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Attitudes Towards E-scooter Safety – A Survey in Five Countries

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ABSTRACT: E-scooters are quite popular among young people in big cities. Their use seems to be a well-studied phenomenon. This study concentrates on the risky behaviour of e-scooter riders and on e-scooter riders' and non-riders' attitudes towards risky e-scooter riding. The goals were to describe these attitudes and to describe the most common types of risky e-scooter behaviours in five participating countries. An online questionnaire was developed and distributed in Australia, Belgium, the Czech Republic, Sweden, and Norway from June to September 2020. Respondents were recruited through sponsored Facebook ads and participant sharing (snowball sampling).

The riders in the countries considered in this study tend to perceive e-scooters as being quite safe. The majority of them even think e-scooters pose no danger to other road users. On the other hand, the non-riders believe riding an e-scooter is rather unsafe, with the exception of Belgium, where the respondents tend to think that it is very unsafe. When risky behaviour is considered, the non-riders tend to report more risky behaviour than e-scooter riders, even though fact-based observable behaviour, e.g. helmet use, should in principle be the same across both groups. In addition, as the existing literature shows, evidence suggests that young riders and male riders engage in more risky riding behaviours in comparison to older and female riders. This phenomenon should be addressed by effective preventive programmers and campaigns. The data shows that a greater frequency of riding predicted more risky riding behaviours. Although there are some differences between the samples under study, these findings can inspire police officers to promote e-scooter safety behaviour.

KEYWORDS: Risky behaviour; Traffic safety; Micromobility; E-scooters; Traffic psychology.

1. INTRODUCTION

Shared micro-mobility, or the shared use of low-speed transportation options for short distance trips represent a new and popular phenomenon in many countries all over the world for over 15 years. These modes of transportation, which might include bicycle sharing and scooter sharing among others, may provide one solution of traffic congestions in cities and may satisfy the need for a cheap, fast, and flexible way of getting round in cities with frequent junctions (Schellong et al., 2019). In 2012 the first startup was launched and short-range vehicles for getting around San Francisco were proposed for (Lawler, 2012). Since that time shared e-scooters have gained great popularity. In the US people in 2018 took 38.5 million (mil.) trips on shared e-scooters and shared e-scooters became more popular than shared bikes. By that time e-scooter sharing systems were available in about 100 different US cities (NACTO, 2018). Later, in 2022 Europeans took 350mil. trips on shared e-scooters, which increased by 45.7% in 2021 (Micro-Mobility for Europe, 2023 in Pinheiro, 2023). In the same year, Czech residents made 2.25 mil. kilometres (km) on shared e-scooters Bolt (Dopravní noviny, 2022). In Norway, the situation is different, as there are some regulations in cities, e.g. since 2021 only 8,000 shared e-scooters are permitted in Oslo (Aarhaug, 2023; Fearnley et al., 2021). Similarly, Swedish capital city Stockholm posed some regulations on shared e-scooters, so that there can be 12,000 shared e-scooters in the whole city (IAA Mobility, 2024). Even the Brussels Government decided that only 8,000 e-scooters can be provided in Brussels instead of current 20,000 (Chini, 2023). According to the Brisbane's e-mobility strategy, shared e-scooters are promoted as beneficial and by the end of the year 2021 there were 2,350 e-scooters (Brisbane City Council, 2023).

As these systems continue expanding, people face cultural, climatic, operational, economical and safety concerns. No wonder, these new means of transport has gained attention of policy makers and researchers started to pay attention to this subject. Research evidence proposes that e-scooter usage has risen dramatically all over the world with a corresponding increase in trauma. There is an increasing number of studies interested in the type of e-scooter injuries and their prevalences (e.g., Aizpuru et al., 2019; Badeau et al., 2019; Bekhit et al., 2020; Dhillon et al., 2020; Schlaff et al., 2019; Rashed et al., 2022; Sikka et al., 2019; Trivedi et al., 2019). Only some studies (Fitt and Curl 2020; McQueen, 2020; Useche et al., 2022) have examined the psychosocial characteristics of e-scooter riders such as attitudes and risk taking and social norms. No research papers were found that examined e-scooter riders' and non-e-scooter-riders' attitudes towards e-scooter safety through five countries: Australia, Belgium, the Czech Republic, Norway and Sweden or alone in the Czech Republic or alone in each country under study.

The study aims to investigate e-scooter riders' and non-e-scooter-riders' attitudes towards e-scooter safety in five countries: Australia, Belgium, the Czech Republic, Norway and Sweden. Therefore, a survey was conducted during July–October

2020 to shed light on the e-scooter safety issues in studied countries. This paper has four main contributions: 1) investigate e-scooter riders' attitudes towards e-scooter safety, 2) explore non-e-scooter-riders' attitudes towards e-scooter safety, 3) provide knowledge of the most common types of e-scooter risky behaviour, 4) find out whether e-scooter riders' attitudes towards e-scooter safety relate to their risky behaviour. The novelty of this paper is in the possibility of comparing the data among five countries.

2. LITERATURE SURVEY

Research papers discussing e-scooter phenomenon has emerged recently. Researchers are interested in sociodemographic characteristics of e-scooter riders, in the e-scooter usage patterns, in sustainability of e-scooters and in attitudes towards e-scooters. These findings can help policymakers to promote safer traffic.

As regard to the sociodemographic characteristics, literature agrees on that young men with higher income prefer using e-scooters than others. McKenzie (2019) discovered that city regions in Washington, D. C. with little or no e-scooter-sharing activity are usually home to the lowest-income families. According to an online survey from Vienna, the majority of e-scooter riders are men (75%) between 26 and 35 years of age, with high education (university students or alumni, 62%), living in Vienna. In the group of e-scooter owners, males prevail: in one study only one respondent owner out of 34 was a woman (Laa & Leth, 2020). Similarly, e-scooter riders from South Korea tend to be younger and higher earners (Lee et al., 2021).

E-scooters are viewed as very beneficial. The biggest benefit as well as the most common purpose of e-scooter rides is commuting to work/education and leisure activities (Hardt & Bogenberger, 2019; Laa & Leth, 2020; McKenzie, 2019; Reinhardt & Deakin, 2020; Radics et al., 2020; Smith & Schwieterman, 2018; Zou et al., 2020). E-scooters are thought to be joyful, timesaving, and money-saving for short journeys in big cities (0.5–4 km). For that reason, e-scooters often represent the "first/last mile" mode of transportation with an average duration of 8–13 minutes (min.) (Mathew et al., 2019; Nikiforiadis et al., 2023; Radics et al., 2020; Smith & Schwieterman, 2018; Zou et al., 2020). To complete the list of benefits, German respondents appreciated easy parking in comparison with cars and a reduction of noise pollution (Hardt & Bogenberger, 2019; Kopplin et al., 2021). Javadinasr et al. (2022) concluded that the most salient factor determining the choice of a shared e-scooter for respondents from Chicago was its perceived usefulness.

