Risky Behaviours and Safety Perception of Moped Riders and Motorcyclists Globally

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Abstract

Motorcyclists and moped riders are among the most vulnerable road users globally, facing elevated crash and fatality risks. This study, based on the third edition of the E-Survey of Road Users' Attitudes, examines the self-reported behaviours of over 6,000 riders from 39 countries. Common risky actions include speeding, riding without a helmet, and riding under the influence of alcohol, drugs, or distractions like social media, with younger and male respondents more likely to engage in these behaviours. Notably, 20%-40% of riders reported helmetless riding, and nearly half admitted to speeding outside built-up areas in the past 30 days. Generalized Linear Mixed Models revealed that those viewing risky actions as acceptable were significantly more likely to engage in them. Gender, age, and residential environment also played critical roles, with younger, male riders consistently exhibiting higher risk-taking. Conversely, support for stricter enforcement and legal obligations correlated with safer self-reported behaviours.

Keywords: *Road Safety, Risky Behaviours, Moped Riders, Motorcyclists, Global Survey.*

1. Introduction

Mopeds and motorcycles form an important component of the transport system as they offer increased mobility at a reduced cost, as well as a special sense of pleasure. Therefore, they serve different purposes in different areas of the world. In low and middle-income countries, mopeds and motorcycles are more commonly used for the transport of goods and people and as an income source (e.g., taxis or delivery vehicles). In high-income countries, they are commonly used as transport means suitable for urban traffic congestion but also for recreation (European Commission, 2018; WHO, 2017). Moped riders and motorcyclists constitute a very vulnerable group of road users, while riding a moped or a motorcycle is considerably more dangerous than using any other motor vehicle (Ziakopoulos et al., 2021). Moped riders and motorcyclists face a higher risk of fatal or serious injury than most other road users, compared by mileage or number of trips, as well as a higher crash risk (2BeSafe, 2012). Mopeds and motorcycles accounted for 18% of the total number of road deaths in the EU countries during the period 2018-2020 (CARE, 2023). Globally, users of motorised two- and three-wheelers represent 21% of all deaths. The global share of fatalities has fallen by 2% among two- and three-wheeler users since 2010 (WHO, 2023).

Several studies on mopeds and motorcycles regarding the correlation of injury severity with external variables such as speeding, drink-driving, road geometry and weather conditions among others have been published in the literature. When the interactions between behaviour, crash rates and severity are co-investigated with other contributory factors, the crash causes and the related solutions are better identified (Theofilatos and Yannis, 2015). Results show that a large number of these variables influence road crash severity considerably. Examples include negative influence on crashes while speeding and at

junctions, while in darkness, and for specific crash types. Overcompensation effects for adverse weather conditions have also been identified, resulting in more conservative driving. Vehicle age and lack of helmet use have been found to have an impact on increased crash severity as well (Ziakopoulos et al., 2018). Meteorological factors are usually considered in moped and motorcycle studies owing to their impact on the state of the roadway surface, most often whether dry or wet (Alnawmasi and Mannering, 2019; Waseem et al., 2019). Regarding crash circumstances, it is found that the highest amount of moped and motorcycle crashes are observed in residential and commercial areas, during daylight conditions, in good weather and dry surface conditions and on local or collector roads. This is explained via exposure, as these conditions are the more favourable ones for two-wheeler trips. The majority of crashes happen within areas with a speed limit of 50km/h followed by 30 km/h, again indicating that two-wheelers are favoured for more urban routes (Ziakopoulos et al., 2018).

Behavioural issues are major moderating factors to moped and motorcycle crashes. Moped and motorcycle drivers present a great variability in their attitudes towards safety. Risk taking and sensation seeking are typical riders' behaviours which are usually expressed through speeding, disobeying traffic signals and signs, ignoring overtaking restrictions or pedestrian crossings, maintaining short gaps with the following vehicles, usual lane sharing etc. (Gupta et al., 2024; Vlahogianni et al., 2012). Moped riders and motorcyclists behaviour is related to age and riding exposure. Riders that speed seem to be more often younger and male. This might be attributed to the needs of younger people for speed, manoeuvrability and sensation seeking. Overconfidence is a primary cause of risky riding behaviour of young riders (Vlahogianni et al., 2012). A literature review paper pointed out that robust investigations of risk factors among children using motorcycles are relatively scarce (Brown et al., 2018). On the other hand, elder people might seek slower travelling speeds or the comfort of a private car, switch to a bicycle or on foot travelling, or limit their exposure by travelling less (Ziakopoulos et al., 2018). Older drivers are less likely to indulge in red-light running and lane sharing (Gupta et al., 2024). Older motorcyclists are more likely to be admitted to hospital, have more severe injuries, require intensive care, have a longer length of stay and suffer more complications. Head and thoracic injuries are more common and injuries at all sites are more severe in older adults. Comorbidities and reduced physiologic reserve predispose older motorcyclists to higher mortality and more severe injuries (Fitzpatrick and O'Neill, 2016). A period of absence from riding might lead to a decline in safety related motorcycle skills, whereas high exposure appears to moderate crash risk (Vlahogianni et al., 2012). An increasing proportion of older motorcyclists are returning riders whose riding skill has likely depreciated over time but are riding on powerful machines (Fitzpatrick and O'Neill, 2016).

