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E-Survey of Road users' Attitudes

Cyclists

ESRA2 Thematic report Nr. 11

Publications Date of this report: 18/11/2020
Main responsible organization for this report: bfu - Beratungsstelle für Unfallverhütung, Switzerland
D/2020/0779/33 - Report number: 2020-T-07-EN

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Please refer to this document as follows: Achermann Stürmer, Y., & Berbatovci, H., Buttler, I. (2020). Cyclists. ESRA2 Thematic report Nr. 11. ESRA project (E-Survey of Road users' Attitudes). Bern, Switzerland: Swiss Council for Accident Prevention.

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Acknowledgement

The authors of this report would like to thank the following persons and organizations for their much-appreciated contribution to this report:

- PRP (Carlos Pires) + CTL (Davide Shingo Usami, Isabella Corazziari) for providing the descriptive figures;
- NTUA (Alexandra Laiou) + bfu (Yvonne Achermann) for providing contextual information on the topic;
- SWOV (Charles Goldenbeld) for reviewing this report and for coordinating the review procedure;
- Vias institute (Uta Meesmann, Katrien Torfs, Huong Nguyen, Wouter Van den Berghe) for coordinating ESRA, conducting the fieldwork and developing the ESRA2 survey and database;
- PRP (Carlos Pires) for supervising the quality of the ESRA2 database;
- all ESRA2 core group organizations for helping to develop the ESRA2 survey and the common ESRA2 output;
- all ESRA2 partners for supporting and financing the national ESRA2 surveys in 32 countries.

ESRA is funded through the contributions of the partner organisations, either from their own resources or from sponsoring. Part of the funding for Vias institute is provided by the Belgian Federal Public Service Mobility & Transport.

Table of contents

List of Abbreviations

Country codes

AT	Austria
AU	Australia
BE	Belgium
CA	Canada
CH	Switzerland
CZ	Czech Republic
DE	Germany
DK	Denmark
EG	Egypt
EL	Greece
ES	Spain
FI	Finland
FR	France
HU	Hungary
IE	Ireland
IL	Israel
IN	India
IT	Italy
JP	Japan
KE	Kenya
KR	Republic of Korea
MA	Morocco
NG	Nigeria
NL	Netherlands
PL	Poland
PT	Portugal
RS	Serbia
SE	Sweden
SI	Slovenia
UK	United Kingdom
US	United States
ZA	South Africa

Other abbreviations

ESRA	E-Survey of Road Users' Attitudes
EU	European Union
ICW	Individual country weight used in ESRA2
ITF	International Transport Forum
OECD	Organisation for Economic Co-operation and Development
OR	Odds Ratio
WHO	World Health Organisation

Executive summary

Objective and methodology

ESRA (E-Survey of Road users' Attitudes) is a joint initiative of road safety institutes, research centres, public services, and private sponsors from all over the world. The aim is to collect and analyse comparable data on road safety performance, in particular road safety culture and behaviour of road users. The ESRA data are used as a basis for a large set of road safety indicators. These provide scientific evidence for policy making at national and international levels.

Vias institute in Brussels (Belgium) initiated and coordinates ESRA, in cooperation with eleven core group partners (BASt, BFU, CTL, IATSS, IFSTTAR, ITS, KFV, NTUA, PRP, SWOV, TIRF). At the heart of ESRA is a jointly developed questionnaire survey, which is translated into national language versions. The themes covered include self-declared behaviour, attitudes and opinions on unsafe traffic behaviour, enforcement experiences and support for policy measures. The survey addresses different road safety topics (e.g. driving under the influence of alcohol, drugs and medicines, speeding, distraction) and targets car occupants, motorcycle and moped drivers, cyclists and pedestrians.

The present report is based on the second edition of this global survey, which was conducted in 2018 (ESRA2_2018). In total this survey collected data from more than 35.000 road users across 32 countries. An overview of the ESRA initiative and the project-results is available on: www.esranet.eu.

This thematic ESRA report on cyclists describes the frequency with which people use a bicycle (electric or not), self-declared behaviours, safety perception while using a bicycle and support for policy measures aimed at cyclists in 32 countries. It includes comparisons across the participating countries as well as between age groups and genders at the regional level.

Key results

The relevant findings based on the ESRA2 results on cyclists can be summarised as follows:

Frequency of cycling

- The region with the highest proportion of persons declaring that they cycle is Asia-Oceania: 65% of the respondents have used a conventional (non-electric) bicycle and 29% an electric bicycle at least a few days during the past 12 months.
- The countries with the highest percentages of users of conventional bicycles are all European: in Poland, Slovenia and Hungary, at least 80% of the respondents used this mode of transport at least a few days during the past 12 months. In addition, in the Netherlands, Hungary and Denmark, 20% or more use a conventional bicycle at least 4 days a week.
- The use of electric bicycles is more widespread in Asia-Oceania and Africa than in Europe and North America. The highest percentages of respondents who reported using an electric bicycle at least a few days during the past 12 months are found in Egypt (36%), India (33%) and Nigeria (32%).
- Men ride bicycles (conventional or electric) more often than women, and young adults more often than elderly people.
- Over the last three years, within the countries that participated in both ESRA surveys (i. e. 2015/2016 and 2018), the number of people who reported cycling has increased.

Self-declared unsafe cycling behaviours

- Of the five proposed unsafe behaviours, cycling under the influence of alcohol is the least frequently mentioned by cyclists, and riding without a helmet is the most frequently mentioned.
- In jurisdictions where the use of helmet is mandatory for all cyclists (Australia, Nigeria and South Africa, some states of Canada and the United States as well as Spain and Israel when riding outside built-up areas), the percentage of persons reporting cycling without a helmet is

markedly lower (between 30% and 54%) than in most other countries. The countries with the highest percentages of cyclists who report that they are not wearing a helmet are all European (i. e. the Netherlands, Hungary, Belgium: all above 82%).

- Overall, men are more likely than women to report unsafe behaviours and the percentage of respondents who report unsafe behaviours while cycling tends to decrease with age.

Perceived safety when using a bicycle

- The highest proportion of respondents who indicated that they feel safe when using a bicycle was found in Asia-Oceania (safety perception average score of 7 points on a scale ranging from 0=very unsafe to 10=very safe for both types of bicycles), and the lowest in Africa (score of 5.8 points for using a conventional bicycle and 5.1 points for using an electric bicycle).
- The perception that using a conventional bicycle was safe was most strongly present in European countries with Danish cycle users having the highest perceived safety score (7.4). Outside Europa, conventional cycle users in India reported the highest perceived safety (7.1 points). Very low perceived safety was found among conventional cycle users in Greece (4.5), Republic of Korea (4.8) and South Africa (5.0).
- The highest safety perception for the use of an electric bicycle was again recorded in Europe, with Denmark and Germany at the top (both 7.0 points). India ranks at the fifth position with 6.8 points. The lowest safety perception is found in Israel (4.1 points), South Africa (4.4 points), Nigeria and the Republic of Korea (both 4.6%).
- Over the last 2-3 years, there were small changes in the safety perception of cyclists. Overall, the perceived safety scores increased by 7 percentage points concerning the use of conventional bicycles and by 2 percentage points for electric bicycles. Attention should be paid to the countries where the safety perception has declined (e.g. in the United States, Korea and Greece).

Support for cycling-related policy measures

- The four policy measures proposed to the respondents (mandatory helmet use for all cyclists, for cyclists under the age of 12, ban of the use of headphones and obligation to wear reflective material when cycling in the dark) are supported by all regions, ranging from 58% approval for banning the use of headphones while cycling in North America to 87% approval for mandatory helmet use for cyclists under the age of 12 in Africa.
- The Netherlands and Japan are the only two countries where the majority of respondents do not agree with a legal requirement for all cyclists to wear a helmet.
- Women tend to be more supportive of policy measures aimed at cyclists, but the differences are rather small.
- Overall, we observe that the older the respondents, the higher the support for policy measures (at least in the European region).
- Over the last 2-3 years, the support for mandatory helmet use for all cyclists has increased among cyclists (using non-electric or electric bicycles) in most countries. Only the United States, the Republic of Korea and Poland recorded a decrease in support.

Explanatory variables associated with self-reported cycling while listening to music, reading messages/checking social media or cycling without a helmet

- Logistic regression models confirmed previous observations regarding the effects of gender and age: women and older cyclists are less likely to report unsafe behaviours.
- Persons who ride bicycles frequently are more likely to report unsafe behaviours than persons who cycle no more than a few days a month. The odds for persons cycling at least 4 days a week, compared to those that rarely cycle, are increased by 40% for 'not wearing a helmet',

by 18% for 'listening to music' and by 75% for 'reading messages/emails or checking social media'.

- Switzerland, Ireland, Portugal, the United Kingdom, Canada, Israel, the United States, Australia and South Africa are the countries where the cyclists were the most likely to wear a helmet. The countries where cyclists were the least likely to protect themselves with a helmet are Belgium, the Netherlands, Poland, Hungary and Serbia.
- The cyclists living in Austria, Switzerland, Slovenia and Japan are most likely to report that they do not use headphones while riding their bicycle. At the other end of the scale, we find Greece, the Republic of Korea, India and four of the five African countries: Egypt, Kenya, Nigeria and Morocco.
- Compared to Poland, the 'average European country' in terms of the behaviour 'reading a message/email or checking social media when cycling', several countries are well below this average (odds decreased by at least 30%): Austria, Switzerland, Germany, Slovenia, Hungary, Nigeria and South Africa. In only two countries, Egypt and Morocco, the cyclists are more likely to report that they "read a message/email" or check social media when cycling".

Description of the road user group 'cyclists'

- In the group of 'cyclists' (i. e. persons who cycle at least a few days a month and drive a car no more than a few days a month) compared to the group of 'car drivers' (persons who drive a car at least a few days a month and cycle no more than a few days a month), the proportion of women is smaller. In Europe, however, there is no gender difference between these two groups.
- The group of 'cyclists' tends to be younger than the 'car drivers' group.
- A relationship was found in Europe between the level of urbanisation and the types of road users, where the percentage of road users living in an urban area is significantly higher among the cyclists (46%) than among the car drivers (36%). However, in the other regions no such evidence was found.
-

Comparison of responses between 'cyclists' and 'car drivers' with regard to support towards policy measures or traffic rules, perception of accident causes and involvement in road crashes

- 'Cyclists' ('persons who cycle at least a few days a month and drive a car no more than a few days a month') are much less inclined to approve policy measures aiming at cyclists than 'car drivers' (persons who drive a car at least a few days a month and cycle no more than a few days a month). Since these measures only apply to cyclists, it is understandable that non-cyclists, who are not forced to change their behaviour, are more supportive.
- With regard to the acceptance of a legal requirement for all cyclists to wear a helmet, there are considerable differences between the types of road users especially in Europe. While 'car drivers' accept with a share of 72% this measure, the share among 'cyclists' is 50% (respectively 57% for those who also often drive a car).
- In all regions, 'cyclists' answered that they were more often involved in a road crash than 'car drivers'. It has to be pointed out that a road crash can also involve a one-sided accident, such as a fall from a bicycle without a collision.

