Table 129. Summary of statistically significant differences in perceptions of efficiency and convenience

Variable	Statistical difference	Description of significant difference
Gender	No	
Age	No	
Motorcycle driving licence status	No	
Passenger driving licence status	No	
Employment status	No	
Education	No	
Place of residence	No	
Household income	No	
Traffic accident involvement	No	
Typical e-scooter travelled distance	No	
Purpose	Yes	Respondents who rely on e-scooters for everyday practical trips evaluate them as more efficient and convenient than those who do not use them for this purpose.
Cost and sustainability	Yes	Respondents who perceive e-scooters as efficient and convenient also tend to rate them more positively in terms of cost-effectiveness and environmental benefit

The findings indicate that most socio-demographic factors—including gender, age, motorcycle and passenger driving licence status, employment, education, place of residence, and household income—did not differentiate respondents in terms of their attitudes toward e-scooter compliance measures. This suggests that support for enforcement-, licensing-, or awareness-oriented policies tends to be broadly shared across demographic groups, with limited variability attributable to personal background characteristics. Such uniformity implies that compliance-related attitudes may be more strongly shaped by experiential or behavioural factors rather than by static demographic attributes.

In contrast, several experience- and behaviour-based factors showed meaningful associations. Individuals who had previously been involved in an e-scooter accident placed greater importance on public awareness and educational initiatives, which may reflect

heightened sensitivity to safety risks following firsthand negative experiences. Similarly, those who typically travel longer distances with an e-scooter expressed greater support for awareness-raising initiatives, possibly because extended trips increase exposure to traffic complexity and potential hazards, reinforcing the perceived value of safety-oriented communication.

No significant differences were found based on the general purpose of use, with one exception: respondents who commute to school tended to show lower support for punitive measures, suggesting that certain subgroups of young or habitual riders might prioritise practicality and ease of use over strict enforcement.

The results also highlight important internal dynamics among the compliance-measure dimensions themselves. Respondents who support stricter enforcement also tend to favour administrative and mandatory regulatory measures, indicating that these views form a coherent attitudinal cluster. Similarly, individuals who evaluate one compliance approach positively are likely to support the others as well, suggesting a general orientation toward stronger regulatory governance. Some nuances emerge—for example, school commuters expressing lower endorsement of punitive enforcement—indicating that specific riding contexts may moderate these broader evaluative tendencies.

Motivational factors further illuminate these patterns. Respondents who emphasise safety or health-related reasons for e-scooter use tend to be more supportive of mandatory or licensing-based measures, consistent with their orientation toward protective behaviour. Similarly, those motivated by health, safety, or sustainability concerns showed stronger support for public awareness initiatives, implying that these individuals recognise the value of education and shared responsibility in promoting safer micromobility environments.

Environmental conditions were also linked with compliance attitudes. Individuals who perceive greater traffic exposure and conflict, as well as those who rate infrastructure quality more strongly, expressed slightly higher support for enforcement, licensing, and awareness measures. These associations, though modest, suggest that perceptions of the riding environment play a role in shaping policy preferences: as perceived risk and infrastructure salience increase, so does support for stronger regulatory and educational frameworks.

Finally, riding behaviours demonstrated distinct associations. Respondents engaging in more frequent risky or rule-breaking behaviours displayed slightly stronger support for mandatory/licensing measures, possibly acknowledging that increased regulation could help mitigate risks they personally encounter or contribute to. Conversely, riders who already display safer behaviours were more supportive of educational and awareness-based interventions, suggesting alignment between their own safety-oriented conduct and their attitudes toward policies that promote shared responsibility and knowledge.

Table 130. Summary of statistically significant differences in compliance measures

Variable	Statistical difference	Description of significant difference
Gender	No	
Age	No	
Motorcycle driving licence status	No	
Passenger driving licence status	No	
Employment status	No	
Education	No	
Place of residence	No	
Household income	No	
Traffic accident involvement	Yes	Respondents who have experienced an e-scooter accident place greater importance on public awareness and educational initiatives, potentially reflecting heightened safety concerns stemming from their firsthand experience.
Typical e-scooter travelled distance	Yes	Respondents who rely on e-scooters for commuting place greater importance on awareness-raising and educational initiatives, possibly reflecting their more frequent exposure to traffic conditions and safety risks
Purpose	No	
Compliance measures	Yes	Respondents who support stricter enforcement also tend to favour administrative or mandatory regulatory measures. Respondents who perceive one type of compliance measure as effective generally tend to view the other types positively as well. Those who ride to school tend to place less emphasis on punitive and enforcement-oriented measures.
Motivation for use	Yes	Respondents who emphasise safety- or health-related reasons for riding an e-scooter tend to be somewhat more supportive of mandatory or licensing-based requirements. Respondents motivated by health/safety considerations or sustainability concerns tend to be more supportive of educational and awareness-raising strategies.
Environmental safety conditions	Yes	Respondents who perceive greater traffic exposure and conflict and who rate infrastructure quality more strongly tend to show slightly higher support for enforcement, licensing, and awareness-oriented compliance measures.
Riding behaviours	Yes	Respondents who report more frequent risky or rule-breaking behaviour tend to express slightly stronger support for mandatory or licensing-based regulation—perhaps reflecting a recognition of risk in their environment, even if they themselves engage in these behaviours Respondents who already engage in safer behaviours tend to be more supportive of educational and awareness-based interventions.

Recommendations

Improving the safety and usability of e-scooters requires a comprehensive approach. A key priority is ensuring continuous cycling infrastructure to reduce reliance on sidewalks and mixed-traffic roads. Addressing sidewalk riding through targeted design measures and clear communication is equally important, as its prevalence signals gaps in safe alternatives. Urban planning should integrate micromobility into dense areas while minimising conflicts with pedestrians, creating safer and more inclusive spaces.

Further research should examine why riders choose sidewalks and pedestrian zones—whether due to safety concerns, convenience, or lack of infrastructure. Developing uninterrupted cycling corridors for trips of 3–7 km, supported by adequate charging and parking facilities, will strengthen everyday mobility. These corridors should connect seamlessly with (e-)bike networks and public transport for longer journeys. Expanding bike-sharing systems and enhancing integration with public transportation through secure parking, wayfinding, and first- and last-mile solutions will help reduce dependence on private cars.

Intermodal integration must be prioritised at rail and bus nodes, supported by clear wayfinding and carriage policies. For monitoring and reporting, adding percentiles (e.g., P25, P75) alongside mean and median values will provide a more transparent view of extreme behaviours. Finally, improving the clarity of regulations and enhancing infrastructure accessibility can significantly reduce unsafe practices and optimise the integration of micromobility.

USERS VS. NON-USERS ATTITUDES TOWARDS E-SCOOTERS

The main aim of this part of the report was to identify the most important differences between e-scooter users and non-users. The first difference is related to the number of days per week a person uses e-scooter, his own or rented from a public network. Based on the results presented in the Table 130, we can conclude that less than every tenth respondent drives his own e-scooter at least once per week. The situation is also similar for e-scooters bordered rented from a public network: less than 5% of the respondents use this option as a possible option for daily mobility.

Table 130. Frequency of the respondents' answers related to choosing e-scooters as an option for weekly mobility

Own e-scooter			E-scooter rented from public network	
Number of days per week	Frequency	Percentage	Frequency	Percentage
0	1003	88,4	1089	95,9
1	42	3,7	15	1,3
2	29	2,6	7	0,6
3	20	1,8	4	0,4
4	16	1,4	3	0,3
5	8	0,7	5	0,4
6	2	0,2	2	0,2
7	10	0,9	1	0,1
No answer	5	0,4	9	0,8
Total	1135	100	1135	100

In the next stage of the study, we wanted to examine statistically significant differences between users and non-users based on the factors such as importance of modality chose, perception of e-scooters as a vehicle, perception of e-scooters drivers as well as attitudes about using e-scooters in traffic.