E-scooters are also promoted and viewed as an environment-friendly means of transport (Allem & Majmudar, 2019; Mitra & Hess, 2021; Kopplin et al., 2021), despite the fact that shared e-scooters are not yet environmentally beneficial as they can cause 202 grams CO_2-eq/passenger-mile; more than an electric moped (119 grams), electric bicycle (40 grams), and even a diesel bus (82 grams) (Hollingsworth et al., 2019). Furthermore, e-scooters mainly replace active traffic modes, and therefore their impact will always be negative (Moreau et al., 2020). Although e-scooters might be a strong alternative to cars for short distances and can fill in a gap in public transport, they replace walking most often, public transport less, and the car least often (Kopplin et al., 2021; Laa & Leth, 2020; Reinhardt & Deakin, 2020).

Despite their popularity, e-scooters have some disadvantages: bad performance in hilly areas or on brick-lined streets, weather dependency, baggage restrictions, the number of travellers, charging infrastructure, and keeping the e-scooter in good condition (in the case of private e-scooters) (Hardt & Bogenberger, 2019; Sanders et al., 2020; Shellong et al., 2019). Some researchers have pronounced safety issues to be a major inconvenience (Hardt & Bogenberger, 2019; Reinhardt & Deakin, 2020). There is an increasing number of studies interested in e-scooter safety, specifically in the type of e-scooter injuries and their prevalence, as well as in healthcare costs resulting from e-scooter crashes. Some studies also concentrate on the impact of e-scooter accidents on public health and the potential severity of such injuries (Schlaff et al., 2019; Sikka et al., 2019). On the one hand, Aizpuru et al. (2019) found out the change in the incidence of e-scooter injuries in the USA between 2013 and 2017was not significant; however there was a notable 77% increase in scooter injuries for millennials from 2016 to 2017. On the other hand, Badeau et al. (2019) noted that after the launch of shared e-scooters in Salt Lake City, there was a 625% increase in e-scooter injuries. Dhillon et al. (2020) concluded that the increase in e-scooter-related injuries in Southern California in 2018 varied according to locations. The most common injuries are superficial soft tissue injuries and extremity and head injuries (Aizpuru et al., 2019; Badeau et al., 2019; Dhillon et al., 2020).

Research on e-scooter safety is not easy to be conducted due to the scarcity of empirical data as they are only recent and suffer from under-reporting. Few researchers have also studied risky (illegal) e-scooter-related behaviour. Such authors usually define risky behaviour as not wearing a helmet, using prohibited infrastructure, and carrying a passenger (doubling) (Haworth et al., 2021; Siebert et al., 2021). Drug use and smartphone use while riding are other characters that can be defined as the e-scooter risky behavior (Gioldasis et al., 2021). E-scooter risky behavior can be defined similarly as risky behaviors of electric bikes. According to Ma et al. (2019) and their literature review, the most frequent e-bike risky behavior characters are the illegal occupation of motor vehicle lanes, over-speed cycling, red-light running and reverse cycling.

Helmet use is rather low in e-scooter riders: a study from Brisbane, Australia, found out only 61% of riders on shared e-scooters had helmets (though helmet use is mandatory) in comparison with the 95% rate observed for private e-scooters (Haworth et al., 2021). The latest online survey by Haworth et al. (2024) found out that most non-use of helmets in a mandatory context seems to be situational and is one of a number of risky behaviors performed by riders. Other studies show lower rates: 2%–10.9% in California, USA (Arellano & Fang, 2019; Todd et al., 2019). Siebert et al. (2021) observed 777 shared e-scooters during 12 hours at three different places in Berlin and the helmet use rate was 0%. Further, they indicate a lack of efficacy of safety-related advice of shared e-scooter providers. Riding on footpaths is seen as another form of risky behaviour especially if it is forbidden or if an e-scooter rider violates the speed limit. Interestingly, Fitt & Curl (2019) found out that over 90% of e-scooter riders from New Zealand had ridden on a footpath for at least a part of their journey. However, most of them agreed the footpath was not suitable for an e-scooter ride. There is evidence that e-scooter riders in Paris "play" with traffic rules by dismounting their e-scooters (and they become pedestrians), which may create dangerous situations for other road users (Tuncer et al., 2020). Similarly, Siebert et al. (2021) found that 32% of 777 observed share riders violated existing road rules (e.g. using prohibited infrastructure, doubling). Moreover, Maiti et al. (2020) observed that the majority of close encounters between a pedestrian and an e-scooter rider happened on narrow pedestrian paths. To our knowledge, there is only one study dealing with doubling: Haworth et al. (2021) found that 14 shared e-scooters (out of 686) were being ridden by two riders. Gioldasis et al. (2021) report about risky behaviour in Paris: young and male e-scooter riders are more likely to ride an e-scooter in a risky manner (under the influence of alcohol or riding while using a smartphone). Furthermore, the length of the trip is associated with riskier behaviour.

Few studies also concentrate on the attitudes of the general public towards e-scooter riders and safety. The majority of e-scooter non-riders perceive e-scooter riding as risky and unsafe. Three quarters of non-e-scooter riders from New Zealand see footpaths as an unsuitable environment for e-scooter use (Fitt & Curl, 2019). Likewise, 56% of the respondents from Rosslyn, Virginia, reported feeling unsafe or very unsafe around dockless e-scooter riders compared to riders of other modes of transport. Specifically, 76% of those respondents with no experience with e-scooter riding stated that they felt unsafe or very unsafe when walking around e-scooter riders (James et al., 2019). Similarly, (Buehler et al., 2021) stated that 43% of non-rider pedestrians reported feeling unsafe walking around e-scooters. Both riders and non-riders would prefer more separate spaces (e.g. bike lanes) for e-scooters. Pedestrians from New Zealand perceive e-scooter riders as threatening their safety, whilst e-scooter riders stated that they used the path considerately (Gibson et al., 2021). Che et al. (2021) highlighted that pedestrians felt less safe in general in comparison with e-scooter riders. The same authors also studied anger levels and revealed that most pedestrians were annoyed by an e-scooter approaching at 20 km/h; however, there was no difference in the anger level between speeds of 10 km/h and 15 km/h. Useche et al. (2022) even found out that, non-riders perceived e-scooter riders as significantly 'worse' riders than cyclists.

Non-riders of e-scooters in five different countries tended to report that riding an e-scooter is rather dangerous (Šucha et al., 2023). Finally, safety issues might be the most common barrier to e-scooter usage (Glavić et al., 2021; Nikiforiadis et al., 2021; Sanders et al., 2020). Almannaa et al. (2021) found safety (49%) to be a major obstacle to the deployment of e-scooters in Saudi Arabia. Similarly, according to Greek university students, increased perceived safety of the infrastructure enhanced the probability of choosing an e-scooter (Nikiforiadis et al., 2023). This might not be a surprise as risky behaviours are considered to be key contributors to e-scooter crashes (Useche et al., 2022). Conversely, Kopplin et al. (2021) considered that the perceived safety risk did not have a significant influence on the intention to use an e-scooter (even if e-scooter owners evaluated the perceived risk as lower than non-owners did).