Riding a motorcycle will never be risk-free. This fact does not mean that motorcyclists are not conscious about their safety. A previous study showed that motorcyclists are well aware and concerned about their own safety. However, they have different opinions to other road users. They do not make the same priorities of actions that authorities do (Nordqvist and Gregersen, 2010). The moped and motorcycle safety situation, risk factors and underlying socio-demographic conditions will vary across regions, countries and within states, territories and provinces, and it is not possible to provide (in a single document) suggestions that will be equally useful across all settings and locales.

The present study aims to provide a quantified update on moped riders and motorcyclists' safety performance by analyzing data from a broad-country sample. To achieve this aim, this research examines data from 39 countries which were collected within the framework and activities of the ESRA3 study, conducted in 2023. Specifically, the study investigates the attitudes and opinions of moped riders and motorcyclists regarding various types of unsafe behaviour (for instance, speeding, alcohol/drug consumption, helmet use, and others). In addition, comparisons among the participating countries are included. The rest of the paper is structured as follows: In Section 2, the methodological background of the study is outlined, comprising details of the ESRA methodology along with the basics of statistical

modelling methodologies that are utilized. Section 3 contains the main descriptive and statistical findings of this research. Lastly, the findings are followed by a discussion and elaboration in Section 4.

2. Methodological Background

2.1 ESRA Methodology

The E-Survey of Road Users' Attitudes (ESRA) is a collaborative effort involving road safety organizations, research centers, public services, and private sponsors worldwide. Its goal is to gather international data on road users' opinions, attitudes, and behaviour related to road traffic risks. The data collected through ESRA are used to develop road safety indicators that inform policymaking at both national and international levels. ESRA conducts an extensive online panel survey, gathering responses from a representative sample of at least 1000 adults in each participating country. A standardized questionnaire is translated into multiple languages and covers various road safety topics. This paper presents the key findings of the third edition of the survey (ESRA3), focusing on moped riders and motorcyclists. It is noted that in Armenia, Kyrgyzstan, and Uzbekistan no online panels were available, so the results of these three countries were not included in regional means due to the different methodology. More detailed information about the survey methodology, data processing, and questionnaire can be found in the ESRA3 methodology report (Meesmann et al., 2023). An overview of the project and its publications can be accessed at www.esranet.eu. In 2023, ESRA included 39 countries in its survey, namely: in Europe (Armenia, Austria, Belgium, Bosnia and Herzegovina, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Netherlands, Poland, Portugal, Republic of Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom), America (Brazil, Canada, Chile, Colombia, Mexico, Panama, Peru, USA) and Asia and Oceania (Australia, Israel, Japan, Kazakhstan, Kyrgyzstan, Thailand, Türkiye, Uzbekistan). This paper evaluates various aspects of self-declared behaviour through the lens of moped riders/motorcyclists. The following aspects, which were analyzed within ESRA3, are:

Question: 'Over the last 30 days, how often did you as a moped rider or motorcyclist …'?

- ride when you may have been over the legal limit for drinking and driving
- ride faster than the speed limit outside built-up areas (except motorways/freeways)
- not wear a helmet on a moped or motorcycle
- read a message or check social media/news while riding
- ride within 1 hour after taking drugs (other than prescribed or over the counter medication)
- ride too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users)

2.2 Mixed Effects Logistic Regression

In this paper, the mixed effects logistic regression model approach under the generalized linear mixed models (GLMMs) framework was used. GLMMs are an extension of linear mixed models that allow dependent variables from different distributions, such as binary responses. Mixed effects logistic regression is used to model binary outcome variables, in which the log odds of the outcomes are modeled as a linear combination of the independent variables when there are both fixed and random effects.The adjusted odds ratio (OR) is a helpful measure of association between the independent variable and an outcome, which is often used to ease interpretation. In particular, the odds ratio is the ratio of odds of the event occurring given X = 0 and X = 1. Taking the anti-log of the regression coefficient, the odds ratio can be provided. An odds ratio higher than one demonstrates a positive association between the dependent and explanatory variables, while value less than one indicates a negative relationship between them. An odds ratio, which is equal to one, shows that there is no association among the variables. The corrected Akaike Information Criterion (AICc), which accounts and corrects for the number of included independent variables, is used for the process of model selection between

models with different combination of explanatory variables. It is important to mention that the extra value of any random effects is assessed by conducting a custom ANOVA between the fixed effects binary Generalized Linear Model (GLM) and any formulated GLMMs. The present analysis was conducted in R-studio with lme4 package following Bates et al. (2008).

3. Results

3.1 Descriptive Statistics

The results of six questions based on moped riders' and motorcyclists' (also described as PTW riders in the following) self-declared behaviour, which have been stated in the Methodology section, are shown by country and world region in the following Table.