T-test for independent samples was used to identify statically significant differences in respondents' importance of different modalities choose factors between e-scooters users and non-users. T-test results showed that there are no significant differences examined for all modalities choose factors, except for the factor "fun to use", for which results are presented in the Table 131. Users of e-scooter perceive this factor as more important than non-users when choosing transpiration modality.

Table 131. Statistically significant differences: importance of modality choose factors

Factor	Respondent	Frequency	Mean	St. deviation	t-value
Fun to use	E-scooter non-users	1003	2.98	1.59	-3,037**
	E-scooter users	127	3.43	1.47	

** significance level $p \leq 0,01$

The t-test analysis was conducted to examine statistically significant differences in the perception of e-scooters as a vehicle between users and non-users. Perceptions were measured using a semantic differential scale composed of opposing adjectives on a nine-point continuum, allowing an assessment of whether respondents evaluated the vehicle attributes positively or negatively. The results presented in Table 132 indicate clear and consistent perceptual differences between the two groups. Non-users perceive e-scooters as significantly less useful than users, a discrepancy likely rooted in personal experience, as individuals who have previously used e-scooters tend to recognize their practicality and convenience. Both groups consider e-scooters relatively unsafe; however, non-users rate them as substantially more unsafe, suggesting that safety concerns may constitute a major barrier to adoption. Although both groups acknowledge certain environmental benefits of e-scooters, users attribute these advantages more strongly, possibly due to greater awareness gained through direct use. Perceptions of noise show smaller but still significant differences, with users viewing e-scooters as quieter, while non-users may overestimate noise levels due to lack of familiarity or external influences such as media reports.

Table 132. Statistically significant differences in e-scooter as a vehicle perception among e-scooter users and non-users

Adverb	Respondent	Frequency	Mean	St. deviation	t-value
1 useful 9 useless	E-scooter non-users	1003	5,07	2,99	8,099**
	E-scooter users	127	2,82	2,52	
1 safe 9 unsafe	E-scooter non-users	1003	6,99	2,85	6,185**
	E-scooter users	127	5,34	2,72	
1 environmentally friendly 9 non-environmentally friendly	E-scooter non-users	1003	3,77	2,69	4,212**
	E-scooter users	127	2,72	2,42	
1 silent 9 disturbing	E-scooter non-users	1003	3,1	2,8	2,7**
	E-scooter users	127	2,4	2,32	

In the next stage, the aim of the study was to investigate if there are statically significant differences in e-scooters drivers' perception among e-scooter users and non-users. Based on this, similar results as for e-scooters as vehicle perceptions were investigate which once

again confirms that personal experience with e-scooters can be a reason for these statically significant differences.

Table 133 presents statistically significant differences in perceptions of e-scooter drivers between individuals who use e-scooters and those who do not. The results reveal consistent and meaningful contrasts across all evaluated attributes, indicating a clear perceptual divide between the two groups.

First, regarding age perception (1 = young, 9 = old), e-scooter non-users perceive drivers as significantly younger compared to users. Although both groups tend toward the “young” end of the scale, non-users attribute slightly higher age values, suggesting subtle differences in how rider demographics are interpreted.

More pronounced differences emerge in safety-related and behavioral evaluations. Non-users consistently rate e-scooter drivers more negatively across nearly all attributes. On the safety dimension (1 = safe, 9 = unsafe), non-users perceive drivers as significantly more unsafe ($M = 6.94$, $SD = 2.87$) than users do ($M = 5.37$, $SD = 2.75$; $t = 5.825$, $p < .01$). A similar pattern appears for intelligence (1 = smart, 9 = foolish), where non-users rate drivers as more foolish ($M = 5.82$) than users ($M = 4.23$; $t = 6.069$, $p < .01$). This negative perception among non-users is further reflected in evaluations of responsibility ($M = 6.35$ vs. 4.52 ; $t = 7.048$, $p < .01$), carefulness ($M = 6.54$ vs. 4.83 ; $t = 6.478$, $p < .01$), and predictability ($M = 6.68$ vs. 5.24 ; $t = 5.43$, $p < .01$). In each case, non-users attribute significantly more undesirable characteristics to e-scooter drivers, perceiving them as more irresponsible, careless, and unpredictable compared to users’ assessments.

Perceptions of social acceptability also differ significantly. On the pleasant–annoying scale (1 = pleasant, 9 = annoying), non-users evaluate drivers as more annoying ($M = 5.79$, $SD = 2.85$) than users ($M = 4.13$, $SD = 2.64$; $t = 6.187$, $p < .01$).

These results suggest that personal experience with e-scooters plays a crucial role in shaping perceptions. Direct usage may foster greater understanding of riding conditions, risks, and behaviours, leading to more balanced evaluations. Conversely, non-users—likely observing e-scooter interactions primarily as pedestrians or drivers—may focus more on perceived risks and conflicts in shared urban spaces.

Table 133. Statistically significant differences in e-scooter drivers' perceptions among e-scooter users and non-users

Adverb	Respondent	Frequency	Mean	St. deviation	t-value
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1 young 9 old	E-scooter non-users	1003	2,61	2,02	-3,333**
	E-scooter users	127	3,26	2,35	
1 safe 9 unsafe	E-scooter non-users	1003	6,94	2,87	5,825**
	E-scooter users	127	5,37	2,75	
1 smart 9 foolish	E-scooter non-users	1003	5,82	2,82	6,069**
	E-scooter users	127	4,23	2,47	
1 responsible 9 irresponsible	E-scooter non-users	1003	6,35	2,78	7,048**
	E-scooter users	127	4,52	2,51	
1 careful 9 careless	E-scooter non-users	1003	6,54	2,82	6,478**
	E-scooter users	127	4,83	2,64	
1 pleasant 9 annoying	E-scooter non-users	1003	5,79	2,85	6,187**
	E-scooter users	127	4,13	2,64	
1 predictable 9 unpredictable	E-scooter non-users	1003	6,68	2,85	5,43**
	E-scooter users	127	5,24	2,7	

In the next stage of this study, statistically significant differences in attitudes towards using e-scooters in traffic between e-scooter users and e-scooters non-users were investigated. Based on the results presented in Table 134, statistically significant differences were identified across all examined attitude items between e-scooter users and nonusers. The results indicate that nonusers consistently reported more negative perceptions of e-scooters in traffic. Specifically, nonusers were more likely to agree with statements suggesting that e-scooters increase traffic conflicts, pose safety risks to pedestrians and other road users, and contribute to disorder in public spaces. They also tended to express stronger concerns regarding rule violations, improper parking, and insufficient regulation. In contrast, e-scooter users demonstrated significantly more positive evaluations across the same dimensions. Users were more likely to perceive e-scooters as a convenient, efficient, and environmentally friendly mode of transport, and they reported lower levels of concern regarding safety and traffic disruption. These consistent differences across all items suggest that personal experience with e-scooters is strongly associated with more favourable attitudes, whereas the absence of direct usage is linked to heightened risk perception and more critical evaluations of their role in urban traffic.