On the basis of the state of the art presented above, we can conclude that the topic of e-scooters, mobility, and traffic safety has been solidly discussed in the literature in the last seven years. The research focuses mainly on micromobility patterns and temporal usage patterns, traffic safety (e.g. the occurrence of crashes and the type of accidents), sustainability, and traffic mode shift (e.g. the replacement of car trips with e-scooters). There is an apparent absence of studies examining e-scooter riders' attitudes towards e-scooter safety, which is crucial for understanding e-scooter risky behaviour. Similarly, little is known about other road users' attitudes towards e-scooter riders and e-scooter safety in studied countries

3. AIMS OF THE STUDY

This paper attempts to close the gap described above by providing insights into the data from Australia, Belgium, the Czech Republic, Norway, and Sweden regarding e-scooter riders' and non-riders' attitudes towards e-scooter safety. The goals are to describe e-scooter riders' attitudes towards e-scooter safety and to describe the most common types of risky e-scooter behaviour.

The study aims to answer the following questions: 1. What are e-scooter riders' attitudes towards e-scooter safety? 2. What are non-e-scooter-riders' attitudes towards e-scooter safety? 3. What types of risky behaviour have e-scooter riders experienced? 4. Do riders' attitudes towards e-scooter safety relate to their risky behaviour?

4. METHODS AND PROCEDURE

The results of an online questionnaire survey of e-scooter riders in five countries are presented in this study. The study was first suggested in Belgium and subsequently developed in conjunction with e-scooter researchers in other countries who were financed independently. Researchers from Australia (Queensland University of Technology (QUT), Brisbane), Belgium (the VIAS Institute), the Czech Republic (Palacky University, Olomouc), Norway (Institute of Transport Economics (TØI)), and Sweden (Chalmers University of Technology) collaborated on the study. As the data was collected anonymously, there was no need for institutional ethical approval in the Czech Republic, Belgium, and Sweden. Ethical approval was obtained in Australia and Norway.

4.1 The questionnaire

The questionnaire survey approach is widely used in traffic safety research (Ma et al., 2019). The entire questionnaire contains items from ISAAC, items from a pilot survey of TØI, items from ESRA 2 and new items created for this questionnaire. Questionnaire was developed based on the several focus groups of international experts, who were participating on the research. Before data collection, questionnaire was piloted. It aimed at riders' and non-riders' opinions about and experiences with e-scooters. It began with a series of screening questions to check that the participants were of legal age (18+) and resided in an eligible country.

Questions about general mobility patterns, attitudes towards e-scooters, environmental attitudes, barriers to more frequent use of e-scooters, interactions with other road and path users, near misses and crashes, risky and protective behaviours, knowledge, compliance, and support for e-scooter rules, and demographic characteristics were included in the questionnaire. In the past behaviour measure a time reference was given, so that the respondents would focus on the same period while answering. A master version of the questionnaire was created in English, with members of the study team translating it into French and Flemish (Belgian variants), Czech, Norwegian, and Swedish. The questionnaire was created using a variety of online survey tools, based on the study contributors' licensing. Except in Australia and in Sweden, it was necessary to answer all the questions.

4.2 Population

The study targeted adult population (18+), other criteria were not specified. Participants were recruited through sponsored Facebook ads and participant sharing (snowball sampling). While recruitment via social media is an efficient way of reaching a large number of people, however such samples may be underrepresentative/overrepresentative. In addition, recruitment via Facebook may have contributed to the participants' high level of education and an underrepresentation of older people.

The desired minimum number of respondents for each group was defined before launching the questionnaire (200 riders and 200 non-riders for each country). However, in some countries (e.g. Norway) the respondents were recruited quite fast (within two weeks) and in large numbers. In other countries (e.g. the Czech Republic), it took a longer time to obtain respondents and to have the sample balanced in terms of gender.

4.3 Data collection and its analysis

Data were collected throughout Europe during the period July–October 2020 and in Brisbane, Australia, during the period July–September 2020. During this period there were no COVID restrictions. The surveys were carried out individually in each nation, with data files provided to a Belgian partner who merged them into a single SPSS data file. The preparation of the questionnaires and the data collection process (e.g. using different online platforms to collect the data) in five different national versions, which in some cases led to minor differences in the coding and, furthermore, to complications when comparing (and interpreting) the data from different countries. Specifically, the main factors that complicated the comparison of data from different countries were: a somewhat different definition of e-scooter riders in Sweden than in the other countries (although, on the basis of the statistical analysis provided and the comparison between countries, we did not identify any indications which would suggest that the results were biased), forced answer design only in some of the participating countries, and differences in the national regulations which might have led to the different interpretation of some questions in the questionnaire.

The data analysis was conducted in R version 4.2.1. First, bar charts were used to explore the distribution of responses to questions regarding e-scooter safety attitudes depending on country in both e-scooter riders and non-riders. Then, we estimated a linear regression model predicting risky riding behavior in e-scooter riders based on gender, age, country, riding frequency and attitudes to safety. Finally, we compared the differences between predicted (conditional) means of countries in risky riding behavior using Tukey's HSD method to adjust for the family-wise error rate.

The study focuses on risky riding behaviour, attitudes toward safety and riding frequency. Risk riding behaviour and its frequency were measured with 11 items that asked respondents how often they had violated the traffic code over the last 30 days when riding an e-scooter. The respondents indicated the frequency of each behaviour using a five-point scale. The reliability estimate was $\alpha = 0.61$.Attitudes toward safety were measured with three items considering safety issues. Again, the respondents answered using a five-point rating scale from 1 to 5. The estimated reliability was $\alpha = 0.64$. The respondents were asked about riding frequency by means of two items. The reliability estimate was $\alpha = 0.87$. Both variables were computed as a mean of respective items. Descriptive statistics of these predictors for each country are provided in Table 5.

4.4 Participants

The study sample comprised a total of 3313 responses. The data was provided by respondents from Australia (n = 1041, 31%), Belgium (n = 308, 9%), the Czech Republic (n = 581, 18%), Norway (n = 865, 26%), and Sweden (n = 518, 16%). The general characteristics of the sample, presented separately for riders and non-riders, are summarised in Tables 2, 3, and 4.

There were 1453 e-scooter riders in total. Respondents were classified as e-scooter riders if they reported riding an e-scooter on at least "one to a few days per month at this time of year", except in Sweden, where respondents were classified as e-scooter riders if they reported "ever riding" an e-scooter. The proportions among countries differ, as shown in Table 2. The age of the riders (Table 3) ranged from 28 to 83 years (M = 36.7, SD = 11.8). There were age differences among the countries which were significant, $F(4, 1155) = 18.18$, $p< .001$, $\eta 2 = .06$. The Games-Howell post-hoc test showed that most of these differences were significant ($p< .05$), except for the differences between Norway, the Czech Republic, and Australia.

The total number of non-riders was 1860. Again, there are differences in proportions among the countries. The age of the non-riders ranged from 18 to 84 years (M = 39.9, SD = 14.5).