Relationship between the perceived safety when cycling and cycling fatalities per billon km cycled

- In countries with a relative low number of cycling fatalities per billion km (the Netherlands, Denmark, Sweden, Switzerland and Finland), the mean scores of perceived safety when cycling are rather high.

- Inversely, in countries where the number of bicycle fatalities per billion km is relatively high, the mean scores of perceived safety when cycling are rather low. This is the case, for example, in Italy or in the United States.
- There are countries, however, where the levels of perceived safety are particularly low compared to their distance-related fatality rates. This is the case for Ireland, the United Kingdom, Belgium and France. Obviously, the perception of being safe/unsafe in traffic is not only influenced by an objective measure of safety.

Key recommendations

The measures presented below were proposed in the works of Morris et al., 2018, Shinar, 2017, Schepers et al., 2017, Goodwin et al., 2015, OECD/ITF, 2013 and Walter et al., 2012.

- Develop high quality (bicycle) networks and design junctions strongly focused on security aspects as well as establish access restriction zones such a low-speed zones.
- Ensure by incentives or legislation that motor vehicles (namely cars, goods vehicles, coaches and busses) are equipped with electronic systems, in particular bicycle detection systems or brake assist systems.
- Motivate cyclists to wear fluorescent and retroreflective materials and to ensure that their bicycles are in good condition with lights in working order.
- Raise awareness of the specific dangers of certain behaviours such as riding impaired, distracted, at an excessive speed or hardly visible.
- Instruct motorists and cyclists on how they should interact safely with each other and inform them of the requirements of relevant laws.
- Develop recommendations about proper rules (i. e. speed limits) for slow and rapid electric bicycles and rules about the interactions between the conventional and electric bicycles.
- Promote bicycle helmet use through information, incentives and/or enforcement of helmet laws.

The ESRA initiative has demonstrated the feasibility and the added value of joint data collection on road safety performance by partner organizations all over the world. The intention is to repeat this initiative on a triennial basis, retaining a core set of questions in every wave. In this way, ESRA produces consistent and comparable road safety performance indicators that can serve as an input for national road safety policies and for international monitoring systems on road safety performance.

1 Introduction

Cyclists are vulnerable road users. In a collision, the kinetic forces resulting from differences in mass and speed of the various types of road vehicles largely determine the severity of the accident (OECD/ITF, 2013). The consequences of collisions are particularly serious for cyclists, who do not benefit from the level of protection provided to the occupants of cars and other vehicles. The high levels of cyclist accidents also reflect an infrastructure that gives priority to cars and other motorized vehicles (WHO, 2018).

In this report, we consider users of conventional (non-electric) as well as of electric bicycles, where the pedalling is supported by a battery-powered electric motor. In many countries, electric bicycles with a pedal assistance that does not exceed 0.25 kW, respectively limited to a speed of 25 km/h are considered as bicycles. Beyond these limits, they are often classified as mopeds. Nonetheless, many experts consider them as part of the cycling experience and cycling problem. As it is difficult to distinguish between the different types of electric bicycles in a population survey, we have decided to include them all in this report.

In 2018, the WHO (2018) reported that cyclists accounted for 3% of all road user deaths worldwide. The corresponding shares are 5% in Europe, 3% in America (North and South), 4% in Africa, 2% in the Eastern Mediterranean and South East Asia and 6% in the Western Pacific region (WHO, 2018). According to Adminaité-Fodor and Jost (2020), in the EU member states as well as in Israel, Norway, the Republic of Serbia and Switzerland, 8% of the total number of road users killed were cyclists. Between 2010 and 2018, the number of cyclists killed in these countries has been decreasing at a slower rate than that of motor vehicle occupants killed (Adminaité-Fodor & Jost, 2020).

However, bicycle accidents are under-reported, as documented in various studies (Santacreu, 2018, Shinar, 2017, OECD/ITF, 2013, Juhra et al., 2012). Especially in an accident not involving motor vehicles, for example if a cyclist hits a fixed object or falls, the event is rarely reported by the police (Shinar, 2017). Therefore, in accident statistics, the number of cyclists injured in road traffic tends to be too low. Underreporting is less prevalent in the event of fatal crashes involving cyclists than in the case of an accident where a cyclist was slightly injured and still managed to leave the accident site on his own (OECD/ITF, 2013). In its publication, the OECD/ITF (2013) quotes several studies that have assessed the extent of the underestimation. Shinar (2017) points out that the under-reporting mentioned above also leads to an underestimation of the risk of bicycle accidents.

Many risk factors play a role in the likelihood or outcome of a bicycle accident. The most important factors are related to an inherently unsafe traffic system, respectively unsafe infrastructure (OECD/ITF, 2013). Further risk factors are associated with age, gender, knowledge of traffic regulations, compliance, hazard awareness, influence of alcohol or other substances, conspicuity, speed, distraction, weather (temperature, road and light conditions), technical defaults at the bicycle, etc. (Shinar, 2017, Walter et al., 2012).

Adminaité et al. (2015) have calculated that the risk of being killed as a cyclist is considerably higher for people older than 65 than for younger age groups (average of 10 deaths annually per million elderly population vs. 1.1 deaths annually per million child population under 15 or 2.6 deaths annually per million population aged 15-24). The loss of agility and skills and the increase in physical frailty can explain these differences (Shinar, 2017, Walter et al., 2012).

Males are more often involved in a bicycle accident than females. One reason lies simply in the fact that males are more likely to ride a bicycle than females. However, there are also true gender-related differences that increase the risk of accidents, such as riding at night, under the influence of alcohol, at higher speed, etc., which are more prevalent among males (Shinar, 2017).

Riding a bicycle after consuming alcohol is an important risk factor. Statistics for the U. S. show that in 2013, one-fifth of all cyclists killed in a road accident had a BAC of over 0.8 g/l (Goodwin et al., 2015). According to Li et al. (1996), the risk of a fatal accident is almost three times higher for cyclists under the influence of alcohol (adj. OR=2.8) than for non-alcoholised cyclists. The authors note that this might in part be due to the significant lower helmet wearing rate among cyclists under the influence of alcohol.

In a further study, Li et al. (2001) assessed the relative risk of fatal or serious bicycling injury associated with alcohol consumption by using a matched case-control design: the odds of sustaining a cycling injury was nearly six times (5.6) higher when the cyclist had a BAC of 0.02 g/dL or higher. The corresponding odds for a BAC of 0.08 g/dL or higher was 20.2. The relationship between riding a bicycle under the influence of alcohol and not wearing a helmet has also been observed in other studies, i. e. from Crocker et al. (2010).

The visibility of cyclists is also a crucial issue. Many accidents occur because car drivers do not detect cyclists early enough. In this respect, the cyclists' clothing seems to be more relevant than the bicycle light (Wood et al., 2012, Kwan & Mapstone, 2006).

Nowadays, the use of portable electronic devices while cycling is widespread. In the Netherlands, 70% of the cyclists use such a device at least sometimes while riding a bicycle (Goldenbeld et al., 2012). Younger cyclists are more likely to listen to music or use the phone than the elder. Goldenbeld et al. (2012) indicate that teen and young adult cyclists who use portable electronic devices on each trip are 1.6 to 1.8 times more likely to be involved in a collision than cyclists in the same age groups who do not use such a device when cycling.

Various measures targeting cyclists, bicycles, potential collision partners, motor vehicles, as well as road infrastructure can be taken to increase cyclist safety. The measures presented below were proposed in the works of Morris et al., 2018, Shinar, 2017, Goodwin et al., 2015, OECD/ITF, 2013 and Walter et al., 2012). Infrastructure measures are to be mentioned first. They should encompass the creation of ambitious plans and the development of high quality networks and of junctions that generate a safe and attractive cycling environment. These infrastructure measures, as well as those described hereafter, should be embedded in an overall safe system approach. Another important measure should ensure by incentives or legislation that motor vehicles (namely cars, goods vehicles, coaches and busses) are equipped with electronic systems, in particular bicycle detection systems or brake assist systems. There is also a need to raise awareness of the specific dangers related to certain behaviours such as riding impaired, distracted or at an excessive speed etc. The bicycles themselves must be in good condition with lights in working order. To increase their conspicuity, cyclists should wear fluorescent and retroreflective materials, if possible at the level of the ankles and knees, i. e. the moving joints of a cycling person. In addition, it seems necessary to instruct motorists and cyclists on how they should interact safely with each other and to inform them of the relevant laws. Finally, an important measure is the promotion of bicycle helmet use through information, incentives and/or enforcement of helmet laws.

In a previous research work based on surveys, i. e. the project SARTRE 4 carried out in 2010 in 18 European countries and Israel, the risk perception of cyclists, the self-declared behaviours such as cycling with a helmet or wearing retroreflective clothing were analysed. The survey included questions on the satisfaction with bicycle safety and bicycle infrastructure and the opinion on drinking and cycling. The results showed, for instance, that the countries with the highest self-declared helmet wearing rates were the Czech Republic, Ireland and Austria (all above 30%) while the lowest rates were found in the Netherlands, Hungary and Poland (below 10%).

The data of ESRA (E-Survey of Road users' Attitudes) make it possible to study and compare different countries with regard to cycling, integrating aspects such as self-declared unsafe behaviours, support for policy measures and risk perception. This report presents the findings on cycling provided by the second edition of ESRA (ESRA2), by which data was collected in 32 countries around the world at the end of 2018. Results based on the first ESRA edition (ESRA1), which gathered data for 17 European countries in 2015 and 8 further countries scattered all over the world in 2016, were published in 2019 (Torfs & Meesmann, 2019.

The ESRA2 findings are used to answer the following research questions:

- *How do regions and countries differ in shares of conventional and electric cycling?*
- *How do regions and countries differ in self-declared unsafe cycling behaviour?*
- *How do regions and countries differ in risk perception concerning cycling?*

- *How do regions and countries differ in their support for cycling safety measures?*
- *What are the main differences between males and females as well as between age groups?*
- *Which explanatory variables are associated with self-reported listening to music, or reading messages/checking social media while cycling or cycling without a helmet?*
- *How do respondent groups identified as (mainly) 'cyclists' and (mainly) 'car drivers' differ in their support for cycling measures, their perception of accident causes and involvement in crashes?*
- *What are the changes over time (between 2015/2016 and 2018) in the perception of safety while cycling and in the support for mandatory helmet use for all cyclists?*

2 Methodology

ESRA (E-Survey of Road users' Attitudes) is a joint initiative of road safety institutes, research centres, public services, and private sponsors from all over the world. The aim is to collect and analyse comparable data on road safety performance, in particular road safety culture and behaviour of road users. The ESRA data are used as a basis for a large set of road safety indicators. These provide scientific evidence for policy making at national and international levels.