Table 1: *Moped riders' and motorcyclists' self-declared behaviour in the past 30 days by country and region (% of moped riders' and motorcyclists' riders that did it at least once). The prefix of the question is that: "As moped riders and motorcyclists, at least once in the past 30 days, how often do you…".*

Country	Drink driving	Ride faster than the speed limit outside built-up areas (except motorways/freeways)	Ride without a helmet	Read a message or check social media/news while riding	Ride within 1 hour after taking drugs	Ride too fast for the road/traffic conditions at the time
Armenia	0.0% (↓)	37.4%	24.8%	0.0%(↓)	0.0% (↓)	0.0% (↓)
Australia	10.5%	18.0% (↓)	13.7% (↓)	11.9%	13.6%	13.0% (↓)
Austria	19.7%	58.8%	19.4%	20.8%	17.1%	49.1% (↑)
Belgium	27.5%	43.4%	32.9%	28.2%	24.5%	32.0%
Bosnia & Herzegovina	13.6%	35.3%	52.0% (↑)	18.1%	9.2%	36.3%
Brazil	15.2%	39.1%	23.8%	22.6%	14.2%	27.6%
Canada	26.8%	39.8%	29.9%	27.3%	26.4%	30.3%
Chile	20.3%	36.0%	37.3%	35.3%	17.4%	33.3%
Colombia	15.6%	45.7%	36.9%	32.7%	14.6%	41.9%
Czech Republic	21.7%	54.0%	32.0%	18.9%	12.6%	41.0%
Denmark	30.0% (↑)	40.0%	32.6%	32.0%	25.3%	40.1%
Finland	15.2%	53.2%	14.5%	14.6%	16.0%	40.1%
France	17.1%	25.3% (↓)	20.7%	21.0%	13.5%	23.2%
Germany	16.9%	33.5%	19.3%	18.0%	14.6%	28.1%
Greece	12.6%	46.4%	27.7%	16.0%	5.0%(↓)	34.7%
Ireland	36.0% (↑)	55.4%	42.5%	37.4%	39.4%(↑)	62.2% (↑)
Israel	18.0%	63.2% (↑)	24.0%	24.8%	12.1%	51.4%
Italy	15.4%	34.5%	19.3%	15.0%	11.6%	29.3%
Japan	6.1% (↓)	39.5%	3.7% (↓)	8.5%(↓)	3.7%(↓)	37.0%
Kazakhstan	37.1% (↑)	47.0%	46.0%	22.8%	23.1%	30.5%
Kyrgyzstan	0.0% (↓)	56.3%	28.1%	42.3%(↑)	14.1%	42.3%
Latvia	11.7%	67.2% (↑)	27.6%	11.9%	7.1%	44.5%
Luxembourg	16.6%	64.6% (↑)	7.1% (↓)	11.5%(↓)	9.4%	46.0%
Mexico	23.5%	37.7%	39.8%	27.5%	19.3%	34.3%
Netherlands	29.0%	49.4%	44.7%	33.1%	31.3%(↑)	43.3%
Panama	22.6%	41.0%	38.6%	39.7%(↑)	11.2%	34.8%
Peru	24.4%	48.1%	47.7%	36.1%	13.8%	47.2% (↑)
Poland	17.8%	42.2%	36.8%	27.4%	16.0%	37.8%
Portugal	16.0%	52.3%	14.8%	16.8%	17.1%	32.4%
Serbia	13.8%	30.2%	45.6%	18.0%	5.4%	20.8% (↓)
Slovenia	13.9%	42.8%	29.3%	13.3%	10.3%	35.3%
Spain	23.1%	43.5%	23.3%	23.7%	20.8%	37.9%
Sweden	27.5%	50.8%	35.0%	27.1%	25.7%	44.1%
Switzerland	18.3%	30.7%	20.4%	19.5%	15.3%	24.3%
Thailand	25.4%	34.2%	52.1% (↑)	33.2%	32.8%(↑)	33.4%
Türkiye	12.3%	26.2%	29.7%	18.6%	12.0%	26.0%
United Kingdom	24.5%	26.4%	29.3%	23.1%	25.8%	25.1%
United States	17.1%	22.5% (↓)	22.4%	20.1%	20.4%	22.2%

Uzbekistan	28.2%	48.7%	49.2% (↑)	42.4%(↑)	28.1%	45.5%
Europe22	19.4%	35.1%	24.5%	20.7%	17.1%	30.3%
America8	17.7%	30.1%	26.2%	22.8%	18.5%	26.6%
AsiaOceania6*	18.9%	31.8%	37.7%	24.9%	22.7%	30.4%

Note: (↑) indicates the three highest safety perception scores while (↓) the lowest three.