Risk riding behaviour
Over the last 30 days, how often did you ride an e-scooter...?
1. Never
2. At least once
3. Sometimes
4. Often
5. (Almost) always
a. while under the influence of alcohol
b. while under the influence of illegal drugs
c. with more than one person on the e-scooter
d. at a higher speed than walking (> 6 km /h) on the footpath
e. on areas forbidden to e-scooters or bicycles (e.g. motorways, tunnels)
f. through a red light
g. while talking on the phone
h. while looking at the phone (text messages, emails, videos, social medias, etc.)
i. while listening to music through headphones
j. without a helmet
k. in the dark without a reflective jacket
Attitudes toward safety
In general, how safe is it for you to use an e-scooter?
1. Very unsafe
2. Unsafe
3. Neutral
4. Safe
5. Very safe
In general, how safe is it for other road users when you're riding an e-scooter?
1. Very unsafe
2. Unsafe
3. Neutral
4. Safe
5. Very safe
To what extent is safety a barrier for you to use e-scooters more frequently?
1. No obstacle
2. Minor obstacle
3. Moderate obstacle
4. Important obstacle
5. Very important obstacle
Riding frequency
In the past 12 months, how often have you travelled by e-scooter?
1. One to a few days a year
2. One to a few days per month
3. One to a few days per week
4. At least 5 days per week
How often have you used an e-scooter over the last 30 days?
1. I haven't used an e-scooter the past 30 days
2. One to a few days
3. One to a few days per week
4. At least 5 days per week

Table 1: Items from the questionnaire

The age differences between the countries were significant, F(4, 1843) = 148.27, p< .001, η2 = .24. The Games-Howell post-hoc test showed that almost all of these differences were significant (p< .001) except for the difference between Australia and the Czech Republic (see Table 4).

In terms of sex, it can be concluded that males outnumbered females in the sample to a considerable degree, especially in Australia, Belgium, and Sweden, although the latter country recorded a great number of missing responses to this question. In terms of education, people with higher levels of education predominated in all the countries with the exception of the Czech Republic, where the distribution of responses with regard to the level of education is rather balanced. In terms of employment, respondents with employment ("employees") predominated in all the countries; a significant number of students participated in Australia. The representation of the respondents' domicile (suburban; urban) differed from country to country. In Australia and Belgium, the majority of the respondents were from suburban areas, in the Czech Republic, the representation was rather proportionate, and in Sweden and Norway, people residing in urban areas predominated among the respondents (in Sweden 43% of the respondents provided no answer for this question).

The percentages of submitted questionnaires which were incomplete varied dramatically, ranging from 0 (Norway and the Czech Republic) to 43% (Sweden). This is due to the different data collection and inquiry methods (different online questionnaire platforms) employed in the different countries (in Norway and the Czech Republic a forced-answer design was applied).

The numbers of questionnaires fully completed by riders and non-riders differed from country to country. In Australia, Belgium, and Norway more questionnaires were completed by non-riders and in the Czech Republic and Sweden the numbers were rather similar. In the further analysis presented in the Results section all the questionnaires (both complete and incomplete) were included in the analysis.

	Australia		Belgium		Czech Rep.		Norway		Sweden		TOTAL
	n	%	n	%	n	%	n	%	n	%	
E-scooter riders	448	31	89	6	283	19	374	26	259	18	1453
E-scooter non-riders	593	32	219	12	298	16	491	26	259	18	1860

Table 2: Frequency of riders and non-riders by country

Variable	Category	Australia		Belgium		Czech Rep.		Norway		Sweden		χ^2 *(df)*	Cramer *V*
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
Gender	Man	206	59	63	77	167	63	208	63	82	61	155.84	0.26
	Woman	64	18	16	20	93	35	116	35	20	15	(12)	2
	Other or no answer	79	23	3	4	5	2	5	2	33	24	3.1	3.2
Age	18–24 years	68	19	5	6	30	11	64	19	15	11	153.58	0.18
	25–34 years	103	30	18	22	115	43	128	39	34	25	(24)	5
	35–44 years	77	22	15	18	79	30	86	26	35	26	6.1	6.2
	45–54 years	56	16	22	27	33	12	34	10	34	25	6.4	6.5
	55–64 years	45	13	14	17	4	2	15	5	13	10	6.7	6.8
	65+ years	0	0	8	10	4	2	2	1	3	2	6.10	6.11
	No answer	0	0	0	0	0	0	0	0	1	1	6.13	6.14
Education	Primary	4	1	0	0	8	3	8	2	2	1	304.12	0.26
	Secondary	36	10	22	27	119	45	52	16	20	15	(24)	8
	Post-school	71	20	14	17	29	11	41	12	22	16	9.1	9.2
	Bachelor's	110	32	25	30	40	15	125	38	24	18	9.4	9.5
	Master's	55	16	21	26	69	26	103	31	37	27	9.7	9.8
	No answer	73	21	0	0	0	0	0	0	30	22	9.10	9.11
Occupation	Employed	200	57	59	72	213	80	242	74	83	61	436.68	0.31
	Stay-at-home	2	1	1	1	27	10	62	19	1	1	(24)	11
	Student	53	15	1	1	25	9	25	8	11	8	12.1	12.2
	Retired	8	2	12	15	0	0	0	0	3	2	12.4	12.5
	Unemployed	10	3	3	4	0	0	0	0	0	0	12.7	12.8
	Other	2	1	6	7	0	0	0	0	0	0	12.10	12.11
	No answer	74	21	0	0	0	0	0	0	37	27	12.13	12.14
Area type	Suburban	178	51	52	63	157	59	131	40	38	28	224.19	0.31
	Urban	93	27	30	37	108	41	198	60	68	50	(8)	14
	No answer	78	22	0	0	0	0	0	0	29	21	15.1	15.2

Note. All χ^2 tests are significant at p< .001,

Table 3: Characteristics of e-scooter riders

Variable	Category	Australia		Belgium		Czech Rep.		Norway		Sweden		χ² (df)	Cramer V
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
Gender	Man	201	34	136	62	114	38	226	46	96	37	155.84	0.26
	Woman	197	33	78	36	177	59	258	53	77	30	(12)	
	Other or no answer	195	33	5	2	7	2	7	1	86	33		
Age	18–24 years	193	33	1	0	62	21	43	9	5	2	153.58	0.18
	25–34 years	161	27	25	11	115	39	145	30	31	12	(24)	
	35–44 years	101	17	32	15	63	21	149	30	60	23		
	45–54 years	83	14	45	21	37	12	91	19	65	25		
	55–64 years	55	9	64	29	19	6	50	10	51	20		
	65+ years	0	0	52	24	2	1	13	3	35	14		
	No answer	0	0	0	0	0	0	0	0	12	5		
Education	Primary	1	0	56	26	6	2	47	10	19	7	309.12	0.26
	Secondary	78	13	15	7	55	18	52	11	33	13	(24)	
	Post-school	61	10	73	33	139	47	149	30	61	24		
	Bachelor's	197	33	71	32	0	0	234	48	57	22		
	Master's	256	43	0	0	0	0	0	0	85	33		
	No answer	0	0	4	2	98	33	9	2	4	2		
Occupation	Employed	234	39	133	61	204	68	391	80	134	52	436.68	0.31
	Stay-at-home	9	2	3	1	66	22	48	10	2	1	(24)	
	Student	131	22	2	1	28	9	52	11	11	4		
	Retired	16	3	59	27	0	0	0	0	26	10		
	Unemployed	18	3	7	3	0	0	0	0	0	0		
	Other	7	1	15	7	0	0	0	0	0	0		
	No answer	178	30	0	0	0	0	0	0	86	33		
Area type	Suburban	274	46	164	75	150	50	192	39	63	24	224.19	0.31
	Urban	132	22	55	25	148	50	299	61	117	45	(8)	
	No answer	187	32	0	0	0	0	0	0	79	31		

Note. All χ^2 tests are significant at $p< .001$,

Table 4: Characteristics of e-scooter non-riders

5. RESULTS

In this part, we concentrate on the results of the survey according to the research questions.