ESRA data is collected through online panel surveys, using a representative sample of the national adult populations in each participating country (at least N = 1000 per country). At the heart of this survey is a jointly developed questionnaire, which is translated into national language versions. The themes covered include self-declared behaviour, attitudes and opinions on unsafe traffic behaviour, enforcement experiences and support for policy measures. The survey addresses different road safety topics (e.g. driving under the influence of alcohol, drugs and medicines, speeding, distraction) and targets car occupants, motorcycle and moped drivers, cyclists and pedestrians. The present report is based on the second edition of this global survey, which was conducted in 2018 (ESRA2_2018). In total this survey collected data from more than 35 000 road users across 32 countries.

The participating countries in ESRA2_2018 were:

- Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom;
- America: Canada, USA;
- Asia and Oceania: Australia, India, Israel, Japan, Republic of Korea;
- Africa: Egypt, Kenya, Morocco, Nigeria, South Afrika.

Vias institute in Brussels (Belgium) initiated and coordinates ESRA, in cooperation with eleven core group partners (BASt (Germany), BFU (Switzerland), CTL (Italy), IATSS (Japan), IFSTTAR (France), ITS (Poland), KFV (Austria), NTUA (Greece), PRP (Portugal), SWOV (the Netherlands), TIRF (Canada)). The common results of the ESRA2_2018 survey will be published in a Main Report, a Methodology Report and at least fifteen Thematic Reports (Table 1). Furthermore, 32 country fact sheets were produced, in which national key results are compared to a regional mean (benchmark) and scientific articles, national reports and many conference presentations are currently in progress. An overview of the results and news on the ESRA initiative is available on: www.esranet.eu

Table 1: ESRA2 Thematic Reports

Driving under influence	Child restraint systems	Cyclists
Speeding	Unsafety feeling & risk perception	Moped drivers & motorcyclists
Distraction (mobile phone use)	Enforcement	Young road users
Fatigue	Vehicle automation	Elderly road users
Seat belt	Pedestrians	Gender aspects

The present report summarizes the ESRA2_2018-results with respect to cycling. An overview of the data collection method and the sample per country can be found in (Meesmann & Torfs, 2019. ESRA2 methodology). Most figures in this report follow the ESRA2 standard. However, for some figures (see sections 3.2.2, 3.3.1 and 3.3.2, a slightly different format is used.

Note that a weighting of the data was applied to the descriptive analyses. This weighting took into account small corrections with respect to national representativeness of the sample based on gender and six age groups: 18-24y, 25-34y, 35-44y, 45-54y, 55-64y, 65y+; based on population statistics from United Nations data (United Nations Statistics Division, 2019). For the regions, the weighting also took into account the relative size of the population of each country within the total set of countries from this region. SPSS 24.0 was used for all analyses.

3 Results

3.1 Overall results

This section presents the results of ESRA2 questions on cycling, conventional (non-electric) as well as electric. They cover the following topics:

- frequency of cycling (in the past 12 months) (Section 3.1.1),
- self-declared behaviour (last 30 days) (Section 3.1.2),
- safety perception of using a bicycle (electric or not) (Section 3.1.3) and
- support for policy measures (Section 3.1.4).

In each country surveyed by ESRA2, about 1000 road users participated in the survey. Statistical tests of differences between regions, gender and age groups have been performed. Given the rather large sample sizes, nearly all regional, gender and age group differences described in this chapter were statistically significant at the $p < 0.001$ level. Besides statistical significance, also the effect sizes of the tested differences were calculated. Nearly all effect sizes were rather "small"(Cramer's V mainly less than 0.2).

3.1.1 Frequency of cycling (in the past 12 months)

In the ESRA2-survey, the respondents had to answer to the question "During the past 12 months, how often did you use each of the following transport modes. About twenty modes of transport were listed, including 'cycle (non-electric)' and 'cycle on an electric bicycle/e-bike/pedelec'. The answering options are presented in Table 2 (see also question Q10 in Appendix 1).

Table 2 presents the frequency of riding a conventional (non-electric) bicycle by countries and regions. The three countries with the highest proportions of respondents that reported riding a conventional bicycle at least a few days a year are Poland, Slovenia and Hungary. However, the countries with the most frequent users of such bicycles - at least 4 days a week - are the Netherlands, followed by Hungary and Denmark. The high proportions of people cycling in these countries can be explained by historical decisions, e. g. a reversal in transport and urban planning policies, and restrictive measures to the disadvantage of the private car (Pucher & Buehler, 2008). In the Netherlands there is evidence that the active promotion and support of cycling, and the production of cycling facilities – cycling paths, cycling storage, cycling repair shops – has its structural roots in the late decades of the 19th Century and first decades of the 20th Century (Lesisz, 2004).

Five years earlier, in 2013, the Eurobarometer study carried out among 27 680 Europeans in 28 Member States had already found the highest proportions of cyclists, in almost the same countries, i. e. the Netherlands, Denmark, Finland and Hungary (European Commission, 2013).

Table 2: Self-declared frequency of non-electric cycling among all road users by country and region (during the past 12 months, how often did you cycle non-electric?).

Country	at least 4 days a week	1 to 3 days a week	a few days a month	a few days a year	never
Australia	3.4%	7.4%	9.0%	11.9%	68.3%
Austria	10.2%	14.4%	20.6%	22.0%	32.9%
Belgium	10.5%	10.8%	13.6%	17.6%	47.5%
Canada	5.1%	9.6%	12.2%	20.9%	52.2%
Czech Republic	7.0%	9.0%	18.0%	24.9%	41.1%
Denmark	19.9%	14.3%	18.0%	19.2%	28.6%
Egypt	9.5%	10.7%	16.0%	18.3%	45.5%
Finland	13.6%	15.4%	18.8%	29.3%	22.9%
France	3.0%	6.9%	15.0%	17.0%	58.0%
Germany	11.3%	16.5%	19.1%	18.0%	35.1%
Greece	9.0%	7.5%	15.2%	30.4%	38.0%
Hungary	22.9%	15.6%	18.4%	23.6%	19.5%
India	17.0%	14.4%	20.7%	17.7%	30.2%
Ireland	5.6%	8.9%	13.6%	19.6%	52.3%
Israel	2.1%	3.2%	6.8%	20.3%	67.6%
Italy	10.6%	16.3%	19.6%	17.2%	36.2%
Japan	14.1%	13.2%	10.1%	8.0%	54.7%
Kenya	10.3%	11.9%	20.4%	19.0%	38.3%
Morocco	11.3%	9.1%	15.3%	19.3%	45.1%
Netherlands	28.4%	20.4%	13.5%	11.7%	26.0%
Nigeria	9.4%	13.2%	15.4%	14.9%	47.2%
Poland	15.9%	16.7%	27.8%	21.3%	18.3%
Portugal	3.1%	6.7%	13.2%	22.5%	54.4%
Republic of Korea	4.3%	13.9%	20.0%	15.0%	46.8%
Serbia	16.4%	13.1%	21.6%	27.4%	21.5%
Slovenia	13.1%	12.5%	28.4%	26.6%	19.4%
South Africa	4.1%	8.3%	12.4%	16.1%	59.0%
Spain	6.4%	12.4%	16.5%	18.3%	46.3%
Sweden	12.6%	15.0%	17.8%	23.0%	31.6%
Switzerland	8.1%	12.0%	16.9%	21.8%	41.3%
United Kingdom	5.4%	6.1%	10.9%	12.4%	65.2%
United States	4.1%	6.6%	10.2%	11.7%	67.3%
Region	**at least 4 days a week**	**1 to 3 days a week**	**a few days a month**	**a few days a year**	**never**
Europe20	9.8%	12.6%	17.4%	18.3%	41.9%
AsiaOceania5	15.8%	14.0%	19.1%	16.4%	34.7%
NorthAmerica2	4.2%	6.9%	10.5%	12.7%	65.7%
Africa5	9.2%	10.0%	15.3%	18.0%	47.6%

On the other hand, about two out of three respondents in Australia, Israel, the USA and the UK stated that they have never ridden a conventional bicycle in the last 12 months. In Australia and Israel topography and climate are important reasons for a low cycle usage, whereas in the US and UK policies to make cycling safe, convenient and attractive have lagged far behind (Pucher & Buhler, 2008).

However, when considering the frequency of respondents performing non-electric cycling per week by *region*, it is not the respondents from Europe that display the highest share but those from Asia-Oceania with 16% cycling at least 4 days a week. Only one third of the latter respondents said they had never ridden a bicycle in the last 12 months.

Table 3: Self-declared frequency of electric cycling among all road users by country and region (during the past 12 months, how often did you cycle on an electric bicycle/e-bike/pedelec?).

Country	at least 4 days a week	1 to 3 days a week	a few days a month	a few days a year	never
Australia	0.8%	2.1%	2.7%	2.7%	91.7%
Austria	1.2%	4.1%	3.8%	8.2%	82.8%
Belgium	2.8%	4.2%	4.3%	5.9%	82.7%
Canada	1.2%	3.6%	3.2%	5.4%	86.6%
Czech Republic	1.3%	1.7%	2.1%	10.2%	84.6%
Denmark	4.2%	4.0%	4.6%	5.4%	81.9%
Egypt	5.6%	7.7%	9.5%	12.9%	64.2%
Finland	0.5%	0.4%	1.7%	5.2%	92.2%
France	1.1%	2.6%	3.8%	6.4%	86.0%
Germany	2.0%	3.1%	3.3%	4.5%	87.0%
Greece	0.8%	2.0%	2.3%	6.6%	88.4%
Hungary	1.4%	2.1%	3.1%	10.3%	83.2%
India	6.4%	7.8%	10.3%	8.8%	66.7%
Ireland	1.5%	2.3%	3.4%	5.3%	87.5%
Israel	1.6%	1.1%	1.6%	5.7%	89.9%
Italy	3.2%	6.1%	8.0%	7.3%	75.4%
Japan	3.4%	4.1%	3.1%	1.8%	87.7%
Kenya	3.3%	2.8%	6.8%	7.7%	79.4%
Morocco	4.8%	5.7%	8.2%	11.7%	69.5%
Netherlands	9.2%	8.6%	5.3%	5.2%	71.7%
Nigeria	5.5%	6.6%	8.7%	11.3%	67.9%
Poland	1.0%	1.7%	4.0%	9.2%	84.1%
Portugal	0.8%	0.8%	2.9%	6.2%	89.3%
Republic of Korea	0.9%	1.6%	4.0%	3.2%	90.3%
Serbia	0.7%	1.0%	1.6%	6.5%	90.2%
Slovenia	0.9%	1.0%	2.6%	8.0%	87.5%
South Africa	1.2%	2.7%	4.9%	6.7%	84.5%
Spain	1.5%	6.3%	8.8%	7.8%	75.5%
Sweden	2.6%	3.7%	3.9%	8.9%	80.9%
Switzerland	3.2%	4.0%	4.8%	10.3%	77.6%
United Kingdom	1.1%	1.8%	2.7%	3.8%	90.5%
United States	1.0%	2.2%	2.9%	3.9%	90.1%
Region	**at least 4 days a week**	**1 to 3 days a week**	**a few days a month**	**a few days a year**	**never**
Europe20	2.0%	3.5%	4.5%	6.5%	83.5%
AsiaOceania5	5.6%	7.0%	9.0%	7.6%	70.8%
NorthAmerica2	1.0%	2.3%	2.8%	4.1%	89.7%
Africa5	4.4%	5.8%	8.0%	11.0%	70.8%

Regarding the self-declared frequency of electric cycling, the numbers in Table 3 provide a somewhat different perspective than in Table 2. The countries with the lowest proportion of respondents answering 'never having ridden an electric bicycle in the last 12 months' were Egypt (64%), India (67%), Nigeria (68%) and Morocco (70%). In other words, about 1/3 of all respondents in these countries have ridden an electric bicycle at least once during the last 12 months. In the other countries it was significantly less.