3.2 Advanced Analysis

3.2.1 Factors associated with self-declared drink and riding

***Table 2**: Logistic regression model for drink and riding in the last 30 days.*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **ride when you may have been over the legal limit for drinking and driving** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-1.057	0.090	-11.707	**<0.001**	-
Gender (ref: Male)					
Female	-0.257	0.079	-3.261	**0.001**	0.773
Age (ref: 18-34)					
35-54	-0.178	0.077	-2.293	**0.022**	0.837
55-74	-0.590	0.126	-4.692	**<0.001**	0.554
Do you oppose or support the legal obligation of forbidding all drivers of motorized vehicles to drive with a blood alcohol concentration above 0.0% (zero tolerance) (ref: oppose)					
Support	-0.822	0.075	-10.995	**<0.001**	0.440
How acceptable do you, personally, feel it is for a MOPED RIDER or MOTORCYCLIST to …? ride when he/she may have been over the legal limit for drinking and driving (ref: unacceptable)					
Acceptable	2.931	0.129	22.806	**<0.001**	18.746

The fixed effects results of the first model indicate that women are 23% less likely to report being over the legal limit for drinking and driving when compared to men (OR=0.77). Furthermore, moped riders and motorcyclists aged over 35 years old are less likely to commit such behaviour compared to people aged 18-34 (35-54: OR= 0.84, 55-74: OR= 0.55). Moped riders and motorcyclists who support the legal obligation of forbidding all drivers of motorized vehicles to drive with a blood alcohol concentration above 0.0% (zero tolerance) are 56% less likely to report self-declared drinking and riding than people who oppose to this statement. Overall, respondents who believe that this behaviour is acceptable are almost 19 times more likely to commit such behaviour. The visual representation of the countries' random intercepts for the dependent variable of self-declared drinking and riding is presented in Figure 1. Moped riders and motorcyclists in countries that present positive values are more likely to ride when they have been over the legal limit for drinking and driving (e.g. Thailand, Peru, etc.), while negative values indicate a less probability of self-declared drinking and riding.

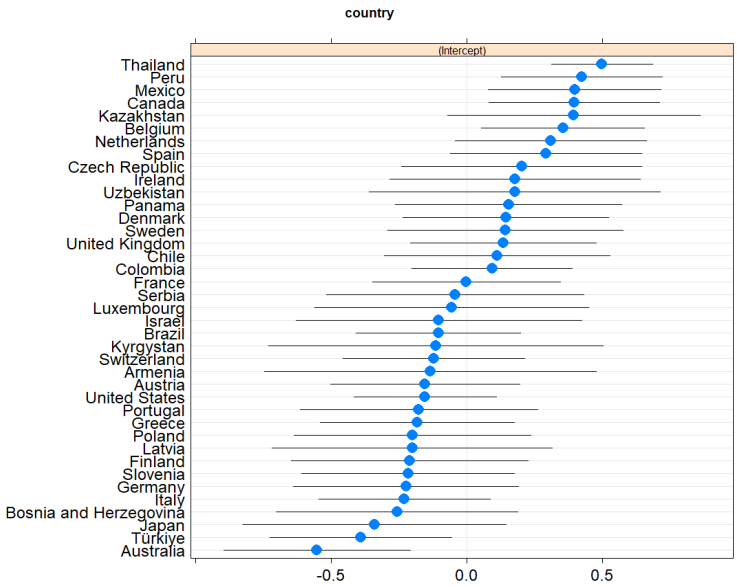

***Figure 1**: Random intercepts for countries in the Binary GLMM for self-declared behaviour of riding when you may have been over the legal limit for drinking and driving.*

The extra value of the inclusion of random effects in the model was assessed by conducting a custom ANOVA between the fixed effects binary GLM and the formulated GLMMs. These assessments are shown in Table 3 for self-declared behaviour of drink and riding. The ANOVA results presented in Table 3 indicate that the added value occurring from the inclusion of random intercepts improves the quality of the model by a statistically significant amount.

***Table 3**: Log-likelihood comparison for self-declared drink and riding binary logistic models.*

Model Family	Model Configuration	D.f.	χ^2	P(χ^2)
GLM	Fixed effects	6		
GLMM	Fixed effects & Random Intercepts	7	50.50	**<0.001**

3.2.2 *Factors associated with self-declared speeding outside built-up areas (but not on motorways/freeways)*

***Table 4**: Logistic regression model for speeding outside built-up areas (but not on motorways/freeways) in the last 30 days.*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **ride faster than the speed limit outside built-up areas (except motorways/freeways)** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-0.121	0.105	-1.157	0.247	-
Gender (ref. Male)					
Female	-0.454	0.063	-7.219	**<0.001**	0.635
Are you currently a student? (ref: No)					
Yes	0.215	0.075	2.870	**0.004**	1.240
Do you oppose or support a legal obligation ...? limiting the speed limit to a maximum of 80 km/h on all rural roads without a median strip (ref: oppose/neutral)					

Support	-0.616	0.061	-10.117	**<0.001**	0.540
How acceptable do you, personally, feel it is for a MOPED RIDER or MOTORCYCLIST to ...? ride faster than the speed limit outside built-up areas (except motorways/freeways) (ref: unacceptable/neutral)					
Acceptable	2.254	0.107	20.977	**<0.001**	9.526
Urbanization level (ref: Rural)					
Urban/ semi-urban	-0.139	0.085	-1.640	0.101	0.870

The fixed effects results of the second model indicate that women are 37% less likely to report speeding outside built-up areas (except motorways/freeways) when compared to men (OR=0.635). Furthermore, moped riders and motorcyclists who are currently students are 24% more likely to commit such behaviour compared to people that are not students (OR=1.24). Moped riders and motorcyclists who support the legal obligation of limiting the speed limit to a maximum of 80 km/h on all rural roads without a median strip are 46% less likely for self-declared speeding outside built-up areas (except motorways/freeways) than people who are opposed to this statement. Overall, people who believe that this behaviour is acceptable are more than nine times more likely to commit such behaviour.