5.1 What are e-scooter riders' attitudes towards e-scooter safety?

We asked our respondents *"In general, how safe is it for you to ride an e-scooter?"*. Around half of the e-scooter rider respondents perceived e-scooters as being "safe" or "very safe" for themselves. Up to 80% of the e-scooter riders in each country think that an e-scooter is "safe" or "very safe" for other road riders when answering *"In general, how safe is it for other road users when you're riding an e-scooter?"*(see Figure 1).

We looked at the barriers that impeded using an e-scooter more frequently (*"To what extent are the following aspects a barrier for you to use e-scooters more frequently?"*). Safety was a "very important" or "important" obstacle among a quarter of Czech and Australian e-scooter riders. Safety as a barrier was the most pronounced among Belgian riders (41%, n = 33), as opposed to Norwegian (13%, n = 43) and Swedish riders (14%, n = 19). To sum up, e-scooter riders do not perceive e-scooters as a threat either for themselves or for other road users. Therefore, safety is not a very important barrier for e-scooter riders. In contrast, Belgian riders reported feeling less safe and (in line with these feelings) safety was a more important barrier for them (41%) in comparison with the other countries under study (13%–25%).

5.2 What are non-e-scooter-riders' attitudes towards e-scooter safety?

To find out the answer to the research question, we asked our non-rider respondents: *„In general, how safe would it be for you to ride an e-scooter?"* Around half of the non-riders from Australia, the Czech Republic, Norway, and Sweden thought riding an e-scooter would be slightly unsafe for them. Only the majority of Belgian non-rider respondents thought it would be very unsafe for them to ride an e-scooter (60%, n = 132) (see Figure 1).

Then, we asked the non-riders: *"In general, how safe is it for other road users when someone is riding an e-scooter?"* The greatest perception that riding an e-scooter posed a risk to other road users was found among the Belgian non-rider respondents (53%; n = 117 rated it as "very dangerous"), while the perception was lowest among the Australian non-riders (16%; n = 79 rated it as "very dangerous"). When comparing their own perceived safety and the perceived safety of e-scooters for other road users (see Figure 2), the non-rider respondents considered riding an e-scooter safer for themselves than for other road users. This is particularly apparent among the Czech non-rider respondents, of whom 16% (n = 49) considered riding an e-scooter "very dangerous" for themselves, while 30% (n = 89) of the same respondents thought that when someone was riding an e-scooter it was "very dangerous" for other road users.

If we look at safety as a barrier to using e-scooters it is not surprising that safety is an "important" or "very important"