As with conventional cycling, the Netherlands again had the highest percentage of respondents (9%) who declared that they had ridden an electric bicycle on at least four days a week in the last 12 months. Conversely, Finland (8%), Australia (8%), the USA (10%) and the UK (9%) belong to the countries with the lowest frequency of electric cycling (at least a few days a year in the last 12 months). The reasons for the low use of electric bicycles in these countries might be the same as for non-electric: topography, climate and the extent of cycling-friendly policymaking (Pucher & Buhler, 2008).

At around 10%, North America indicates the lowest proportion of respondents who declared that they have ridden an electric bicycle (at least a few days a year in the last 12 months). The most respondents who declared that they use an electric bicycle at least a few days a year were found in the Asian-Oceanic and African region with 29%, i.e. more than one out of four.

3.1.2 Self-declared behaviour (last 30 days)

Respondents were asked about their behaviours as a cyclist in the last 30 days. The questions referred to the frequency of e.g. having read a text message, checked social media or worn headphones while cycling (see Figure 1 and question Q12_4 in Appendix 1). The answering scale ranged from 1 (never) to 5 (at least 4 days a week). For every question, it was determined how many respondents declared the behaviours mentioned at least once in the last 30 days (answering scale 2 to 5). The weighted means of these questions by region are displayed in Figure 1.

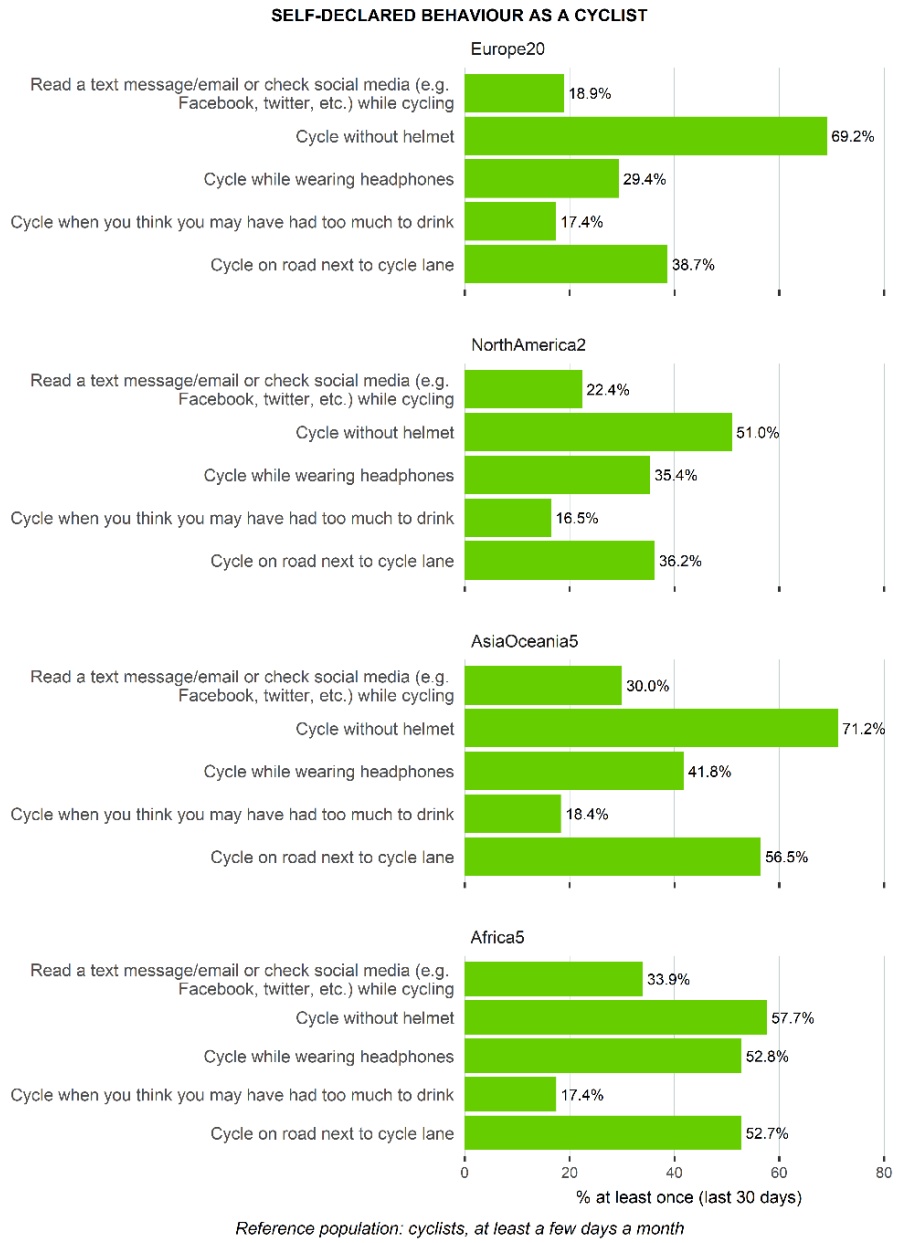


Figure 1: Self-declared behaviours as a cyclist, by region (% of cyclists that did at least once… in the last 30 days).

From Figure 1 it can be deduced that more than half of the respondents in all regions declared that they cycle without wearing a helmet. The differences between the regions are significant ($p < 0.001$; Cramer's V= 0.113), except between Europe and Asia-Oceania. Actually, in Europe and Asia-Oceania more than 2 out of 3 respondents indicated that they are not wearing a helmet while cycling.

Most respondents in Africa and Asia-Oceania declared that they cycle on the road next to the cycle lane, whereas in Europe and North America, only about a third stated doing so. Consequently, significant differences are observed only between Europe, Africa and Asia-Oceania as well as between North America, Africa and Asia-Oceania ($p < 0.001$; Cramer's $V = 0.158$).

More than 3 out of 4 respondents in all regions declared not to cycle when they think they may have had too much to drink. The interregional differences are not statistically significant.

Interestingly, the extent to which respondents declared that they cycle while wearing headphones differs significantly between all regions ($p < 0.001$; Cramer's $V = 0.180$). The use of headphones while cycling was most common among African cyclists. According to the results, every second cyclist rides his bicycle at least sometimes while wearing headphones in Africa. The least proportion of respondents using their headphones while cycling are located in Europe.

Clearly more respondents in Africa and Asia-Oceania stated that they read a message or check social media while cycling compared to those in Europe and North America. However, the score difference between Africa and Asia-Oceania is also significant at the $p < 0.001$ level (Cramer's $V = 0.144$), with Africa showing the highest proportion of cyclists reading a message or check social media.

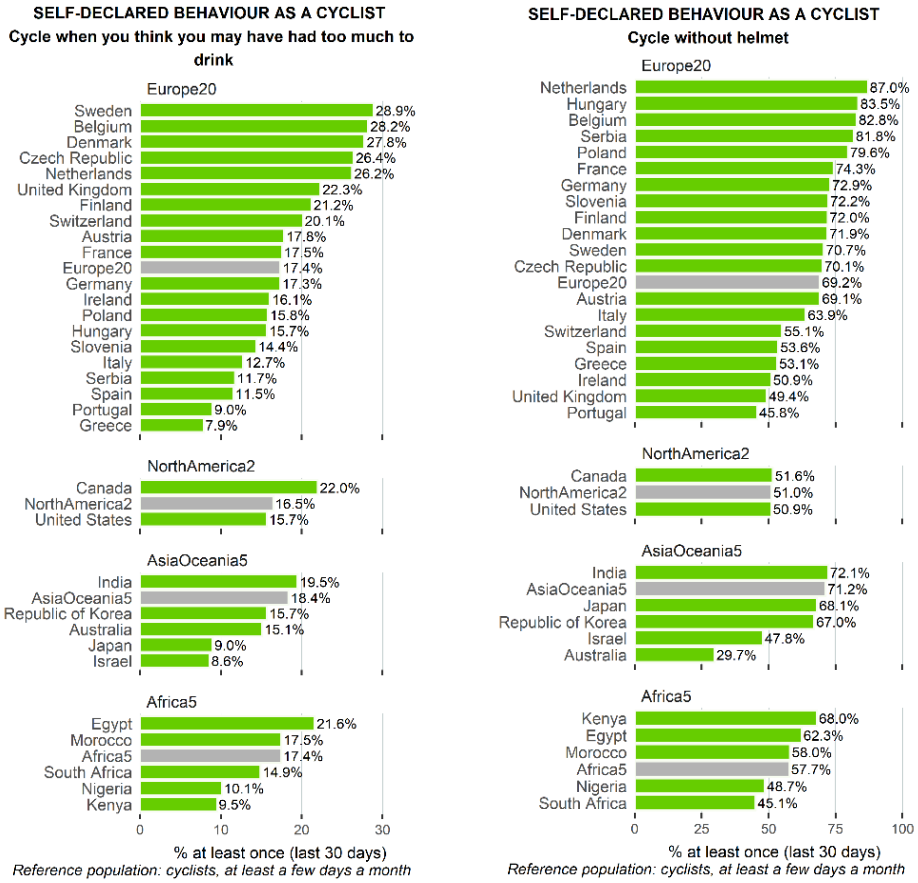


Figure 2: Self-declared behaviours as a cyclist by country and region (% of cyclists that did at least once… in the past 30 days).

Figure 2 gives a first country-specific overview of self-declared behaviours as a cyclist, or more precisely, the proportion of respondents having cycled with the feeling of being drunk and without wearing a helmet (at least once in the last 30 days). In all regions, the self-reported cycling when one may have had too much to drink varied considerably between the different countries in the region. Sweden shows the highest share of respondents affirming this statement with 29%, while in Greece, the share is only 8%. There is also a strikingly higher proportion of respondents in Canada (22%) displaying this behaviour in comparison to the respondents in North America (16%). In Asia-Oceania, more than twice

as many respondents in India (20%) make this statement compared to the cyclists from Israel (9%). The same pattern arises for the African states Egypt (22%) and Kenya (10%).