Table 134. Statistically significant differences in attitudes towards using e-scooters in traffic among e-scooter users and non-users

	Independent Samples Test							
	t	Significance One-Sided p	Test for Equality of Means				95% Confidence Interval of The Difference	
			Significance t	p	Mean Difference	Std. Error Difference	Lower	Upper
To use e-scooters, users should obtain proper education and knowledge	Equal variances assumed	Equal variances assumed	4.224	112.0	.739	.177	0.563	1.072
There should be more training and awareness programs about the safe use of e-scooter	Equal variances not assumed	Equal variances Two-Sided p	4.038	70.5	.733	.733	0.733	1.095
The use of e-scooters should be monitored/supervised	Equal variances not assumed	Equal variances assumed	3.418	115.3	.499	0.49	0.162	0.815
The use of e-scooters would increase respect for traffic rules	Equal variances assumed	Equal variances assumed	3.541	112.8	.622	.622	0.622	0.269
Due to the perceived use of e-scooters, I feel less safe in public spaces today than I did five years	Equal variances assumed	Equal variances assumed	3.316	156.02	.546	0.19	0.246	0.672
E-scooter users are often dangerous and /vulnerable participants in traffic	Equal variances assumed	Equal variances Two-Sided p	4.166	116.8	.733	0.75	0.733	0.999
The use of e-scooters should be strictly prohibited	Equal variances not assumed	Equal variances assumed	4.336	79.3	.751	0.73	0.751	1.096
Riding an e-scooters should require a special legal permit with specific insurance	Equal variances assumed	Equal variances Two-Sided p	3.797	156.0	.650	0.51	0.451	1.149
Riding an e-scooter on regular roads is very dangerous	Equal variances assumed	Equal variances 0.239	1.218	67.3	.224	0.194	-0.143	0.582
E-scooters, are a good substitute for cyclists	Equal variances assumed	Equal variances Two-Sided	4.216	112.9	.821	0.67	0.621	0.913
I feel threatened when—as a pedestrian, I use the same areas as e-scooter users	Equal variances not assumed	Equal variances assumed	4.760	169.8	.858	0.58	0.503	1.113
E-scooters should be registered, insured, and properly technically inspected	Equal variances not assumed	Equal variances Two-Sided p	4.313	157.2	.734	0.34	0.384	1.084

Discussion with recommendations

The main objective of this part of the study was to identify and explain the key differences between e-scooter users and non-users. The findings reveal several important patterns that consistently point to the role of personal experience in shaping perceptions and attitudes toward e-scooters.

First, the descriptive results clearly indicate that regular e-scooter use remains relatively low within the observed sample. Fewer than 10% of respondents reported using their own e-scooter at least once per week, while the proportion of respondents using shared e-scooters from public networks on a weekly basis was even lower, below 5%. This suggests that e-scooters, although present in the urban mobility landscape, are not yet widely integrated into respondents' regular weekly mobility routines. Consequently, the majority of respondents can be considered non-users, which provides important context for interpreting the attitudinal differences observed in subsequent analyses.

When examining factors influencing transport mode choice, statistically significant differences between users and non-users were found for only one factor: "fun to use." E-scooter users rated this factor as significantly more important compared to non-users. This

finding suggests that hedonic motivation plays a more prominent role among users, whereas non-users may prioritize more utilitarian criteria (e.g., cost, speed, practicality) when evaluating transport options. The absence of significant differences for other modality choice factors indicates that both groups may share similar general mobility priorities, but differ in the emotional or experiential value they attribute to e-scooters.

More substantial differences emerged in the perception of e-scooters as a vehicle. Across all examined attributes—usefulness, safety, environmental friendliness, and noise—non-users evaluated e-scooters significantly more negatively than users. Non-users perceived e-scooters as less useful and more unsafe, while users rated them as more practical and somewhat safer. Although both groups expressed certain safety concerns (with mean values leaning toward the “unsafe” end of the scale), non-users’ assessments were considerably more critical. These findings suggest that safety perception represents a key barrier to adoption. Similarly, while both groups acknowledged environmental benefits, users attributed stronger positive environmental characteristics to e-scooters. This may reflect greater awareness gained through direct use or post-hoc rationalization of their chosen mobility behaviour.

Differences were even more pronounced in perceptions of e-scooter drivers. Non-users consistently evaluated drivers more negatively across all examined attributes, perceiving them as more unsafe, foolish, irresponsible, careless, unpredictable, and annoying. In contrast, users provided significantly more moderate or positive evaluations. These findings indicate that non-users may associate e-scooter riding with problematic or risky behaviour, possibly based on selective exposure to negative incidents in traffic or media coverage. The perception of drivers as young further reinforces potential stereotypes about inexperience or recklessness. Such social perceptions may contribute to broader resistance toward e-scooter integration in urban traffic systems.

Finally, statistically significant differences were identified across all examined items related to attitudes toward using e-scooters in traffic. Non-users consistently reported more negative attitudes, expressing stronger agreement with statements about increased traffic conflicts, safety risks, improper parking, rule violations, and insufficient regulation. In contrast, users expressed more favourable and accepting attitudes, emphasizing convenience, efficiency, and environmental benefits, while downplaying safety concerns.

Taken together, these results suggest a clear perceptual and attitudinal divide between users and non-users. The consistency of statistically significant differences across vehicle perception, driver perception, and traffic attitudes highlights the central role of personal experience in shaping evaluations. Direct use of e-scooters appears to foster more positive and balanced perceptions, whereas non-users—likely observing e-scooters primarily as pedestrians or drivers in shared spaces—tend to focus more on perceived risks and conflicts.

From a policy perspective, these findings imply that efforts to improve safety regulations, infrastructure integration, and public awareness may be crucial in reducing negative

perceptions among non-users. Addressing safety concerns and improving behavioural standards could help narrow the perceptual gap between the two groups and support more harmonious integration of e-scooters into urban mobility systems.

PERSONALITY TRAITS OF USERS VS. NON-USERS

The research is related to finding an answer to the research question of how to approach communication with e-scooter users in order to increase compliance with traffic rules and users' willingness to engage in self-protective behaviour to protect themselves and others (RV6). Within this research question, we focused on one of the project's objectives: to determine the attitude of other users of mobility systems towards e-scooters (C4).

Methods

The study involved 1,060 participants with an average age of 43 ($M = 43.06$; $SD = 13.33$; range = 15–67).

Table 1: Age of participants.

Age	N	%
<20	54	5,1
21-30	172	16,2
31-40	216	20,4
41-50	253	23,9
51-60	256	24,2
61>	109	1,03
Total	1060	100

The vast majority of participants do not own an e-scooter ($N = 940$; 89%) and never rent one ($N = 1015$; 96%). In the entire sample of participants, there are 115 (10.8%) e-scooter owners and 36 (4.2%) participants who rent e-scooters. Both genders are represented equally in the

sample; there are 499 men (47.1%) and 550 women (51.9%), with some respondents not providing an answer (N = 11; 1.1%).

Questionnaire

Participants responded to an online survey published on 1KA. In the first question, participants gave their opinion on e-scooters using four pairs of opposite adjectives (useful – useless, modern – outdated, safe – dangerous, friendly – unfriendly/harmful to the environment). In the second question, they described their attitude towards e-scooter users in the same way, using six pairs of opposite adjectives (young – old, safe – dangerous, smart – stupid, responsible – irresponsible, cautious – reckless, predictable – unpredictable). This was followed by questions about the age and gender of the participants.

The personality traits of the participants were determined using a short version of the Big Five Inventory (BFI-2-S), which has been officially translated into Slovenian (Soto and John, 2017). The questionnaire consists of 30 items that ask the person to what extent they agree with the statements that describe them. Agreement was expressed on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). The items are used to determine the values of five personality dimensions based on the Big Five personality theory (extraversion, agreeableness, conscientiousness, negativity, and openness).

These personality dimensions are briefly described below (summarized from Soto and John, 2017). Extraversion describes the degree to which an individual is sociable, energetic, assertive, and oriented toward the outside world. Highly extroverted individuals are typically communicative, active, and seek social stimulation, while low extroversion (introversion) involves reserve, less need for social contact, and greater inward focus. Agreeableness refers to interpersonal orientation, specifically the degree of empathy, cooperation, trust, and altruism. Highly agreeable individuals are typically friendly, compassionate, and willing to help others, while low agreeableness individuals are more competitive, sceptical, or confrontational. Conscientiousness describes the degree to which an individual is organized, responsible, self-disciplined, and goal-oriented. High conscientiousness is associated with reliability, planning, and persistence, while low conscientiousness is associated with impulsivity, disorganization, and less self-control. Negative emotionality or neuroticism reflects a tendency to experience negative emotions such as anxiety, sadness, irritability, and emotional instability. High scores are associated with greater vulnerability to stress, while low scores indicate emotional stability and resilience. Openness to experience describes cognitive and experiential openness, interest in new ideas, aesthetic experiences, and intellectual exploration. Highly open individuals are curious, creative, and tolerant of novelty, while low open individuals are more traditional and pragmatic.