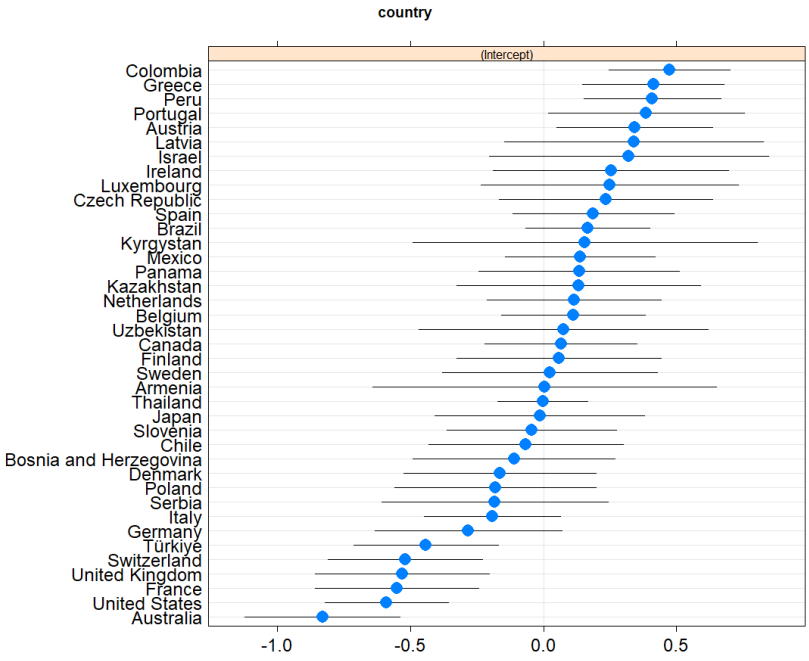

***Figure 2**: Random intercepts for countries in the Binary GLMM for self-declared speeding outside built-up areas (but not on motorways/freeways).*

***Table 5**: Log-likelihood comparison for self-declared speeding outside built-up areas binary logistic models.*

Model Family	Model Configuration	D.f.	χ^2	P(χ^2)
GLM	Fixed effects	6		
GLMM	Fixed effects & Random Intercepts	7	111.14	**<0.001**

3.2.3 *Factors associated with self-declared riding without a helmet*

***Table 6**: Logistic regression model for riding without a helmet in the last 30 days.*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **not wear a helmet on a moped or motorcycle** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-0.741	0.131	-5.652	**<0.001**	-
Age (ref: 18-34)					
35-54	-0.317	0.066	-4.789	**<0.001**	0.728
55-74	-0.618	0.102	-6.046	**<0.001**	0.539
How acceptable do you, personally, feel it is for a MOPED RIDER or MOTORCYCLIST to …? not wear a helmet on a moped or motorcycle (ref: unacceptable/ neutral)					
Acceptable	2.395	0.118	20.330	**<0.001**	10.968
Urbanization level (ref: Rural)					
Urban/ semi-urban	-0.275	0.088	-3.131	**0.002**	0.760

The fixed effects results of the third model indicate that people aged over 35 years old are less likely to report not wearing a helmet on a moped or motorcycle when compared to people aged 18-34 years old (35-54: OR=0.73, 55-74: OR=0.54). Furthermore, people who believe that this behaviour is acceptable are almost 11 times more likely to commit such behaviour. Moped riders and motorcyclists living inside urban or semi-urban areas are 24% less likely to ride without a helmet compared to those who live in rural areas (OR=0.76).