More than half of the cyclists surveyed across all regions have generally confirmed cycling without a helmet (at least once in the last 30 days). On average, respondents in Asia-Oceania (71%) and Europe (70%) most frequently stated that they had ridden without a bicycle helmet at least once in the last 30 days. The region with the lowest percentage is found in North America (51%). There is a general, weak tendency that the countries in which respondents indicated that they tend to cycle more frequently (see Table 2 and Table 3) are also the countries with the highest number of respondents who have cycled without a helmet at least once in the last 30 days.

In addition, we observe that in jurisdictions where helmet use is mandatory for all cyclists (Australia, Nigeria and South Africa, some states of Canada and the United States as well as Spain and Israel when riding outside built-up areas), the percentage of persons reporting cycling without a helmet is markedly lower than in most of the other countries (between 30% and 54%)[1].

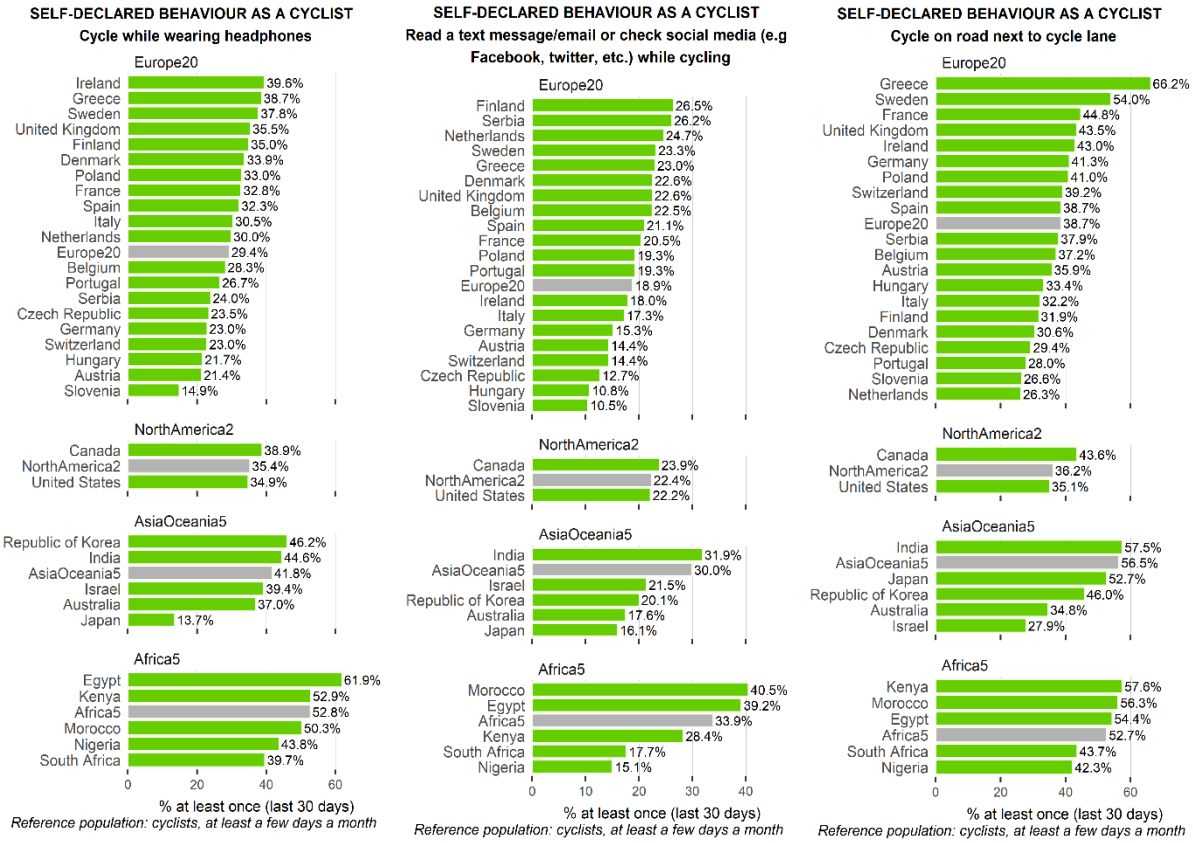


Figure 3: Self-declared behaviours as a cyclist by country and region (% of cyclists that did at least once… in the past 30 days).

Considering the wearing of headphones while riding a bicycle in Europe, Figure 3 reveals that the highest proportion of cyclists claiming this behaviour can be found in Ireland (40%), while in Slovenia only 15% reported that behaviour. As a result, a strong variability occurs between the respondents of the 20 European countries around the mean score of 30%. There is an even higher contrast for the Asian-Oceanian countries, where in the Republic of Korea, three times more respondents declared that they cycle while wearing headphones (46%) than in Japan (14%). Large differences appear in Africa as well, showing Egypt to be the country where more than half (62%) of the respondents reported that

[1] Information on the legal situation regarding cycling helmets in the various countries has been obtained from the IRTAD Annual Report 2017

behaviour compared to South Africa where only 40% indicated the same behaviour. In addition, Africa obtained the highest mean score (53%), reflecting the fact that every second respondent reports cycling while wearing headphones. In North America, respondents show a similar response pattern with a mean score of 35%.

Compared to the wearing of headphones, respondents declared on average a lower frequency of reading a text message/email or checking social media. The lowest frequency was shown by the European countries (19% on average) but there is also a high variability: Self-reported reading text messages or checking social media was most frequent in Finland (27%) and lowest in Slovenia (11%). The countries representing Africa show again the highest mean (34%) headed by Morocco (41%) and Egypt (40%). The respondents of the southern African countries, Nigeria and South Africa itself, show the lowest rates of self-declared reading text messages/email or checking social media at least once in the last 30 days (15% and 18%, respectively).

In India, almost one in three confirmed reading an SMS/e-mail or checking social media while cycling at least once in the last 30 days. In Japan, on the other hand, only 16% of the respondents declared doing so.

Concerning the statement if they cycled on the road next to the cycle lane, the result of the respondents from Greece stands out: 2 out of 3 reported this behaviour at least once in the last 30 days. This share is significantly outlying from the European mean score of 39%. In addition, more than half of the respondents in Sweden (54%) indicated that they at least sometimes engage in this behaviour. By contrast, only one in four respondents in the Netherlands made this statement (26%). The respondents with the highest percentage (57%) are found in Asia-Oceania. Once more, there is a strong contrast between the representing countries, namely India and Israel. While 28% of the respondents from Israel affirmed to cycle on the road next to the cycle lane at least once in the last 30 days, more than twice as many declared to do so in India (58%).

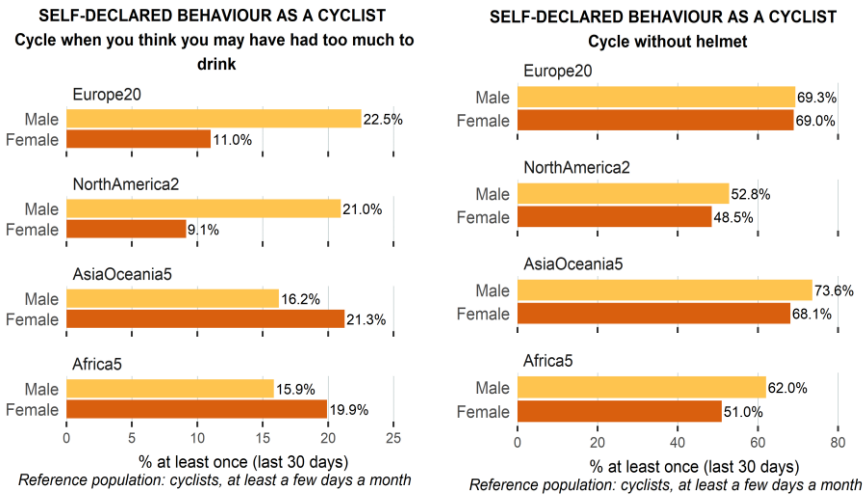


Figure 4: Self-declared behaviours as a cyclist by region and gender (% of cyclists that did at least once… in the past 30 days).

Figure 4 presents self-declared behaviours for male and female cyclists at least once in the last 30 days. Concerning the statement if the respondents 'cycled when they thought they might have had too much to drink', a gender effect appears for all regions, except Africa. While in Europe and North America significantly more male than female respondents reported this behaviour, in Asia-Oceania ($p < 0.001$), the contrary was observed. However, the strength of the association between this behaviour and the gender is rather small (Cramer's V between 0.064 and 0.156).

Significant differences between men and women are also found for the statement 'cycling without a helmet' in Asia-Oceania and Africa. In both regions, markedly more male than female respondents

declared that they have ridden a bicycle without a helmet at least once in the last 30 days (p= 0.001; Cramer's V between 0.061 and 0.109).

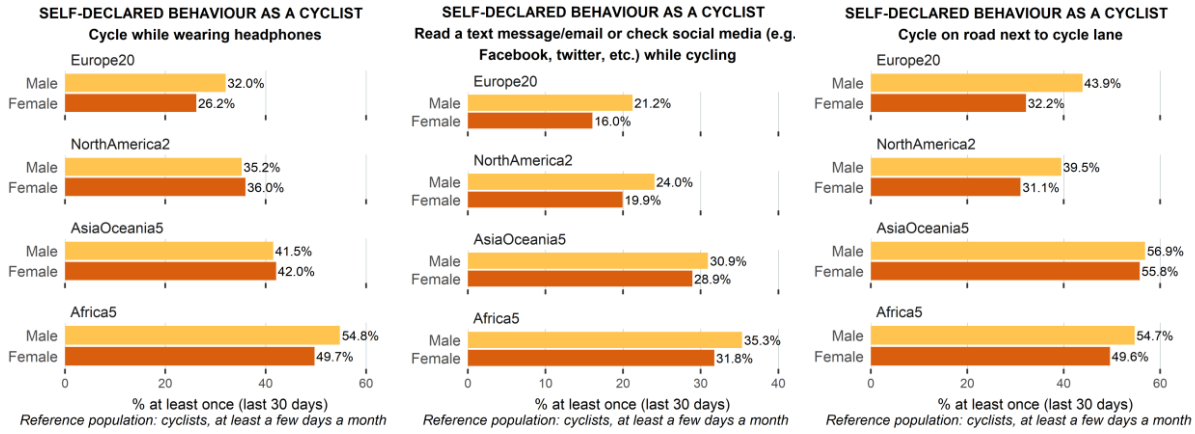


Figure 5: Self-declared behaviours as a cyclist by region and gender (% of cyclists that did at least once… in the past 30 days).