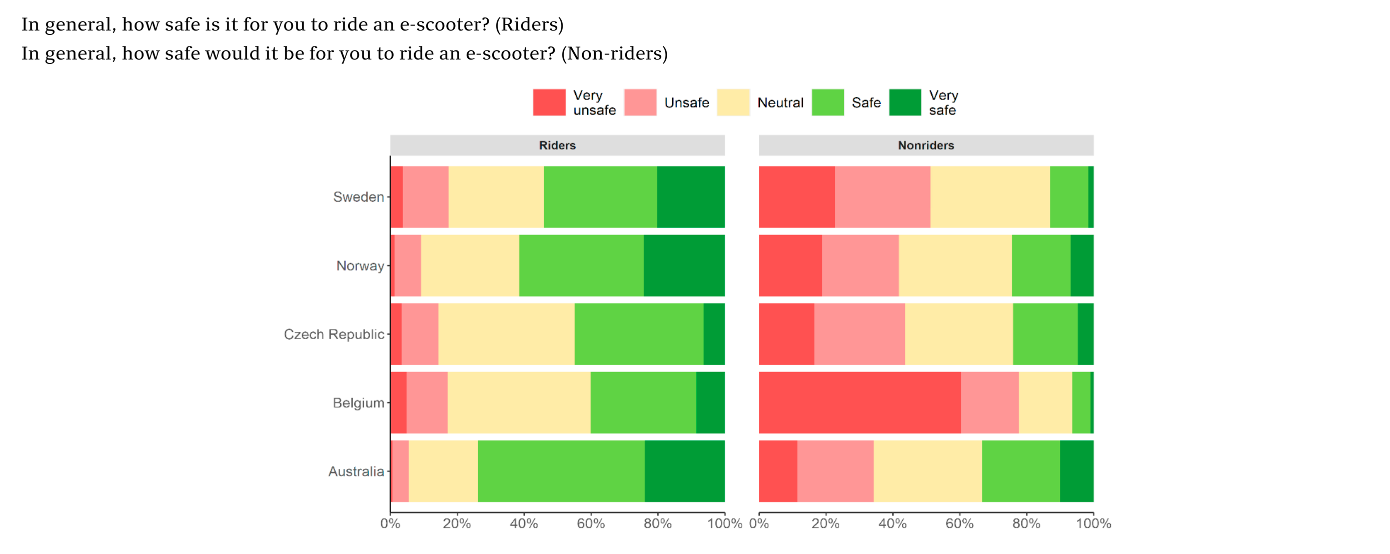

Figure 1: Safety when riding an e-scooter as perceived by riders and non-riders

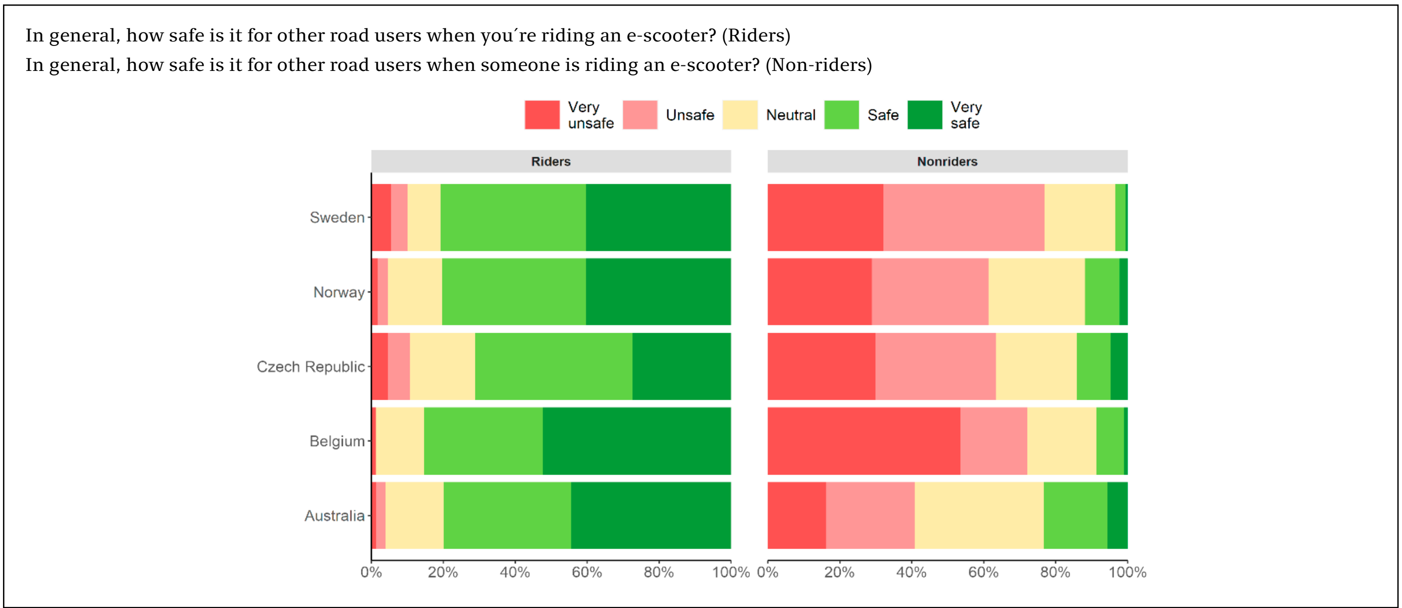

Figure2: Safety for other road users as perceived by riders and non-riders

barrier among the non-riders. The results among the countries correspond to the results among the riders. Again, the Belgian non-riders considered safety as the most important barrier (87 %, n = 191). Then, 75% of the Czech (n = 222) and 64% (n = 131) of the Swedish non-riders think safety is a very important barrier to using an e-scooter. Finally, around half of the Australian (55%, n = 275) and Norwegian (54%, n = 268) non-riders perceived safety as being an important barrier.

To sum up, the non-riders considered riding an e-scooter as being more unsafe for other road users than for themselves. This finding might be affected by their own experience: non-riders may perceive some interaction from their point of view as more dangerous than e-scooter riders, who feel their operation is safe. Another reason why non-riders may see e-scooters as more dangerous (especially for other road users) might be their lack of experience. Unsurprisingly, the non-riders in all the countries under study see safety as a very important barrier to using e-scooters (54%–87%).

5.3 What types of risky behaviour did e-scooter riders report?

We asked our respondents about risky behaviours during the last month *("Over the last 30 days, how often have you ridden an e-scooter….."/"Over the last 30 days, how often have you interacted with people riding an e-scooter….. ?")*. Respondents reported the frequency of various risky behaviours. The most frequent risky behaviour according to the riders is riding without a helmet: around 60% of the Norwegian and Swedish riders reported riding without a helmet *"(almost) always"*. Another frequent risky behaviour among the riders from all the countries was *"riding in the dark without a reflective jacket"* (around 20% of the riders in each country). Riding fast on a footpath was stressed by the Australian e-scooter riders (around 70% of the riders reported riding fast on a footpath *"often"* or *"(almost) always")*.

From the non-riders' point of view, the situation is not the same. Generally, the non-riders report more frequent risky behaviour regardless of the type of risky behaviour. The non-riders agreed with the riders that the most frequent risky behaviour was riding without a helmet: 70-80% of the non-riders had interacted "(almost) always" during the last 30 days with riders in each country except Australia (less than 20%). Similarly, riding in the dark without a reflective jacket was perceived "(almost) always" by the non-riders in Sweden (almost half of them), Norway, and the Czech Republic (around one third of them).

Figure3: Perceived likelihood of police checks by e-scooter riders

We asked our rider respondents: *"How likely is it that an e-scooter rider would be checked by the police for…?"*According to the rider respondents in all the countries under study, except Belgium, police checks for all the response categories are *"very unlikely"* or *"unlikely"*. On the contrary, the Belgian rider respondents reported that police checks are more likely. The most probable checks are for speeding on a footpath and for mobile phone use. For a comparison see Figure 3.

5.4 Do riders' attitudes towards e-scooter safety relate to their risky behaviour?

We tried to find out whether attitudes towards risky behaviour depend on the risky behaviour. Risky riding behaviour and its frequency, riding frequency and attitudes toward safety were measured. The reliability estimate of risky riding was $\alpha = 0.61$. Then, the reliability estimate of riding frequency was $\alpha = 0.87$. Last, the estimated reliability of attitudes towards safety was $\alpha = 0.64$. Items are described in Table 1. Descriptive statistics of these predictors for each country are provided in Table 5.

We predicted risky riding behaviour using multiple linear regression. The predictors were entered in two steps. In Step 1, gender (dummy coded with men as the reference category), age, country (dummy coded with Australia as the reference category), and riding frequency were entered. These explanatory variables – gender and age - were in concordance with Gioldasis et al. (2021) who reported that young and male e-scooter riders are more likely to ride an e-scooter in a risky manner. Furthermore, the length of the trip was associated with riskier behaviour. Because of different laws and cultural norms, differences among countries were expected, that is why country was included as a predictor as well. In Step 2, attitudes towards riding safety ("attitudes to safety") as a predictor were added. As can be seen in Table 6, gender, age, country, and riding frequency all significantly predicted risky riding behaviour. Controlling for the effects of other predictors, women showed less risky riding behaviours than men ($B = -0.16$, 95% CI [-0.21, -0.10], $\beta = -0.16$), older people showed less risky riding behaviours than younger people ($B = -0.09$, 95% CI [-0.11, -0.07], $\beta = -0.24$), and greater riding frequency predicted more risky riding behaviours ($B = 0.06$, 95% CI [0.02,0.09], $\beta = 0.10$). The effect of the country was also significant, and it is analysed in more detail in the next paragraph using pairwise comparisons. However, when attitudes towards riding safety were added, the explained variance increased negligibly.

The estimated marginal means or risky riding behaviour, averaged over the levels of other predictors, were (in descending order): $M = 1.85$ (95% CI [1.79, 1.92]) for Norway, $M = 1.74$, (95% CI [1.65, 1.83]) for Sweden, $M = 1.72$(95% CI [1.65, 1.79]) for the Czech Republic, $M = 1.64$ (95% CI [1.57, 1.70]) for Australia, and $M = 1.51$ (95% CI [1.41, 1.61]) for Belgium. We compared the differences between countries (controlling for the effect of gender, age, and riding frequency) using Tukey's HSD method to adjust for the family-wise error rate. As can be seen in Table 7, the Norwegian riders showed significantly riskier riding behaviour than the respondents from all other countries except Sweden. There were no significant differences between the Czech, Australian and Swedish riders. However, the Belgian riders showed significantly safer riding behaviour than the riders from the Czech Republic, Norway, and Sweden, but not Australia.