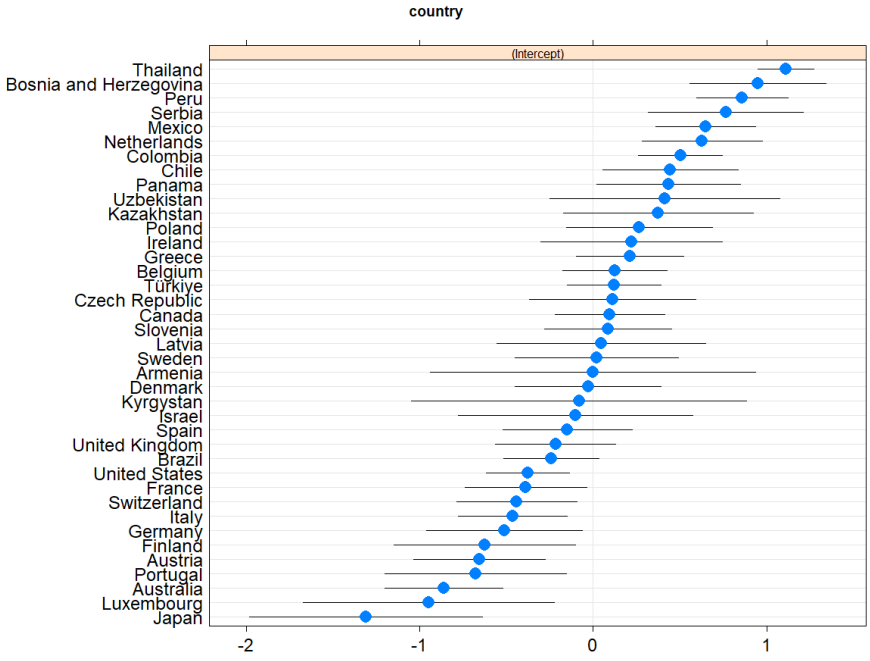

***Figure 3**: Random intercepts for countries in the Binary GLMM for self-declared riding without a helmet.*

***Table 7**: Log-likelihood comparison for self-declared riding without a helmet binary logistic models.*

Model Family	**Model Configuration**	**D.f.**	**χ^2**	**P(χ^2)**
GLM	Fixed effects	5		
GLMM	Fixed effects & Random Intercepts	6	325.46	**<0.001**

3.2.4 *Factors associated with self-declared behaviour such as reading a text message/email or check social media while riding*

***Table 8**: Factors that influence the self-declared behaviour of reading a text message/email or checking social media (e.g. Facebook, twitter, etc.) while riding a moped or a motorcycle.*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **read a message or check social media/news while riding** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-1.198	0.086	-13.893	**<0.001**	-
Gender (ref: Male)					
Female	-0.148	0.071	-2.094	**0.036**	0.862
Age (ref: 18-34)					
35-54	-0.372	0.071	-5.241	**<0.001**	0.689
55-74	-1.114	0.127	-8.786	**<0.001**	0.328
How acceptable do you, personally, feel it is for a MOPED RIDER or MOTORCYCLIST to …? read a message or check social media/news while riding (ref: unacceptable/neutral)					
Acceptable	2.889	0.137	21.095	**<0.001**	17.975
Motorcyclists/moped riders who have been personally involved in a road crash where at least one person was injured (light, severe or fatal crashes) (ref: No)					
Yes	0.551	0.164	3.365	**<0.001**	1.735

The fixed effects results of the fourth model indicate that that women are 14% less likely to report reading a message or check social media/news while riding when compared to men (OR=0.86). Moreover, people aged over 35 years are less likely to report this driving behaviour when compared to people aged 18-34 years (35-54: OR=0.69, 55-74: OR=0.33). Furthermore, respondents who believe that this behaviour is acceptable are almost 18 times more likely to commit such behaviour. Finally, moped riders and motorcyclists who have been personally involved in a road crash where at least one person was injured (light, severe or fatal crashes) are 74% more likely to read a message or check social media/news while riding.

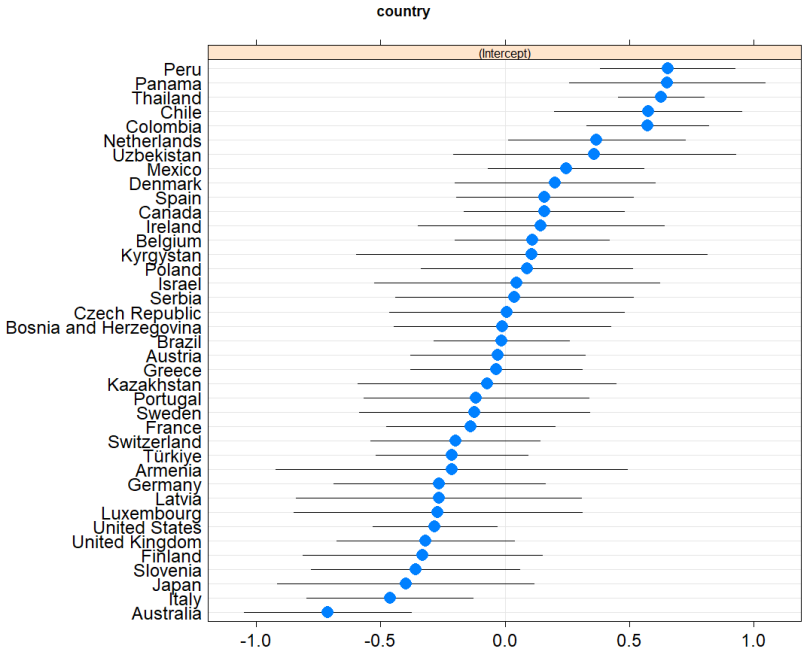

***Figure 4**: Random intercepts for countries in the Binary GLMM for self-declared reading a text message/email or checking social media (e.g. Facebook, twitter, etc.) while riding a moped or a motorcycle.*

***Table 9**: Log-likelihood comparison for self-declared reading a text message/email or checking social media (e.g. Facebook, twitter, etc.) binary logistic models.*

Model Family	Model Configuration	D.f.	χ^2	$P(\chi^2)$
GLM	Fixed effects	6		
GLMM	Fixed effects & Random Intercepts	7	108.89	**<0.001**

3.2.5 *Factors associated with self-declared behaviour such as riding within 1 hour after taking drugs (other than prescribed or over-the-counter medication)*