According to Figure 5, only in Europe do we find a significant difference between male and female respondents as to the respective behaviours ('having cycled while wearing headphones', 'read a text message or check social media', 'cycle on road next to cycle lane'). Although the differences are significant at the p< 0.001 level, the strength of the association between the respective behaviour and gender is small (Cramer's V= 0.064 – 0.066).

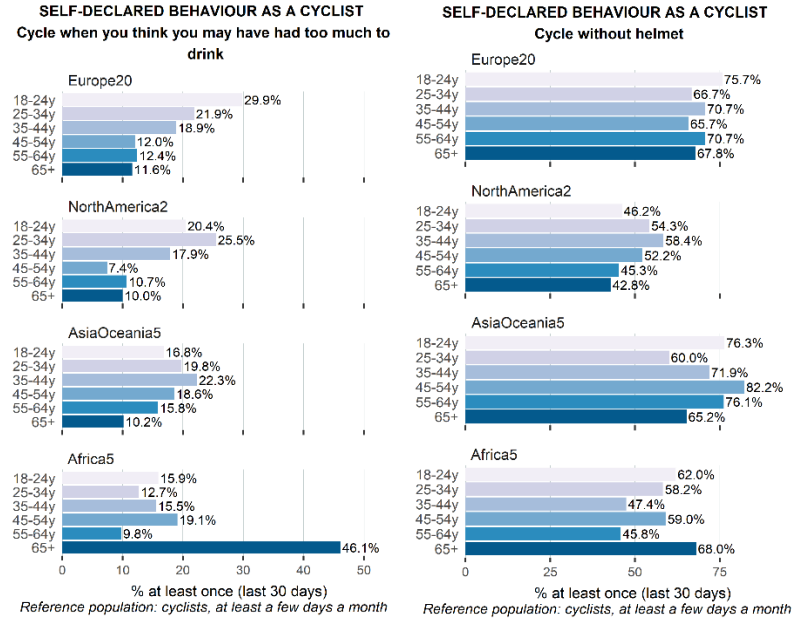


Figure 6: Self-declared behaviours as a cyclist by region and age group (% of cyclists that did at least once… in the past 30 days).

As can be seen on the left-hand side of Figure 6, in Europe, North America and Asia-Oceania the rates of self-declared drunken cycling tend to decrease with age. In Europe, the highest rates are found among the youngest cyclists (30%). Strikingly, in Africa, the proportion of self-declared drunken cycling is extremely high for the oldest age group. This result is very likely not representative and arises from methodological shortcomings/limitations. In the African countries, a lower percentage of people has access to the Internet (in Kenya and Nigeria less than 30%). Moreover, within these

countries, the numbers of 65+ respondents who participated in the ESRA2 survey were quite low (with the exception of South Africa), so that the answers of this particular age group cannot be considered to be representative (see chapter 3.4 Limitation of the data).

Two-thirds of the respondents aged 25 and older in Europe affirmed cycling without a helmet (at least once in the last 30 days). Among the 18 to 24 year-olds, even more than 75% do so. In Asia-Oceania, it were the respondents between 45 and 54 years who declared the most frequently (82%) that they cycle without a helmet. The respondents between 25 and 34 years were the least in the affirmative (60%). In Africa, the self-declared rates for cycling without a helmet per age category are unsystematic. The high figure for the respondents aged 65 and more is striking again and, as mentioned above, is probably due to methodological reasons.

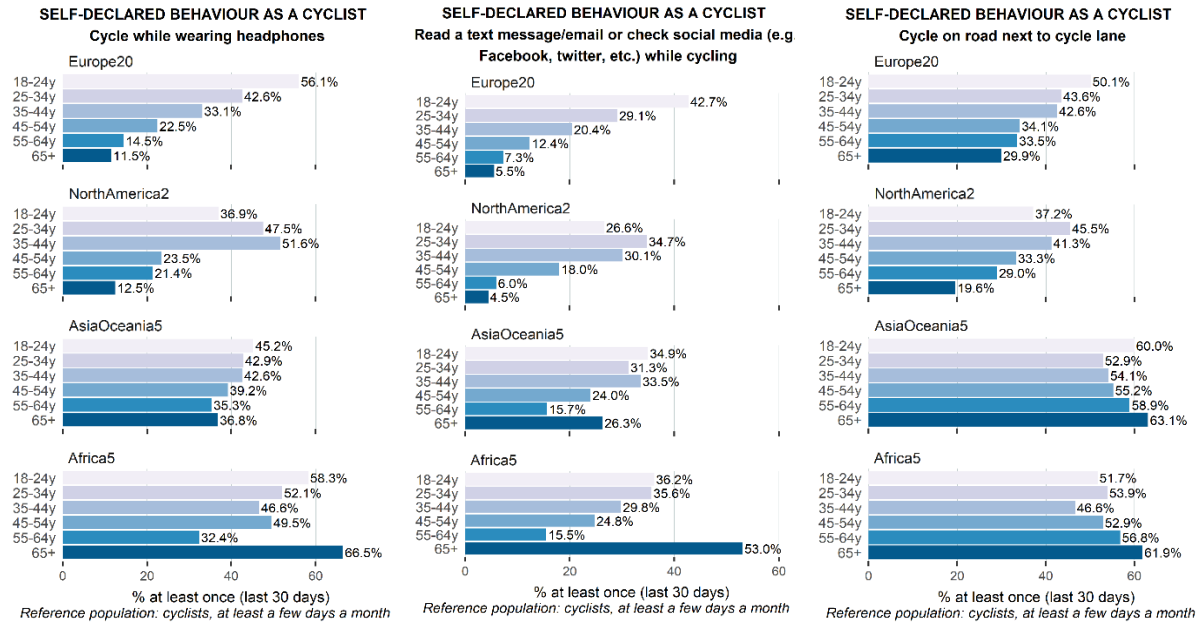


Figure 7: Self-declared behaviours as a cyclist by region and age group (% of cyclists that did at least once… in the past 30 days).

Concerning the self-declared behaviours described in Figure 7, there is an obvious age group effect in Europe. The older the respondents, the less they tend to show risky behaviours during cycling, e.g. wearing headphones, read a text message or check social media and deviate from the prescribed cycle lane. Most of these differences between the age groups are statistically significant at the P< 0.001 level and the strength of the age group effect is small to moderate (Cramer's V between 0.137 and 0.326).

Again, the high scores of the African respondents aged 65+ for all unsafe behaviours while cycling is striking and probably due to methodological reasons (see chapter 3.4 Limitation of the data). Additionally, a large percentage of respondents belonging to all age groups in Asia-Oceania and Africa reported cycling on the road next to the cycle lane (unlike Europe and North America). There are only few differences between the age groups on this behaviour in these two regions, which nevertheless proved to be statistically significant (p= 0.01; Cramer's V= 0.068).

3.1.3 Safety perception of using a bicycle (electric or not)

All respondents who used a conventional (non-electric) or electric bicycle in the past 12 months were asked how safe or unsafe they felt when using these transport modes in the past 12 months. They could answer on a 11-point scale ranging from 0= very unsafe to 10= very safe (see question Q16 in Appendix 1). The mean results per country and region are displayed in Table 4 and Table 5.

The results at regional level show that on average, respondents in the Asian-Oceanic region felt the safest in terms of both conventional and electric cycling. In contrast, respondents from African countries felt the most unsafe in comparison with the other regions. Overall, the perception of safety as a cyclist

can be described as moderate to slightly higher than average (scores ranging from 5 to 7). An analysis of the ESRA1 results showed that respondents feel the least safe when using this mode of transport or a motorcycle; by contrast, they feel by far the most safe when using public transport (Furian et al., 2016).

As shown in Table 4, the countries with the highest safety perception average scores among people using conventional bicycles are all European, with Denmark at the top (7.4 points). The country outside the European region with the highest score is India (7.1 points). The countries with the lowest safety perception scores are Greece (4.5 points), the Republic of Korea (4.8 points) and South Africa (5.0 points).

Table 5 reveals that the highest safety perception average scores for the use of an electric bicycle were also recorded in Europe, in Denmark and Germany (both 7.0 points), followed by the Netherlands and Switzerland (both 6.9 points). India ranks fifth with 6.8 points. The lowest scores are found in Israel (4.1 points) and South Africa (4.4 points), Nigeria and the Republic of Korea (both 4.6 points).

Table 4: Average safety perception of using a *non-electric* bicycle among the cyclists by country and region (11-point scale from 0= very unsafe to 10= very safe).

Country	Mean
Australia	6.3
Austria	7.2
Belgium	5.6
Canada	6.7
Czech Republic	6.1
Denmark	7.4
Egypt	5.9
Finland	7.3
France	5.9
Germany	7.2
Greece	4.5
Hungary	6.1
India	7.1
Ireland	5.5
Israel	5.1
Italy	6.2
Japan	6.1
Kenya	6.3
Morocco	6.1
Netherlands	6.9
Nigeria	5.4
Poland	6.3
Portugal	6.3
Republic of Korea	4.8
Serbia	5.8
Slovenia	6.0
South Africa	5.0
Spain	6.0
Sweden	7.2
Switzerland	7.3
United Kingdom	6.1
United States	6.3
Region	**Mean**
Europe20	6.4
AsiaOceania5	6.9
NorthAmerica2	6.3
Africa5	5.8

Table 5: Average safety perception of using an *electric* bicycle among the cyclists by country and region (11-point scale from 0= very unsafe to 10= very safe).

Country	Mean
Australia	6.0
Austria	6.6
Belgium	6.0
Canada	6.0
Czech Republic	6.0
Denmark	7.0
Egypt	5.4
Finland	6.8
France	6.0
Germany	7.0
Greece	5.1
Hungary	5.5
India	6.8
Ireland	5.7
Israel	4.1
Italy	5.6
Japan	6.2
Kenya	5.1
Morocco	5.2
Netherlands	6.9
Nigeria	4.6
Poland	6.5
Portugal	6.2
Republic of Korea	4.6
Serbia	5.1
Slovenia	6.4
South Africa	4.4
Spain	5.7
Sweden	6.3
Switzerland	6.9
United Kingdom	6.0
United States	5.5
Region	**Mean**
Europe20	6.1
AsiaOceania5	6.8
NorthAmerica2	5.6
Africa5	5.1

3.1.4 Support for policy measures

In addition, all road users were asked if they support four policy measures aiming at cyclists (see Figures 8 and 9 and question Q18 in Appendix 1). These measures require the following:

- All cyclists are obliged to wear a helmet.
- Cyclists are obliged to wear reflective material when cycling in the dark.
- Cyclists under the age of 12 are obliged to wear a helmet.
- While riding a bicycle it is forbidden to use headphones (or earbuds).

The response scale ranged from 1 (oppose) to 3 (neutral) until 5 (support). The results in Figure 8 and Figure 9 show the proportions of respondents who supported the respective measures (scale points 4 and 5) by region and country.