A short version of the BFI-2 was added to the other questions in the online questionnaire. It was selected because it exceeds the minimum criterion that still allows for satisfactory measurement validity. The authors recommend that the BFI-2-S be used only on samples with an N of at least 400 (Soto and John, 2017). Since the N of participants in the presented study is 1060, the use of the short version of the questionnaire is methodologically justified and practically meaningful.

Procedure

After completing the final draft of the online questionnaire, the researchers met and reviewed the questionnaire again, this time as a whole. Once consensus was reached on the individual items, it was uploaded to the 1KA web portal. Participants were invited to take part in the survey via email using the snowball method. The survey was available for three months (from September 9 to December 9, 2025). We analysed the data matrix using SPSS v31.

Results

Data verification, primarily a visual inspection of histograms of variable value distributions, revealed significant deviations from normality in all variables used to determine participants' attitudes toward e-scooters and their users. In addition, these variables are ordinal and bipolar, so ordinal logistic regression and Spearman's correlation coefficient were used in the data analysis. The variables used to determine personality traits are approximately normally distributed. The age and gender of the participants did not significantly influence the findings.

There are no statistically significant differences in personality traits between users and non-users of e-scooters. Independent sample t-tests and effect size (Cohen's d) show that there is no difference in extraversion ($t(1055) = -.45, p = .68, d = -.04$), agreeableness ($t(1051) = 1.56, p = .12, d = .15$), conscientiousness ($t(1047) = -.50, p = .61, d = -.05$), negative emotionality ($t(1048) = -.35, p = .72, d = -0.03$) and openness ($t(1051) = 0.07, p = 0.95, d = 0.01$).

Table 131 Table 2: Statistically significant correlations (Spearman's coefficient ρ) between personality traits and opinions about e-scooters and their users.

	Personality traits				
	EXT	AGRE	CONS	NEG	OPEN
Useful - useless					

Opinion on e-scooter	Modern - outdated								
	Safe - dangerous								
	Ecological - non-ecological								
Opinion on e-scooter users	Young - old								
	Safe - dangerous								
	Smart - foolish								
	Responsible - irresponsible								
	Cautious - reckless								
	Predictable - unpredictable								

Notes. EXT: extraversion; AGRE: agreeableness; CONS: conscientiousness; NEG: negative emotionality; OPEN: openness

Table 3: Predicting attitudes toward e-scooters using personality traits (ordinal logistic regression).

Dependant var.	Predictor	χ^2 (p)	Beta	SE	Wald	p	OR	TPL: χ^2 (p)
Usefulness	EXT		,003	,017	,041	,839	1,003	
	AGRE		-,008	,018	,205	,650	0,992	
	CONS	1,524 (,910)	,021	,019	1,274	,259	1,021	54,027 (,021)
	NEG		,003	,016	,025	,874	1,003	
	OPEN		-,002	,016	,014	,907	0,998	
Modern	EXT		,025	,017	2,224	,136	1,025	
	AGRE		-,027	,018	2,118	,146	0,973	
	CONS	25,17 (,001)	-,067	,019	12,745	,001	0,935	331,733 (,001)
	NEG		-,001	,016	,002	,968	0,999	
	OPEN		,018	,017	1,225	,268	1,018	
Safety	EXT		-,019	,017	1,252	,263	0,981	
	AGRE	27,763 (,001)	,003	,019	,033	,855	1,003	41,717 (,202)
	CONS		,082	,019	18,023	,001	1,085	

	NEG		-,017	,017	1,026	,311	0,983	
	OPEN		-,013	,017	,571	,450	0,987	
	EXT		-,013	,017	,620	,431	0,987	
	AGRE		-,014	,018	,607	,436	0,986	
	CONS		-,049	,019	6,984	,008	0,952	
	NEG		-,010	,016	,366	,545	0,990	
Ecological	OPEN	12,821 (,025)	,024	,016	2,223	,136	1,024	35,125 (,462)
	AGRE		-,010	,019	,309	,578	0,990	
	CONS		,084	,019	19,356	,001	1,087	
	NEG		,029	,017	3,059	,080	1,029	
	OPEN		,029	,017	2,902	,088	1,029	

Notes. EXT: extraversion; AGRE: agreeableness; CONS: conscientiousness; NEG: negative emotionality; OPEN: openness. OR = Odds Ratio. TPL: Test of Parallel Lines.

Table 132 Table 4: Predicting attitudes toward e-scooter users using personality traits (ordinal logistic regression).

Dependant var.	Predictor	χ^2 (p)	Beta	SE	Wald	p	OR	TPL: χ^2 (p)
	EXT		,038	,017	5,185	,023	1,038	
	AGRE		-,009	,018	,215	,643	0,991	
Age	CONS	12,142 (,033)	-,043	,019	5,265	,022	0,957	26,689 (,842)
	NEG		-,001	,016	,000	,999	0,999	
	OPEN		-,011	,017	,438	,508	0,989	
Safety	EXT	30,291 (,001)	-,019	,017	1,241	,265	0,981	28,508 (,773)

	AGRE		-,001	,019	,002	,967	0,99	
	CONS		,084	,019	19,154	,001	1,087	
	NEG		-,019	,017	1,236	,266	0,981	
	OPEN		,001	,017	,004	,952	1,001	
	EXT		-,004	,017	,070	,792	0,996	
	AGRE		-,017	,018	,867	,352	0,983	
Relevance	CONS	10,050 (,074)	,039	,019	4,318	,038	1,039	44,018 (,141)
	NEG		,018	,016	1,167	,280	1,018	
	OPEN		,033	,017	3,900	,048	1,033	
	EXT		-,006	,017	,115	,734	0,994	
	AGRE		-,021	,018	1,346	,246	0,979	
Responsibility	CONS	19,819 (,001)	,072	,019	14,841	,001	1,074	28,903 (,758)
	NEG		,010	,016	,402	,526	1,010	
	OPEN		,024	,017	2,028	,154	1,024	
	EXT		,002	,017	,010	,922	1,002	
	AGRE		-,018	,018	,956	,328	0,982	
Caution	CONS	23,109 (,001)	,068	,019	12,952	,001	1,070	26,282 (,856)
	NEG		,002	,016	,011	,916	1,002	
	OPEN		,032	,017	3,638	,056	1,032	
	EXT		,010	,017	,351	,553	1,010	
Predictability	AGRE	32,215 (,001)	-,010	,019	,309	,578	0,990	35,313 (,453)
	CONS		,084	,019	19,356	,001	1,087	

NEG	,029	,017	3,059	,080	1,029
OPEN	,029	,017	2,902	,088	1,029

Notes. EXT: extraversion; AGRE: agreeableness; CONS: conscientiousness; NEG: negative emotionality; OPEN: openness. OR = Odds Ratio. TPL: Test of Parallel Lines.

Conclusion

As can be seen in Tables 3 and 4, all OR values are very close to 1.00, which means that predictors or personality traits have no significant effect on opinions about e-scooters or their owners, as observed in the study. Among the personality dimensions, conscientiousness stands out somewhat, having some statistically significant effects, but these are negligible (Tables 3 and 4). Table 2 shows the existence of statistically significant correlations, which is not surprising in such a large sample. Although statistically significant, they are lower than 0.30, so they can be classified as weak (Cohen, 1988) and practically useless. This means that personality traits most likely do not influence opinions about the use of e-scooters and their owners.

The survey covered 1,060 participants, but there were few scooter users among them—about 150. Since data on how many e-scooters are sold in Slovenia and how often they are rented are not available, we cannot know whether the sample of e-scooter users is representative. Thus, conclusions about the personality traits of e-scooter users can only be made at the level of speculation, and based on the results obtained, it is reasonable to expect that personality traits are not related to the use of e-scooters, at least not significantly.