6. DISCUSSION AND CONCLUSIONS

The goals of this study were to describe (1) e-scooter riders' attitudes towards e-scooter safety and (2) the most common types of risky e-scooter behaviour. The research questions

Variables	Australia		Belgium		Czech Rep.		Norway		Sweden	
	M	SD	M	SD	M	SD	M	SD	M	SD
Risky riding behaviour	1.66	0.40	1.48	0.44	1.77	0.38	1.87	0.45	1.73	0.46
Riding frequency	2.92	0.73	3.10	0.78	3.17	0.75	2.65	0.72	2.69	0.85
Attitudes to safety	3.93	0.75	3.46	0.69	3.40	0.72	3.88	0.78	3.75	0.92

Table 5: Descriptive statistics

Predictors	Step 1				Step 2			
	B	SE_B	95% CI_B	β	B	SE_B	95% CI_B	β
Intercept	1.87***	0.07	[1.73, 2.01]		1.96***	0.11	[1.75, 2.17]	
Gender: woman	−0.16***	0.03	[−0.21, −0.10]	−0.16	−0.16***	0.03	[−0.21, −0.10]	−0.16
Gender: other	−0.04	0.08	[−0.19, 0.11]	−0.02	−0.04	0.08	[−0.19, 0.11]	−0.02
Age (in decades)	−0.09***	0.01	[−0.11, −0.07]	−0.24	−0.09***	0.01	[−0.11, −0.06]	−0.23
Country: Belgium	−0.13*	0.05	[−0.23, −0.03]	−0.08	−0.13*	0.05	[−0.24, −0.03]	−0.08
Country: Czech Rep.	0.08*	0.04	[0.01, 0.15]	0.08	0.08*	0.04	[0.00, 0.15]	0.08
Country: Norway	0.21***	0.03	[0.15, 0.28]	0.22	0.21***	0.03	[0.14, 0.28]	0.22
Country: Sweden	0.10*	0.05	[0.01, 0.19]	0.07	0.09*	0.05	[0.00, 0.19]	0.07
Riding frequency	0.06***	0.02	[0.02, 0.09]	0.10	0.06***	0.02	[0.02, 0.09]	0.10
Attitudes to safety					−0.04*	0.02	[−0.07, 0.00]	−0.06
R^2	0.15				0.15			
adj. R^2	0.14				0.14			
ΔR^2	32.1				0.005			
F(df) for R^2	22.65 (8,1052)***				17.08 (11, 1049)***			
F(df) for ΔR^2	32.2				2.05 (3, 1049)			

Note: Gender and country were dummy coded with men and Australia as reference categories, respectively.
* p <.05, **p <.01, ***p <.001.

Table 6: Stepwise multiple linear regression with risky riding behaviour as a dependent variable

Comparisons	ΔM	95% $CI_{\Delta M}$	Cohen's d	95% CI_d	p
Australia – Belgium	0.13	[−0.01, 0.27]	0.31	[−0.02, 0.64]	.084
Australia – Czech Republic	−0.08	[−0.18, 0.01]	−0.20	[−0.42, 0.03]	.132
Australia – Norway	−0.21	[−0.30, −0.12]	−0.50	[−0.72, −0.29]	<.001
Australia – Sweden	−0.10	[−0.23, 0.03]	−0.24	[−0.53, 0.06]	.196
Belgium – Czech Republic	−0.21	[−0.36, −0.07]	−0.51	[−0.84, −0.17]	<.001
Belgium – Norway	−0.34	[−0.49, −0.20]	−0.81	[−1.15, −0.48]	<.001
Belgium – Sweden	−0.23	[−0.39, −0.07]	−0.55	[−0.93, −0.16]	.001
Czech Republic – Norway	−0.13	[−0.22, −0.04]	−0.31	[−0.53, −0.08]	.002
Czech Republic – Sweden	−0.02	[−0.15, 0.11]	−0.04	[−0.35, 0.27]	.997
Norway – Sweden	0.11	[−0.01, 0.24]	0.27	[−0.03, 0.56]	.099

Note: Confidence intervals and p-values are adjusted using Tukey's HSD method for comparing a family of five estimates (i.e. marginal means of five countries). The pooled standard deviation of risky riding behaviour between countries (SD = 0.423) was used to standardise the difference between means to compute Cohen's d.

Table 7: Pairwise comparison b etween countries in risky riding behaviours

were defined to reflect these goals. In this section the results are discussed and presented in line with the research questions.

E-scooter riders' attitudes towards e-scooter safety are discussed first (research question: "What are e-scooter riders' attitudes towards e-scooter safety?"). It can be seen that the riders across the countries under this study perceive e-scooters as quite safe. This finding is in line with Gibson et al. (2021). The riders involved in this study feel safe when riding e-scooters and they think e-scooters are no danger for other road users, similarly to Che et al. (2021). These findings are not surprising, as it might be hypothesised that feeling unsafe when riding an e-scooter would otherwise be a barrier (e.g. according to Glavić et al., 2021) which would prevent people from riding e-scooters. On the other hand, another explanation is also possible: e-scooter riders might have experienced driving e-scooter as a safe operation, and thus this experience shapes their attitudes towards safety. Another possible explanation is that young (M = 36.7, SD = 11.8) males from urban areas predominated in the current sample (which is in concordance with literature, e.g. Useche et al., 2022) and this group of people has low risk perception. This fact makes young men susceptible to undertake risky behaviours (Burt & Ahmed, 2023).The current research design does not allow to explore causality, so the answer to the question of causality has to be left to future studies.

When one looks at the non-riders' attitudes, the situation is different. The reader can see a solid tendency to believe that riding an e-scooter is rather unsafe – again more or less constantly across the countries under study, with the exception of Belgium, where the respondents tend to think that this is very unsafe. This could be affected by the fact, that the Belgian respondents were older than the respondents from other countries under study. This finding – the non-riders have tendency to believe that riding an e-scooter is rather unsafe - corresponds to previous conclusions (Che et al., 2021; Gibson et al., 2021; James et al., 2019). In any case, this tendency to label e-scooter operation as unsafe can be caused by following factors. The first factor might be no experience with riding an e-scooter. E-scooters are a new means of transport and people with no experience with using one may feel fear of this novelty, which is in line with a general psychological theory which proposes that what is unknown might bring feelings of insecurity (Zhang et al., 2022). What is more, e-scooters may unpredictably 'transform' between different transport categories which can cause feelings of uncertainty. Second, non-e-scooter riders may have negative experience with encountering e-scooters in the public space (e.g. as pedestrians or car drivers), which may make them think that they are not a safe traffic mode. Therefore, we agree with Buehler et al. (2021) that both riders and non-riders would take advantage of separate spaces/lanes. Third, non-riders' safety attitudes may be influenced by social media (e.g. e-scooters were presented rather negatively in the media when introduced in the Czech Republic), which may cause people with no e-scooter experience to believe that e-scooters are not safe. Again, the design of our study does not allow us to deal with the issue of causality. Finally, besides subjective feeling of unsafety or perceiving e-scooters as a threat (arguments above), data shows that riding an e-scooter is rather a dangerous way to get around the city for all parties – riders and non-riders (e.g. Gössling, 2020).

Generally, both explanations are in line with the general social psychology literature, which says that when a person has experience with something or has the opportunity to understand it in depth, it will increase the chances of them having positive attitudes towards a certain situation or action (Petty & Cacioppo, 1981).