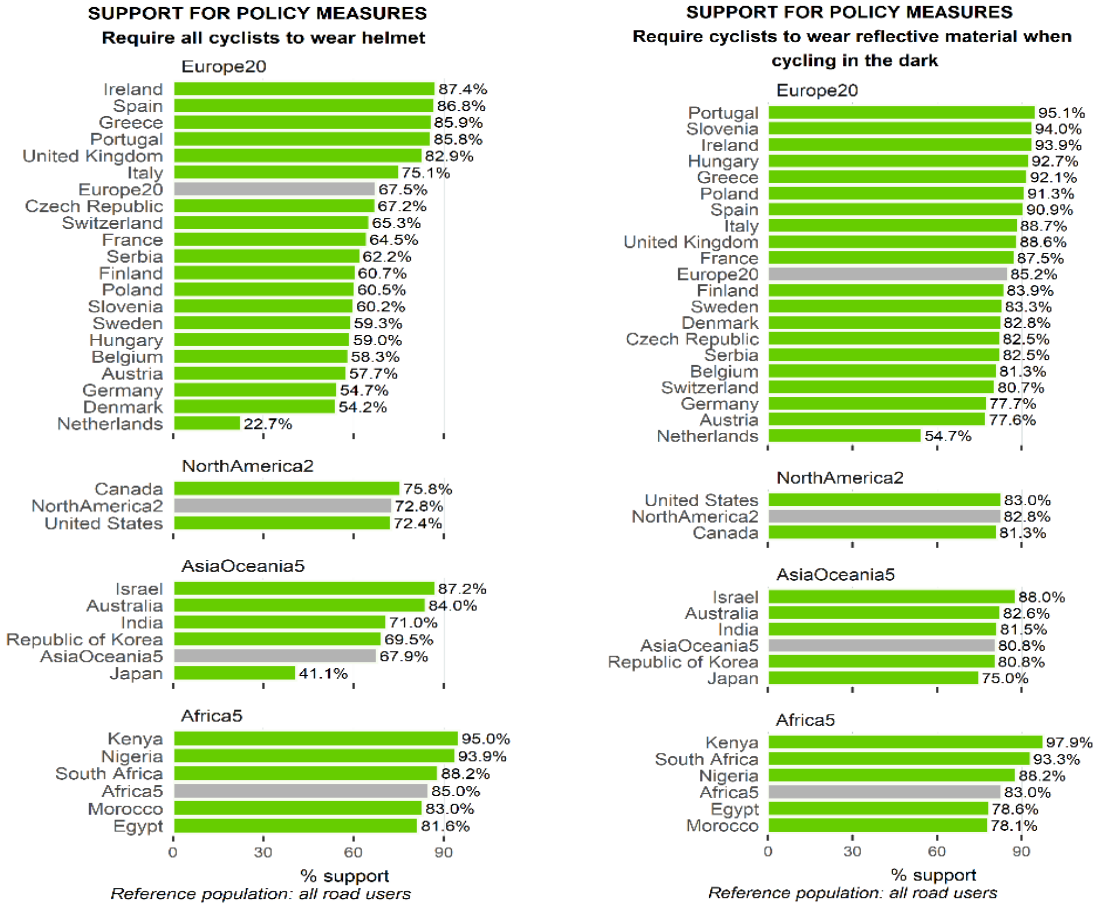


Figure 8: Support for cycling-specific policy measures ('require all cyclists to wear helmet' and 'require cyclists to wear reflective material when cycling in the dark') among all road users by country and region (% of support).

Figure 8 depicts the percentages of respondents supporting two cycling-specific policy measures ('require all cyclists to wear helmet' and 'require cyclists to wear reflective material when cycling in the dark'). On average, a majority of the respondents in all regions declared that they support these measures. The supporting rates vary between 68% (Asia-Oceania) and 85% (Africa) with regard to the first mentioned policy measures and between 81% (Asia-Oceania) and 85% (Europe) with regard to the second one. The high supporting rates for compulsory helmet wearing by all cyclists among the African respondents are striking.

A closer look at the country results reveals large national differences. In Europe, the support for these two measures are markedly above average in Ireland, Spain, Greece and Portugal (at least 86% with regard to the requirement that all cyclists should wear a helmet and at least 91% with regard to the obligation to wear reflective material when cycling in the dark). The European country which is the least in favour of these two measures are the Netherlands (23%, respectively 55%).

In Asia-Oceania, the percentage of respondents in favour of these two measures is higher than the average in Israel and Australia. The least support can be found in Japan.

In the two other regions, North America and Africa, the differences between countries tend to be small.

We can observe that in all countries that have introduced a mandatory helmet use for all cyclists (Australia, Nigeria, South Africa, as well as Spain and Israel when riding outside built-up regions), the percentage of people in favour of this measure is very high (at least 84%).

The Netherlands and Japan are the only two countries where the majority of respondents do not support a legal requirement for all cyclists to wear a helmet.

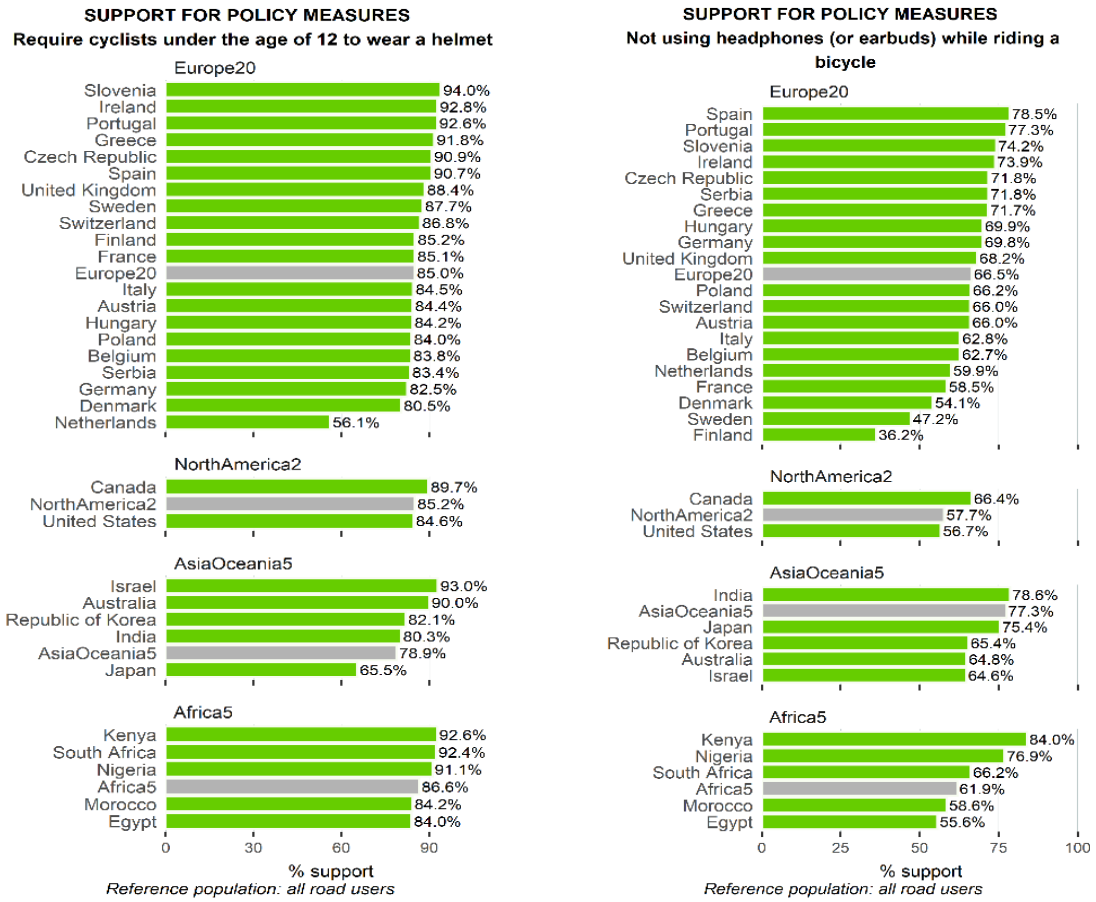


Figure 9: Support for cycling-specific policy measures ('require cyclists under the age of 12 to wear a helmet' and 'not using headphones or earbuds while riding a bicycle') among all road users by country and region (% of support).

As shown in Figure 9, the support for the requirement to wear a helmet for cyclists under the age of 12 is even higher than for the mandatory helmet use for all cyclists. The pattern of countries supporting or not the measure are very similar. Again in the Netherlands and Japan, we find the weakest support. In Africa, the approval rate is the highest (87%).

On average, two out of three respondents from Europe do not support the measure of not being allowed to wear headphones (or earbuds) when cycling. The highest support for this measure can be found in Spain (79%) and the lowest in Finland (36%).

The respondents from Asia-Oceania have significantly higher supporting rates for a ban on wearing headphones (or earbuds) during cycling than those of the other regions. Respondents in Israel showed the highest levels of support for three of the four measures. At the same time, they expressed the least support for the measure 'no use of headphones (or earbuds) while cycling' (65%) among the Asian-Oceanian region. The respondents in India agreed most with this measure (79%).

The country with the highest supporting rates for all four measures within the African region is Kenya. For three of four measures (require all cyclists to wear helmet, require cyclists to wear reflective material when cycling in the dark, require cyclists under the age of 12 to wear a helmet), road users in Canada and the USA show a similar level of support. However, Canadian road users show more support for a ban on wearing headphones than their American counterparts (66% and 57% respectively).

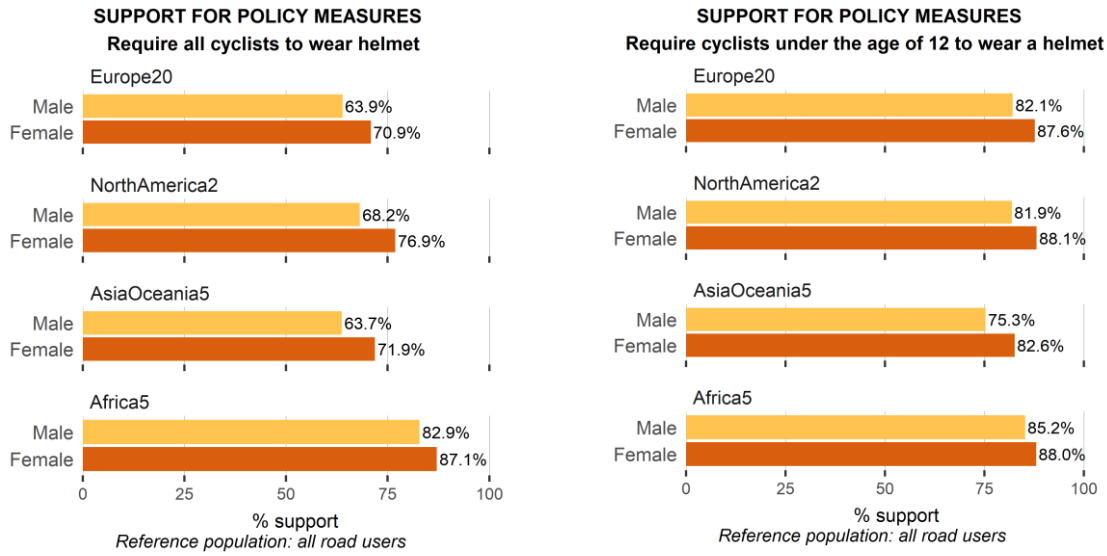


Figure 10: Support for cycling-specific policy measures ('require all cyclists to wear helmet' and 'require cyclists under the age of 12 to wear a helmet') among all road users by gender and region.