What is the practical significance of these findings? From the perspective of policymakers or regulators of e-scooter use, the findings may be good news. They suggest that personality traits do not influence attitudes toward e-scooter users and e-scooter use, which makes it easier to design appropriate strategies or methods for regulating e-scooter use. One of the more difficult to determine and predict variables – an individual's personality traits – can be excluded from the equation of mutual influences. Without knowledge of these, social influence and other measures can be used to achieve the desired goals related to traffic safety and the use of e-scooters in general. Of course, we must not neglect other personality traits, such as age or personality maturity, which are nevertheless worth considering, but are not examined in this part of the study.

QUALITATIVE ANALYSIS OF OPEN-ENDED QUESTIONS

N = 60 respondents answered the open-ended question Q36 ("What is your opinion on electric scooters? Consider their safety, infrastructure for use, legislation and awareness, social acceptability, user experience, motivation, and usefulness"). The analysis covered all open-ended responses received from both versions of the survey. The responses were mostly short and focused on specific aspects of the use of electric scooters in traffic.

The responses were analysed using inductive thematic coding, which means that the thematic categories were not predetermined but were formed on the basis of recurring content in the respondents' answers. First, all responses were reviewed, then content patterns were identified, and only then were thematic clusters formed. A single response could contribute to several themes at the same time.

The analysis showed that respondents' opinions focused on issues of safety, user behaviour, and regulation of electric scooter use.

The most frequently mentioned topic was safety. In 42 of the 60 responses, electric scooters were directly or indirectly described as dangerous, threatening, or risky. The danger is mostly not attributed to the vehicle itself, but to the circumstances of use and the shared use of traffic areas with other participants, especially pedestrians. Respondents often mention a feeling of vulnerability and concern for vulnerable groups in traffic.

Closely related to safety is the issue of irresponsible user behaviour, which appears in 38 responses. Electric scooter users are described as reckless, too fast, unpredictable, and often disregarding traffic rules. Several responses state that the problem is not electric scooters as a means of transport, but the way they are used. This distinction between technology and users indicates that some respondents do not reject the technology itself.

Thirty-one responses highlight inadequate legislation and supervision. Respondents cite the lack of effective supervision, disregard for speed limits, and technical modifications to e-scooters. There are frequent suggestions for the introduction of stricter rules, such as registration, mandatory protective equipment, technical inspections, exams, or special permits. A smaller number of responses also call for a partial or complete ban on the use of electric scooters.

The topic of infrastructure and spatial conflicts appears in 17 responses. Respondents point to the unclear demarcation of traffic areas and the unpredictable movement of e-scooters between sidewalks, bike lanes, and roadways. In their opinion, this increases risk and reduces the sense of safety in urban areas.

Fourteen responses specifically mention the age of users, particularly concerns about underage and very young riders. These responses often refer to immaturity, lack of

knowledge, and greater exposure to injury, which further contributes to the negative perception of e-scooters.

Despite the predominantly critical tone, 19 responses also recognize the usefulness of electric scooters, but generally in a conditional form. Respondents cite practicality over shorter distances, the possibility of combining them with other forms of transport, and their potential role as an alternative to cars for certain journeys as advantages. At the same time, they almost consistently emphasize that such usefulness is acceptable mainly with a more clearly organized infrastructure, stricter rules, and more effective supervision, as well as responsible behaviour on the part of users.

Twenty-one responses expressed rejection of electric scooters, with claims that they are unnecessary, disruptive, or should be banned. Environmental aspects are rarely mentioned and were noted in 4 responses, where respondents mainly pointed to batteries and questionable sustainability compared to walking or cycling.

Overall, the open responses reveal a distinctly critical attitude among respondents towards the current use of electric scooters. The prevailing perception is that their use is not adequately regulated, supervision is ineffective, and user behaviour poses a significant safety risk. At the same time, the analysis shows that complete rejection of the technology is not unanimous, as some respondents acknowledge its potential, but only under significantly changed systemic conditions.

The joined array of all verbatim responses to question Q36, providing additional transparency and insight into the qualitative data (translated from Slovenian with DeepL), is below:

- Unregulated and, as a result, too powerful
- Not safe, but less harmful to the environment than cars
- I don't like them. Most young drivers drive without thinking and too fast
- Negative
- I dislike them because I only hear news stories about children aged 13+ getting into accidents and suffering serious injuries or even death. I notice very immature behaviour among young people who use scooters.
- Dangerous, drivers drive recklessly (too fast), some drivers are too young
- They should be banned because people are not aware enough, they deliberately drive too fast (even when the person who is not holding the handlebars and is standing behind is shouting), they are loud, they force their way through and don't even warn you... they are dangerous. I really don't feel safe.
- They can be very useful, but in my opinion that is the only good thing about them. They are more harmful to the environment than regular scooters or bicycles because of their lithium-ion batteries, and those that are modified to go faster than they should can also be dangerous.

- I think they are dangerous, especially scooter riders who drive around at high speeds and without helmets. They bother me because they ride sometimes on the road and sometimes on the sidewalk and are very unpredictable. Otherwise, they are easy to use and do not take up much parking space; you can park them almost anywhere, but unfortunately, I consider scooter riders to be a danger on the roads.
- I have never ridden an e-scooter. I believe that the use of e-scooters should be prohibited until a certain age (e.g., until you can take your moped test). Therefore, I would not support education in primary schools as for bicycles, but rather as preventive workshops for the last three years of primary school (or only in the 8th and 9th grades). I would like the visibility of e-scooter riders to be regulated by law: reflective ...
- Society does not need them. Be nice ;)
- Very useful, add volume/sound when riding and introduce a test category.
- They are not dangerous in themselves, but e-scooter riders are.
- They are useful. Their safety depends on the users. In any case, they should be subject to the same traffic regulations as cyclists - they have no business on sidewalks, helmets are mandatory for minors...
- Dangerous
- Use should be limited based on: weather, distance, age, road or sidewalk, road or sidewalk maintenance, time of day
- Personally, I would ban them.
- Ban them for certain people
- Those that go up to 25 km/h are okay, but modified and faster ones are a problem
- Useful and appropriate with appropriate responsibility and user training
- The problem is not with e-scooters but with their users.
- They are very practical for certain routes, but they should be used strictly on bike paths like other motor-assisted vehicles and, of course, at a maximum speed of 25 km/h.
- They are okay, but there is not enough control over those who drive irresponsibly (too fast).
- Bad
- Dangerous to the environment
- The use and appearance of scooters is good and welcome, but there is not enough regulation.
- They are certainly practical, but they are dangerous and most of their drivers drive them much too fast and recklessly.
- It would be great if the people who use them were a little smarter and obeyed traffic regulations.
- Drivers are quite irresponsible, riding in the opposite direction, often significantly exceeding the speed limit (even over 80 km/h) ...
- Their use is perfectly acceptable if stricter rules and controls are introduced.
- Not safe enough

- They should be banned
- I dislike scooters; the people who ride them are reckless, driving at 70 km/h on the road without helmets or other safety equipment. When you try to pass a scooter with your car, the rider reacts arrogantly and starts driving in the middle of the lane, disregarding other traffic rules.
- I think they are dangerous and pointless.
- It's a fad and will pass.
- A necessary evil for some, but others should get rid of them.
- I am more against them.
- Scooters should be registered with a license plate, undergo an annual technical inspection, require the use of a protective helmet, and have a speed limit of 25 km/h.
- I don't have a particular opinion. I see them as another means of transport – if the driver is responsible, I would say they are safe to use.
- Not very good.
- I don't know.
- Negative.
- They are very popular among young people, who are often not careful enough in traffic.
- Special lanes would be useful.
- Bad, dangerous for other road users, especially children.
- I don't have one.
- They are not safe.
- They are not safe.
- Bad, there are already too many of them on the road.
- Very useful.
- Great alternative to a bike, because you can drive half the way, park at the P+R and continue to the center on a scooter. A bike, for example, doesn't fit in the trunk and you have to park your car in the center, but you can't walk that far, so with a scooter you can easily replace that part of the journey to the center and leave the scooter at the office. In the afternoon, you drive past the traffic to the park-and-ride, put the scooter in the trunk, and get home faster than if you had...
- They're not okay
- Electric scooters are practical and sustainable, but they require better infrastructure, clearer legislation, and greater attention to safety.
- For use, more control and registration
- Terrible
- Ban
- Most riders take riding too lightly
- I don't know
- I wouldn't ban them, but I would change the legislation, make helmets compulsory, set a maximum speed limit, etc.
- Very useful and practical in some cases

FUZZY ANALYTIC HIERARCHY PROCESS WITH A TEST GROUP

The use of electric scooters is rapidly spreading in urban environments and raises numerous questions related to safety, infrastructure, regulation, user experience, and social acceptability. Due to the diversity of factors involved and the often-conflicting interests of different stakeholders, there is a need for a systematic and structured approach to the factors influencing the use of electric scooters and their prioritization.