***Table 10**: Factors that influence the self-declared behaviour of riding within 1 hour after taking drugs (other than prescribed or over-the-counter medication).*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **ride within 1 hour after taking drugs (other than prescribed or over the counter medication)** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-0.564	0.549	-1.026	0.305	-
Gender (ref: Male)					
Female	-0.295	0.074	-3.980	**<0.001**	0.745
Age (ref: 18-34)					
35-54	-0.088	0.073	-1.201	0.230	0.916
55-74	-0.611	0.125	-4.885	**<0.001**	0.543
What is the highest qualification or educational certificate that you have obtained? (ref: None)					
Primary education	-0.695	0.576	-1.206	0.223	0.499
Secondary education	-0.894	0.542	-1.648	0.099	0.409
Bachelor's degree or similar	-0.614	0.541	-1.135	0.256	0.541
Master's degree or higher	-0.513	0.544	-0.943	0.346	0.599
Urbanization level (ref: Rural)					

Urban/ semi-urban	-0.285	0.097	-2.928	**0.003**	0.752

The fixed effects results of the fifth model indicate that women are 26% less likely to report riding within 1 hour after taking drugs (other than prescribed or over the counter medication) when compared to men (OR=0.745). Furthermore, people aged over 55 years are less likely to report this behaviour when compared to people aged 18-34 years (55-74: OR=0.54). Moped riders and motorcyclists living in urban or semi-urban areas are 25% less likely to declare riding within 1 hour after taking drugs compared to those who live in rural areas (OR=0.75).

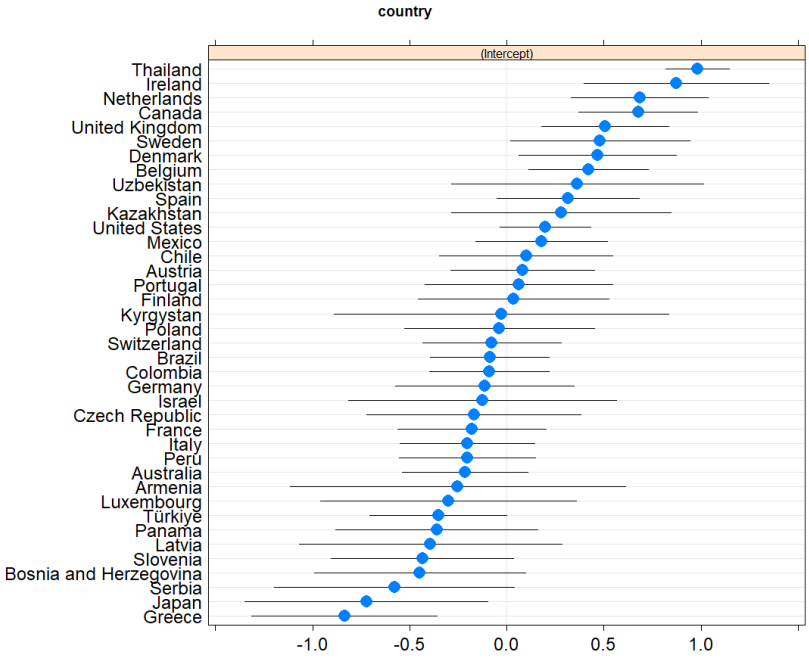

***Figure 5**: Random intercepts for countries in the Binary GLMM for self-declared riding within 1 hour after taking drugs (other than prescribed or over-the-counter medication).*

***Table 11**: Log-likelihood comparison for self-declared riding within 1 hour after taking drugs binary logistic models.*

Model Family	Model Configuration	D.f.	χ^2	P(χ^2)
GLM	Fixed effects	9		
GLMM	Fixed effects & Random Intercepts	10	149.70	**<0.001**

3.2.6 *Factors associated with self-declared behaviour such as riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users)*

***Table 12**: Factors that influence the self-declared behaviour of riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users).*

Independent variable (reference category)	Dependent variable: self-declared behaviour (past 30 days) – **ride too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users)** {0=never; 1=at least once}				
	Beta Estimate	S.E.	z-value	P(>[z])	Adj. Odds Ratio
(Intercept)	-0.443	0.084	-5.256	**<0.001**	-
Gender (ref: Male)					
Female	-0.437	0.065	-6.764	**<0.001**	0.646
Age (ref: 18-34)					

35-54	-0.147	0.064	-2.273	**0.023**	0.863
55-74	-0.362	0.095	-3.826	**<0.001**	0.696
Do you oppose or support a legal obligation ...? limiting the speed limit to 30 km/h in all built-up areas (except on main thoroughfares) (ref: oppose/neutral)					
Support	-0.563	0.062	-9.118	**<0.001**	0.569
How acceptable do you, personally, feel it is for a MOPED RIDER or MOTORCYCLIST to ...? ride faster than the speed limit outside built-up areas (except motorways/freeways) (ref: unacceptable/neutral)					
Acceptable	1.865	0.093	20.144	**<0.001**	6.456

The fixed effects results of the last model indicate that women are 36% less likely to report riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users) when compared to men (OR=0.646). Moreover, people aged over 35 years are less likely to report this driving behaviour when compared to people aged 18-34 years (35-54: OR=0.86, 55-74: OR=0.696). Individuals who support the legal obligation of limiting the speed limit to 30km/h in all built-up areas (except on main thoroughfares) are 43% less likely to adopt this driver behaviour than people opposed to this statement. Overall, people who believe that this behaviour is acceptable are over six times more likely to commit such behaviour.