When considering risky behaviour, there is a similar tendency. Non-riders tend to report more risky behaviour than e-scooter riders, even though fact-based observable behaviour, e.g. helmet use, should, in principle, be the same across both groups. First, non-riders may be more sensitive to risky riding which might be associated with their feeling of being unsafe. Second, this discrepancy is probably caused by self-report bias, which is known as "in group versus out group" attribution. This means, that when person identifies them self as a part of the group, their attitudes are shaped in a "wished-for way" and vice versa. An alternative explanation might be that non-riders tend to be more "critical" of e-scooter riders as they have experience with some unsafe operation or conflict with an e-scooter from the past. Third, another explanation of why e-scooter riders do not perceive their risky behaviour as risky could be insufficient enforcement of traffic rules or little attention to risky/safe behaviour by the media. It is hypothesised that if an e-scooter rider breaks a traffic rule (e.g. riding on a pavement at a speed greater than 6 km/h) often without punishment, the e-scooter rider becomes accustomed to this risky behaviour and does not perceive it as risky. Obviously, safe riding is associated with following the traffic rules. Road users need understand the rules. Enforcing the regulations seems to be necessary.

The focus of this study was also on the factors which might predict risky behaviour. As regards gender and age, our results are fully in line with the well-known literature dealing with traffic safety. Women and older people tend to ride more safely when riding an e-scooter. Even though this is known to be the case for other traffic modes too, we assume that showing this for e-scooter riding is quite important. As regards riding frequency, the data shows that greater riding frequency predicted more risky riding behaviours which is in line with Gioldasis et al., 2021. This might be caused simply by higher exposure. However, attitudes towards riding safety were non-significant predictors of risky riding behaviours.

As regards the differences across the countries involved in the study, we see that Norwegian e-scooter riders perform the risky behaviour the most and Belgian e-scooter riders perform the risky behaviour the least (controlling for the effect of gender, age, and riding frequency). This might be caused mainly by three factors: first, the very different legal norms (laws) which stipulate what is allowed and what is forbidden in each country. This possibly also influences how safe or unsafe specific behaviour is perceived as being by e-scooter riders in each country; second, the real infrastructure for micromobility through cities (e.g. Belgian cities are usually well-equipped with bike lanes, whereas in Czech cities comprehensive infrastructure might be missing), and third, the heterogeneity of the research sample in each country might bias these results (when comparing country to country).

7. LIMITATIONS

We identify three major issues as limitations in this study: the collection process, the differences between the samples and the low reliability. First, the data collection process used snowball sampling based on sponsored Facebook ads and participant sharing. While recruitment via social media is an efficient way of reaching a large number of people, however such samples may be underrepresentative/overrepresentative. In addition, recruitment via Facebook may have contributed to the participants' high level of education and an underrepresentation of older people. The response rate for the survey cannot be calculated because it is not known how many people saw the advertisement without responding to it.

Although the authors tried to control all the contributing factors influencing the data collection and sample in all five countries, the samples might differ slightly, which complicates the international cooperation. The last issue is the preparation of the questionnaires and the data collection process (e.g. using different online platforms to collect the data) in five different national versions, which in some cases led to minor differences in the coding and, furthermore, to complications when comparing (and interpreting) the data from different countries. Specifically, the main factors that complicated the comparison of data from different countries were: a somewhat different definition of e-scooter riders in Sweden than in the other countries (although, on the basis of the statistical analysis provided and the comparison between countries, we did not identify any indications which would suggest that the results were biased), forced answer design only in some of the participating countries, and differences in the national regulations which might have led to the different interpretation of some questions in the questionnaire.

Other limitations are the differences among the samples and their sizes across the countries. Firstly, the desired minimum number of respondents for each group was defined (200 riders and 200 non-riders for each country). However, in some countries (e.g. Norway) the respondents were recruited quite fast (within two weeks) and in large numbers. In other countries (e.g. the Czech Republic), it took a longer time to obtain respondents and to have the sample balanced in terms of gender.

We suppose that the low reliability might be caused by the fact that risky behaviour is a formative construct. In a formative measurement model, the latent construct is considered to be a combination of the observed indicators. The indicators are assumed to be factors that contribute to the formation of the construct, and they are not necessarily correlated with each other. This is because they may be measuring different aspects of the construct. For that reason we cannot suppose the internal consistency to be high. A test-retest measurement as more suitable in the future research is proposed.

As regards the contribution of the study, first, the authors helped deepen knowledge in the field of micromobility. Research on e-scooter safety is not easy to be conducted due to the scarcity of empirical data as they are only recent and suffer from under-reporting. While few studies concentrate on micro-mobility risky behavior, e-scooter riders' behaviour can change over time and across countries. Our research supported the previous findings associated with e-scooter behaviour. An innovative and compelling aspect of our research can be seen in its effort to achieve an international comparison. Second, our study might inspire urban policy makers to promote safe traffic infrastructure and behaviours.

8. IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

Regarding the implications for practice according to our data, it seems to suggest that on the one hand e-scooter riders feel quite safe and do not perceive e-scooters as a threat to other road users. On the other hand, the non-rider respondents seem to think that e-scooters are not so safe. Despite the fact that the countries participating in this study have different regulations (e.g. while riding on pavements is forbidden in the Czech Republic, it is allowed, at walking speed, in other countries), perceived safety does not differ much. Therefore, accident prevention measures are proposed. Improvements of the riding environment for both e-scooter riders and other road users (mainly pedestrians who interact with e-scooters on pavements) seem to be necessary. Creating bike lanes shared with e-scooters might be the first step in promoting both safety and comfort. As our data shows that enforcing traffic rules is rather unlikely in the countries under study, consistent enforcing of traffic rules is considered as effective measures for preventing e-scooter accidents.

Then, another way of promoting safety is through education and training. Riding e-scooters should be incorporated into school-based traffic education in order to promote safe behaviour among children and teenagers. Another reason why e-scooter riding-specific education and training in schools may be essential is that in many countries no permit is required for riding an e-scooter. Therefore, the possibilities of teaching people how to ride e-scooters safely later are limited. Evidence suggests that young riders and male riders engage in more risky riding behaviours in comparison to older and female riders. This phenomenon should be addressed by effective preventive programmes and campaigns.

Finally, based on the evidence from the current research, the authors highlight future research directions. The association of traffic rules and risky riding behavior should be studied using big data analysis. Another way of future research is studying the association of risk awareness and risk perception with the e-scooter risky riding behavior. It is evident; there is a gender gap among e-scooter riders. This gender gap and its association with e-scooter risky riding behaviour should be also investigated by future research.

9. CONCLUSIONS

This study found out three main conclusions. First, the riders involved in this study feel safe when riding e-scooters and they think e-scooters are no danger for other road users. Second, non-riders have a solid tendency to believe that riding an e-scooter is rather unsafe – again more or less constantly across the countries under study, with the exception of Belgium, where the respondents tend to think that this is very unsafe. Third, non-riders tend to report more risky behaviour than e-scooter riders, even though fact-based observable behaviour. Fourth, Norwegian e-scooter riders perform the risky behaviour the most and Belgian e-scooter riders perform the risky behaviour the least. Based on the findings implications for practice are proposed in this paper.

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