The purpose of the study was to identify the key factors influencing the use of electric scooters in urban environments and to determine their relative importance in a structured multi-criteria framework. The research was designed as a targeted study of perceptions and priorities among young people, based on the assessments of participants in the field of mobility, which enable an informed and consistent evaluation of the factors under consideration. This approach provides an in-depth insight into perceived priorities and provides a suitable starting point for further analysis and comparison with other stakeholder groups.

Methodology

The research methodology was based on a sequential combination of qualitative group methods and quantitative multi-criteria evaluation. The research process was conducted in two phases: in the first phase, criteria and sub criteria were formulated, and in the second phase, their relative importance was quantitatively evaluated using the fuzzy analytical hierarchical process (FAHP).

First phase: identification of criteria and definition of sub-criteria

In the first phase, a two-stage process was carried out to develop a hierarchical structure of factors. Master's students studying mobility participated in the study and subsequently acted as stakeholders in the multi-criteria evaluation. First, based on a review of the literature in the field of micromobility, the main criteria were defined that broadly describe the use of electric scooters in urban environments. These criteria formed the basis for further group discussion.

Subsequently, sub-criteria were developed within the defined main criteria using a modified focus group method in combination with the nominal group technique. The process began with individual work, in which participants independently proposed sub-criteria within

individual criteria. This was followed by a group discussion in smaller groups, during which participants coordinated their understanding of concepts, combined similar proposals, and formed content-consistent sets of sub criteria. The discussion was moderated and focused on clarifying meanings and structuring content.

In the final phase of the nominal group technique, participants ranked the sub criteria within each main criterion and identified priority sub criteria for inclusion in the FAHP model. The result of the first phase was a hierarchical structure consisting of main criteria defined on the basis of the literature and sub criteria developed with the help of FG and NGT.

Second phase: FAHP

In the second phase of the research, a fuzzy analytical hierarchical process was used. In this phase, the same participants acted as individual evaluators and performed pairwise comparisons of criteria and sub criteria within a predefined hierarchical structure. The evaluations were performed individually.

Based on the collected assessments, the weights of the criteria, the local weights of the sub criteria, and their global weights were calculated. The consistency of the pairwise comparisons was verified and confirmed. The individual steps of the FAHP method are presented below.

FAHP methodology step by step¹

1. Step 1: Construction of a hierarchical structure. Based on the results of the first phase, a hierarchical FAHP structure was developed, which includes the objective, six main criteria, and corresponding sub criteria.
2. Step 2: Pairwise comparisons and creation of sharp matrices. Experts performed pairwise comparisons using Saaty's scale, based on which sharp matrices of pairwise comparisons were created.
3. Step 3: Consistency check. The consistency ratio was calculated for all crisp matrices. All matrices were within acceptable limits and included in further analysis.
4. Step 4: Conversion to fuzzy matrices. Crisp values were converted to triangular fuzzy numbers using a predefined fuzzy scale.
5. Step 5: Aggregation of fuzzy judgments. The fuzzy judgments of individual experts were aggregated into group fuzzy matrices.

¹ Povzeto po: (Kramar, 2019; Kramar idr., 2019; Kramar & Sternad, 2025)

6. Step 6: Calculation of fuzzy weights. Fuzzy weights of criteria and sub criteria were calculated from the aggregated fuzzy matrices.
7. Step 7: Defuzzification. The fuzzy weights were converted into crisp values using the "best non-fuzzy performance" (BNP) method.
8. Step 8: Final ranking. Based on the defuzzified weights, the final ranking of criteria and sub criteria was performed.

Results

First phase

The result of the first phase of the research was the creation of a hierarchical structure of factors influencing the use of electric scooters in urban environments. Based on a review of the literature, the main criteria were defined, within which sub-criteria were formed and structured with the help of FG and NGT. The final model includes six main criteria: safety, infrastructure, user experience, legislation and awareness, motivation and usefulness, and social acceptability.

The structure of the criteria reflects the multidimensional nature of the phenomenon under consideration. Safety and infrastructure cover the physical and operational conditions of use, user experience and motivation are based on the perspective of the individual user, legislation and awareness represent the institutional framework, and social acceptability represents the broader social context of e-scooter use. This distribution has enabled a clear distinction between the different aspects of use and their further quantitative evaluation.

Table 133: Figure below shows the set of criteria and sub criteria used in the FAHP model.

Six main factors – criteria	What it means (short explanation)	Sub-criteria within the main criterion
Safety	How safe the user feels when using e-scooters and the level of exposure to risks.	Perceived feeling of danger while riding Frequency of or fear of accidents Conflicts with other road users (e.g. pedestrians, drivers) Use of protective equipment and personal caution
Infrastructure	Whether routes are suitable, e-scooters are accessible, and parking or docking areas are properly arranged.	Quality of surfaces (smoothness, asphalt, safety) Availability of dedicated lanes for e-scooters or bicycles Parking and storage options for e-scooters Accessibility of sharing systems (locations, density) Absence/presence of obstacles

Regulation and awareness	Whether rules are clear, well known, penalties appropriate, and users adequately informed.	Clarity and knowledge of rules and legislation Effectiveness of supervision and enforcement of sanctions Appropriateness of penalties and measures Information to users (campaigns, notifications)
Social acceptability	How the public perceives e-scooters and their use (tolerance, conflicts, social norms).	Public attitude towards e-scooter users Frequency of conflicts with other traffic participants Social perception (trendiness, stigma, environmental benefits) Tolerance of e-scooter users and non-users towards others in the traffic environment
User experience	How easy, reliable, and pleasant it is to use an e-scooter, including the app and vehicle condition.	Accessibility of e-scooters (location, availability) Functionality of the rental system app Technical reliability (battery, brakes, condition) Comfort and ergonomics while riding
Motivation and usefulness	Whether using an e-scooter is worthwhile for the user (speed, cost, sustainability, appeal).	Speed, ease, and flexibility of transport Price compared to other modes of transport Sustainability (environment, lower emissions) Fun and trendy to use

Results of the FAHP analysis at the level of main criteria

The results of the FAHP analysis at the level of the main criteria show the distribution of relative weights of factors influencing the use of electric scooters in urban environments (Figure 2). The criterion of safety has the highest weight (0.2456), followed by infrastructure (0.2242) and user experience (0.1812). The distribution of weights shows that the factors most highly valued in the participants' assessments are those related to the direct conditions of use and perceptions while riding.