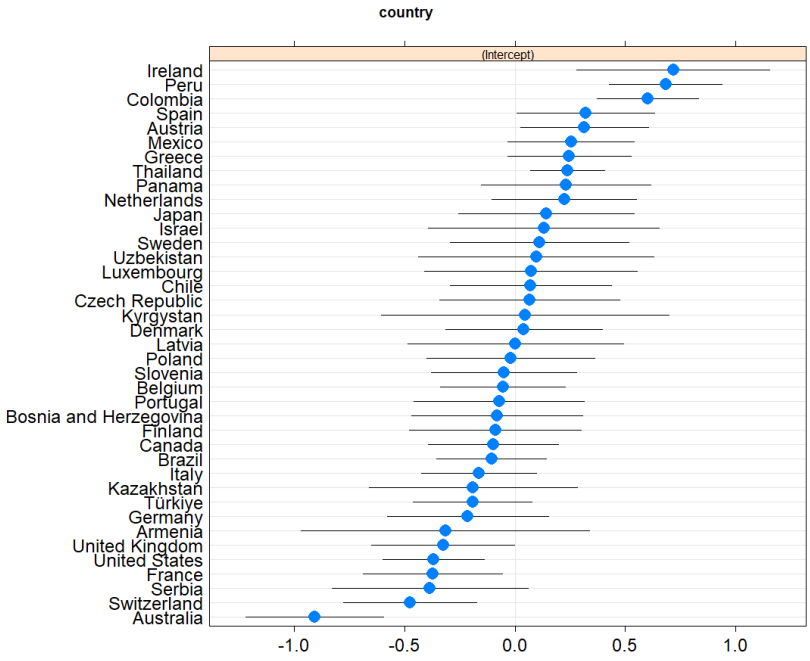

***Figure 6**: Random intercepts for countries in the Binary GLMM for self-declared riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users).*

***Table 13**: Log-likelihood comparison for self-declared riding too fast for the road/traffic conditions at the time binary logistic models.*

Model Family	Model Configuration	D.f.	χ^2	$P(\chi^2)$
GLM	Fixed effects	6		
GLMM	Fixed effects & Random Intercepts	7	109.98	**<0.001**

4. Discussion

Moped and motorcycles are common means of transport in the three examined world regions. However, in all the examined countries road users do not consider them to be safe enough (Nikolaou et al., 2024). Despite recognising the more dangerous nature of driving a moped or motorcycle, a significant percentage of moped riders and motorcyclists admit to having adopted risky behaviours while riding in the past 30 days. This is the case for all the examined risky behaviours, namely drinking and riding, speeding outside built-up areas (but not on motorways/freeways), riding without a helmet, reading a text message/email or checking social media while riding, riding within 1 hour after taking drugs (other than prescribed or over the counter medication) and riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users) for all world regions. The selection of just a 30 days period of reference ensures increased accuracy of the responses as it is a relatively recent period to recall.

The above results may indicate that moped riders and motorcyclists attribute the increased risk not to their own behaviour but rather to their interaction with other road users, road infrastructure and the environment. Similar perceptions have been recorded in previous works (2BeSafe, 2012; Nordqvist and Gregersen, 2010). Age and gender are well-known factors affecting the behaviour of road users with younger, male users being more prone to adopting risky behaviours. Concerning drink-riding, speeding, riding without a helmet, reading a text message/email or checking social media while riding, riding within 1 hour after taking drugs (other than prescribed or over the counter medication) and riding too fast for the road/traffic conditions at the time (e.g., poor visibility, dense traffic, presence of vulnerable road users) no common pattern was observed among the different age groups in the three world regions. This could be possibly explained due to regional special characteristics and actions, such as differences in alcohol consumption due to religious and social habits or the dispersion of technology in different areas and age groups, as well as of targeted enforcement and awareness raising measures related to the specific risky behaviours. A more uniform situation was recorded concerning the gender of moped riders and motorcyclists adopting risky behaviours with males prevailing in most cases and world regions. A few deviations where more female riders adopt a risky behaviour in certain world regions may be again explained based on local particularities related to social and safety culture.

Advanced analysis of the willingness to report adopting risky behaviours also confirmed that this is higher among male moped riders and motorcyclists. This may be related to the increased experience and higher confidence that usually male riders have. On the other hand, female riders may be more reluctant to admit to breaking the law. The strong association of perceived behavioural control with most of the examined risky behaviours can also be an indication that enforcement measures may be markedly effective in eliminating such behaviours. In any case, motorcyclists and moped riders constitute one of the most vulnerable road user groups. Thus, targeted measures to improve their behaviour on the road are necessary, especially in the world regions where moped or motorcycle is a prevailing mean of transport used by people with different socio-demographic characteristics and serve several different purposes.

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