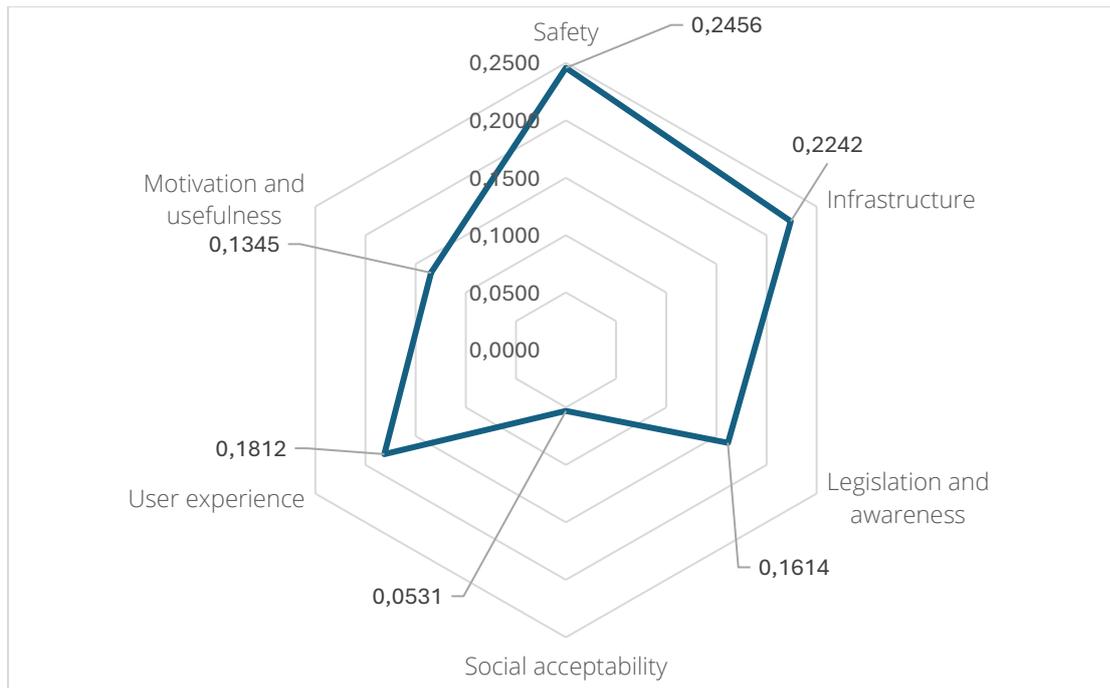


Figure 68: Importance of key criteria influencing the decision to use or not use e-scooters in urban environments

The criteria of legislation and awareness (0.1614) and motivation and usefulness (0.1345) have lower relative weights, but remain an important part of the overall model. Their position in the middle of the ranking indicates that normative and motivational aspects complement perceptions of use, rather than prevailing over safety and infrastructure factors. The lowest weight is achieved by the criterion of social acceptability (0.0531), reflecting its lesser relative role in the aggregate assessment of the main criteria.

The overall weight distribution shows a gradual decrease in relative importance from physical and operational conditions of use towards broader social and contextual factors..

Results of the FAHP analysis at the level of sub criteria and global weights

The following section presents the global weights and ranking of sub-criteria, which break down the results at the level of the main criteria in more detail. The global ranking of sub criteria shows that the top positions are mainly occupied by safety sub criteria, with infrastructure sub criteria and the technical reliability sub criterion from the user experience group also among the higher-ranked sub criteria.

The highest-ranked sub criteria are as follows: in 1st place is the feeling of insecurity while riding (0.0786), in 2nd place is the technical reliability of e-scooters (0.0634), in third place is the frequency or fear of accidents (0.0634), and in fourth place is the use of protective equipment and personal caution (0.0627). The distribution of the top rankings shows that the most important individual factors include safety aspects of risk perception, aspects of risk

management, and the technical aspect of e-scooter operation from the perspective of user experience.

Below, the results within individual criteria show which sub-criteria contribute most to their overall relative importance. In terms of infrastructure, the presence of separate lanes for e-scooters or bicycles (0.0619) and the quality of road surfaces (0.0585) are ranked higher, indicating the importance of spatial and technical conditions of use. Within the criterion of legislation and awareness, user information has the highest global weight (0.0508), while sub criteria related to control and sanctions are ranked lower. In the user experience criterion, the technical reliability of e-scooters stands out (0.0634), confirming that this set is not only related to digital support, but primarily to the performance and reliability of the vehicle.

The sub-criteria within the motivation and usefulness set achieve medium and lower global weights. Speed, ease, and flexibility of transport (0.0451) and price compared to other modes of transport (0.0446) are ranked in the middle, indicating their supporting role compared to safety, infrastructure, and experience factors. Social acceptability as a criterion achieves lower global weights, but within this group, the frequency of conflicts with other traffic participants (0.0232) stands out, indicating that social aspects are most relevant where they are directly reflected in interactions and perceptions of safety.

The results at the sub criteria level complement the findings at the main criteria level and provide a more detailed insight into the distribution of relative priorities within the entire FAHP model.

Table 134: Weighting of criteria, sub criteria, and global weights

Criteria name	Criteria weight	Rank	Sub criteria	Sub criteria weight	Rank	Generic weight	Final rank
Safety	0,2456	1	Perceived feeling of danger while riding	0,3200	1	0,0786	1
			Frequency of or fear of accidents	0,2579	2	0,0634	3
			Conflicts with other road users (e.g. pedestrians, drivers)	0,1669	4	0,0410	14
			Use of protective equipment and personal caution	0,2552	3	0,0627	4
Infrastructure	0,2242	2	Quality of surfaces (smoothness, asphalt, safety)	0,2608	2	0,0585	6
			Availability of dedicated lanes for e-scooters or bicycles	0,2759	1	0,0619	5

			Parking and storage options for e-scooters	0,0955	5	0,0214	21
			Accessibility of sharing systems (locations, density)	0,1436	4	0,0322	16
			Absence/presence of obstacles	0,2242	3	0,0503	8
Legislation and awareness	0,1614	4	Clarity and awareness of rules and legislation	0,2880	2	0,0465	10
			Effectiveness of monitoring and enforcement of sanctions	0,1932	4	0,0312	17
			Appropriateness of penalties and measures	0,2041	3	0,0329	15
			Informing users (campaigns, notices)	0,3148	1	0,0508	7
Social acceptability	0,0531	6	Public attitude towards e-scooter users	0,1330	3	0,0071	24
			Frequency of conflicts with other traffic participants	0,4369	1	0,0232	20
			Social perception (trendiness, stigma, environmental benefits)	0,1312	4	0,0070	25
			Tolerance of e-scooter users and non-users towards others in the traffic environment	0,2989	2	0,0159	22
User experience	0,1812	3	Accessibility of e-scooters (location, availability)	0,2693	2	0,0488	9
			Functionality of the rental system app	0,2288	3	0,0415	13
			Technical reliability (battery, brakes, condition)	0,3497	1	0,0634	2
			Comfort and ergonomics while riding	0,1521	4	0,0276	19
Motivation and usefulness	0,1345	5	Speed, ease, and flexibility of transport	0,3355	1	0,0451	11
			Price compared to other modes of transport	0,3320	2	0,0446	12
			Sustainability (environment, lower emissions)	0,2228	3	0,0300	18
			Fun and trendy to use	0,1098	4	0,0148	23

Discussion

The results of the study show that participants assess the use of electric scooters in urban environments primarily through the prism of perceived safety and infrastructure conditions for use. The highest-ranked sub-criteria are related to subjective feelings of vulnerability,

perceived risk, and the technical reliability of e-scooters, which shows that direct experiences in real traffic environments are the main basis for forming opinions about the use of micromobility.

Particularly noteworthy is the fact that the subjective feeling of vulnerability has a higher global weight than formal regulatory aspects or broader social acceptability. This indicates that perceptions of safety are not merely a consequence of the existence of rules or controls, but primarily the result of actual interaction between the user, the vehicle, and the traffic environment. In this context, the high ranking of the technical reliability of e-scooters is important, as it links safety perceptions to the reliable operation of the vehicle and thus to the reduction of unpredictable risks.

The weighting of the infrastructure sub-criteria further confirms the importance of the physical layout of the space. The presence of separate paths and the quality of road surfaces are highly ranked, indicating that infrastructure does not function merely as a supporting element, but as a key factor that also indirectly influences the perception of safety and comfort of use. Infrastructure aspects thus appear as a connecting element between safety and user experience.

In terms of legislation and awareness, the results show that informing users is relatively more important than monitoring and sanctioning. This indicates that softer regulatory approaches that increase understanding of rules and expectations are perceived as more relevant to the use of e-scooters than repressive measures. Similarly, the user experience shows that it is not limited to the digital interface or accessibility of the service, but is primarily associated by participants with technical reliability and flawless vehicle performance.

The relatively lower global weight of the criteria of motivation and usefulness and social acceptability does not mean that they are irrelevant, but rather that these aspects only gain weight once the basic conditions of safety and infrastructure are met. This is also confirmed by the example of social acceptability, where the overall criterion has a low weight, while the sub-criterion of conflict frequency has a higher relative importance. This distribution shows that social aspects become relevant primarily when they directly affect the perception of safety and quality of use.

From a methodological perspective, the results confirm the appropriateness of the sequential combination of FG, NGT, and FAHP, which allows for a clear distinction between the content identification phase and the quantitative prioritization phase. This approach allows for the inclusion of content-based and structured factors in FAHP, which increases the interpretability and analytical value of the results. The discussion thus confirms that the selected methodological framework provides an in-depth insight into the perceived priorities of the informed target group and represents a solid starting point for further comparative research.

Conclusion

The study provided a structured insight into the perceived factors influencing the use of electric scooters in urban environments and their relative importance from the perspective of young stakeholders in the field of mobility. Using a sequential combination of qualitative group methods and quantitative multi-criteria evaluation, a hierarchical model was developed that allows for a transparent and comparable treatment of the multidimensional phenomenon of micromobility.

The FAHP results show that the factors most highly rated by participants are those related to perceived safety, infrastructure conditions, and the technical reliability of e-scooters. The highest-ranked sub criteria are mainly from the safety cluster, with infrastructure sub criteria and the technical reliability sub criterion from the user experience cluster also appearing among the top rankings. This distribution shows that direct experience in the traffic environment and vehicle performance are key factors in forming opinions about the use of e-scooters.

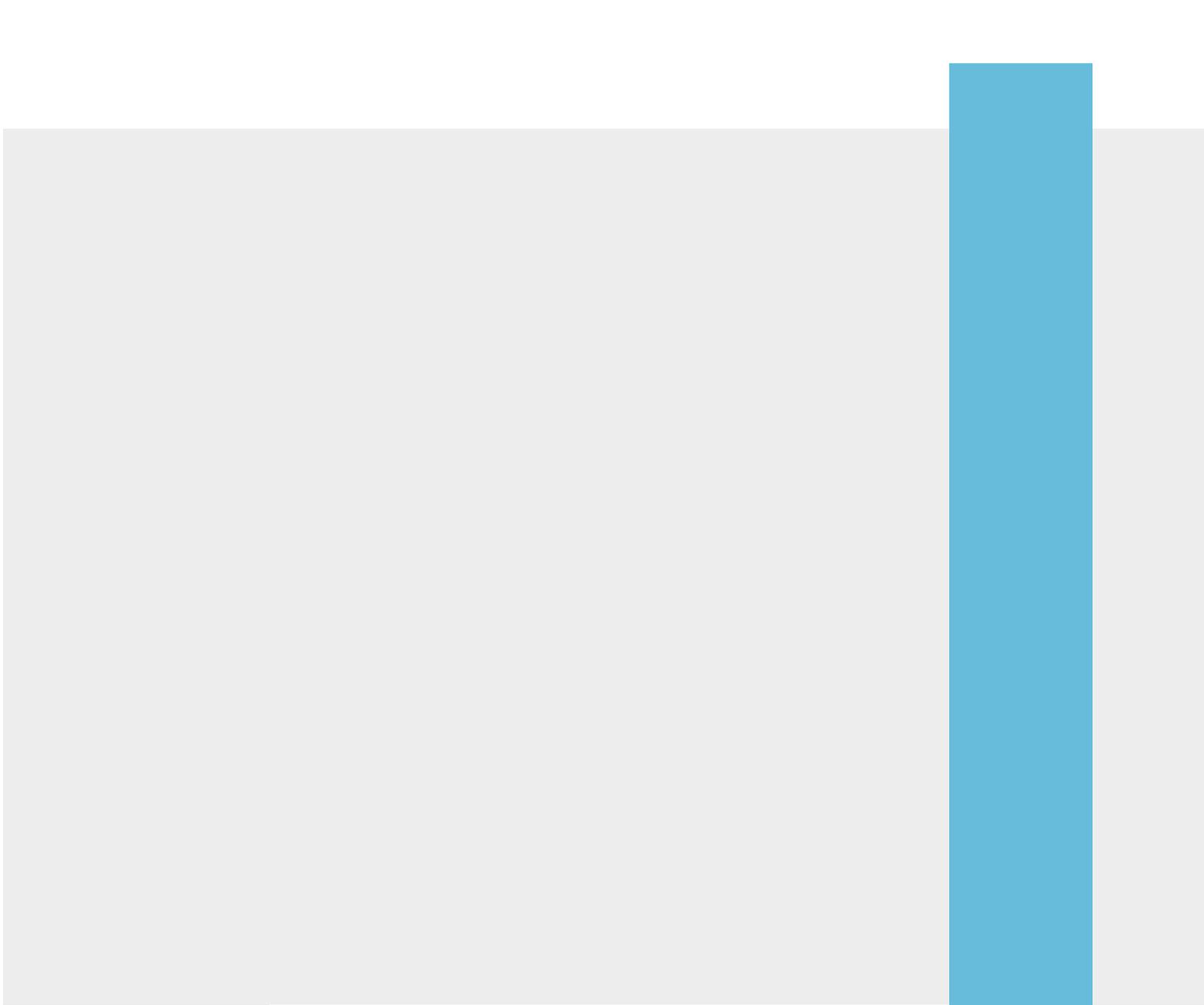
The lower weightings of criteria related to motivation, usefulness, and social acceptability do not mean that they are unimportant, but rather indicate that these aspects gain greater weight when the basic conditions of safety and adequate infrastructure are met. This is also confirmed by the fact that individual sub-criteria within otherwise lower-ranked criteria are ranked relatively high when they are directly related to risk perception or quality of use.

Methodologically, the study confirms the usefulness of combining FG, NGT, and FAHP for addressing complex micro-mobility issues. This approach enables the systematic identification of factors, their structuring, and quantitative prioritization, while maintaining the transparency and interpretability of the results. The model developed represents an analytical starting point that can be used in further research, particularly in comparisons of perceptions and priorities among different stakeholder groups or in monitoring changes over time.

In conclusion, we can say that the report contributes to a better understanding of the perceived priorities for the use of electric scooters in urban environments and provides a structured basis for further research, analytical, and discussion approaches in the field of micromobility.

REFERENCES

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.
- Kramar, U. (2019). Celovitejši pristop k planiranju urbanega mobilnostnega sistema na osnovi mehkega večkriterijskega odločitvenega modela: Doktorska disertacija [Thesis, [U. Kramar]]. <https://dk.um.si/lzpisGradiva.php?id=75807>
- Kramar, U., & Sternad, M. (2025). Integrating Participatory Approaches and Fuzzy Analytic Hierarchy Process (FAHP) for Barrier Analysis and Ranking in Urban Mobility Planning. *Sustainability*, 17(4), 1558. <https://doi.org/10.3390/su17041558>
- Kramar, U., Dragan, D., & Topolšek, D. (2019). The Holistic Approach to Urban Mobility Planning with a Modified Focus Group, SWOT, and Fuzzy Analytical Hierarchical Process. *Sustainability*, 11(23), Article 23. <https://doi.org/10.3390/su11236599>
- Soto, C. J., & John, O. P. (2017). Short and extra-short forms of the Big Five Inventory–2: The BFI-2-S and BFI-2-XS. *Journal of Research in Personality*, 68, 69-81. <https://doi.org/10.1016/j.jrp.2017.02.004>



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