Figure 10 shows the support for the above-mentioned policy measures by gender and region. There is a gender effect for both measures across all regions. In other words, with regard to the requirement to wear a helmet both for all cyclists and only for those under 12, significantly more women than men declared that they support the measures ($p < 0.001$). However, the gender effect is relatively weak for all regions (Cramer's V between 0.041 and 0.098).

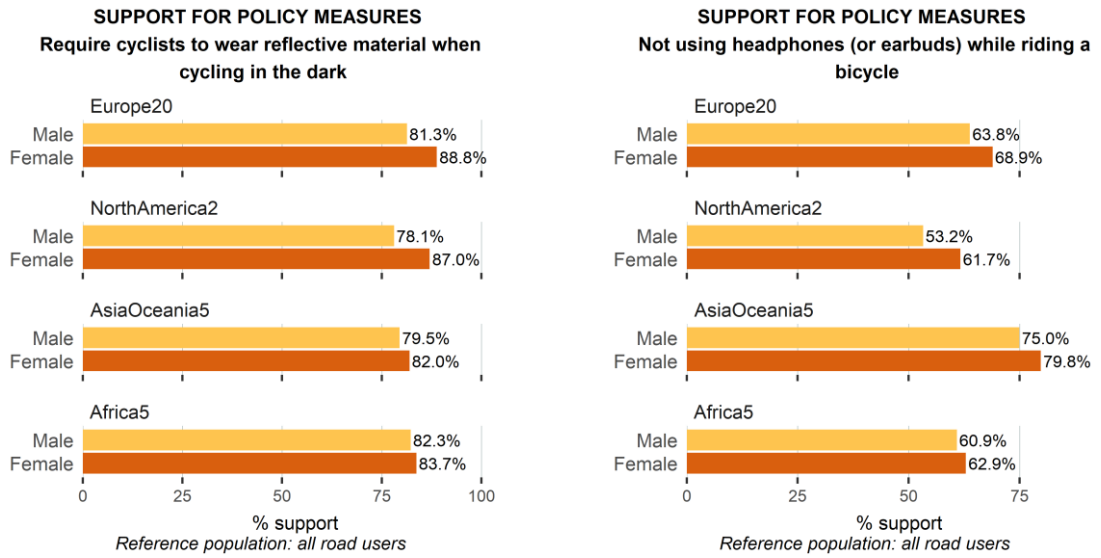


Figure 11: Support for cycling-specific policy measures ('require cyclists to wear reflective material when cycling in the dark' and 'not using headphones or earbuds while riding a bicycle') among all road users by gender and region (% of support).

Figure 11 shows, as in Figure 10 above, that in all regions, significantly more female than male respondents support the proposed policy measures, namely the demands for reflective materials for cycling in the dark on the one hand, and for not wearing headphones (or earbuds) during cycling on the other hand. For the first measure, this finding only applies to Europe and North America ($p < 0.001$), but not to Asia-Oceania and Africa. For the second measure, the support of women is significantly higher than the one of men in all regions except Africa. However, as for the measures in Figure 10, the strength of the association between gender and the support for these policy measures is (very) small (Cramer's V between 0.054 and 0.118).

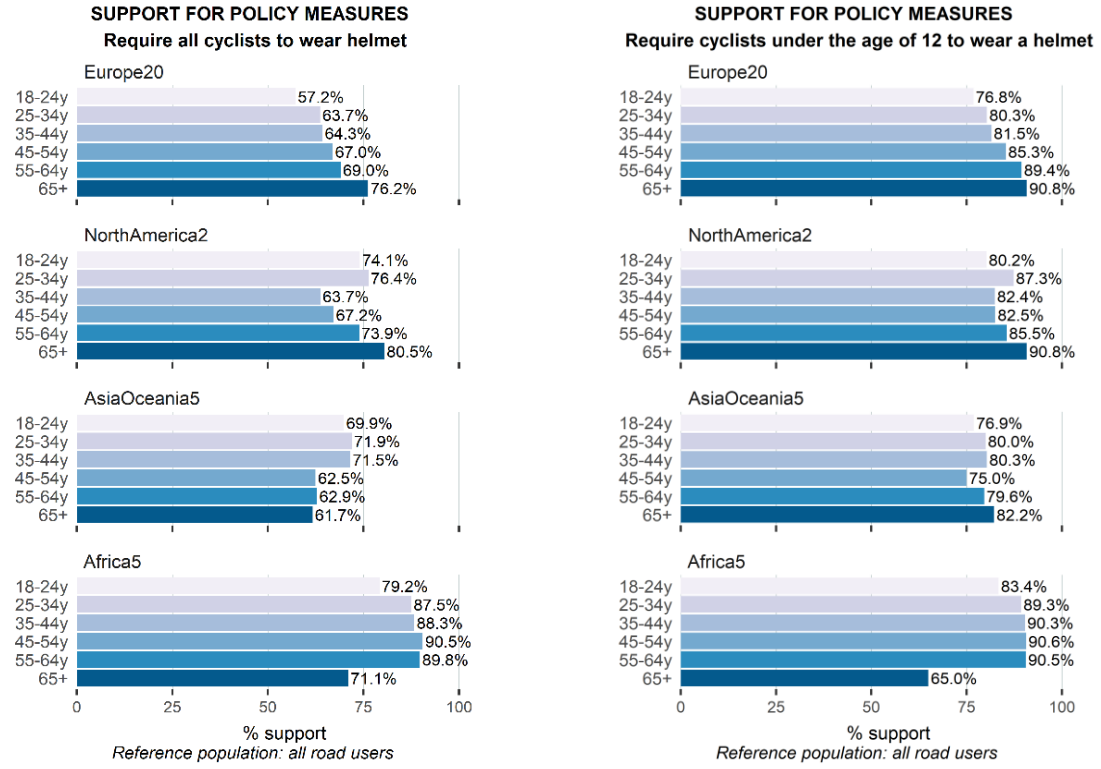


Figure 12: Support for cycling-specific policy measures ('require all cyclists to wear helmet' and 'require cyclists to wear reflective material when cycling in the dark') among all road users by age group and region.

With regard to the support of compulsory helmet wearing for all cyclists as well as for those under 12 years of age, an age group effect can be observed in Europe. The older the respondents, the higher the support. In Asia-Oceania there are also significant differences at the p< 0.001-level between the respondents who are 18 to 44 years old and those 45 to 65+ years old, but only as far as the wearing of helmets for all cyclists is concerned. Again, those who are older (>45 years) indicate significant higher supporting rates than those who are younger (<45 years). However, the strength of the age group effect is rather small (Cramer's V between 0.093 and 0.122).

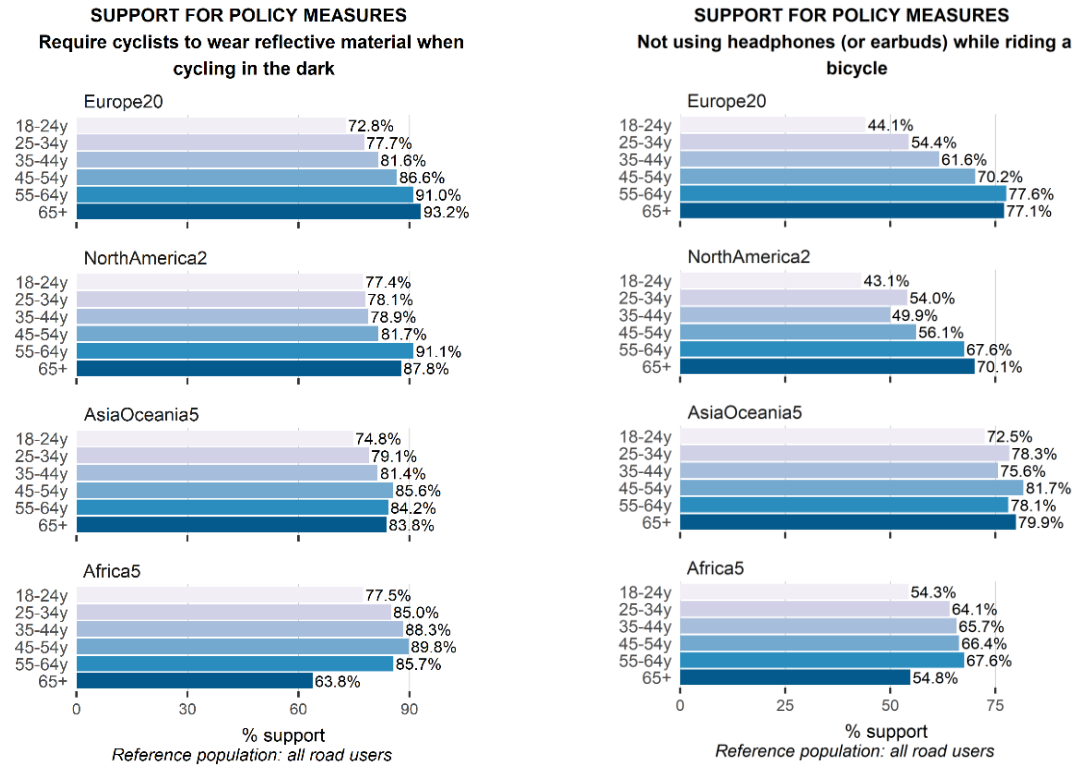


Figure 13: Support for cycling-specific policy measures ('require cyclists to wear reflective material when cycling in the dark' and 'not using headphones or earbuds while riding a bicycle') among all road users by region and age group (% of support).

As with the results in Figure 12, Figure 13 shows an age effect for European respondents in relation to the policy measures 'requirement for cyclists to wear reflective material when cycling in the dark' and 'not using headphones (or earbuds) while riding a bicycle' (p< 0.001). The older the respondents, the more likely they are to agree with these measures. The strength of the association is small to moderate (Cramer's V between 0.193 and 0.236).

In the other regions, the relationship between age and the support for policy measures is less clear. The particularly low support of the 65 years old in Africa has probably methodological reasons (see chapter 3.4 Limitation of the data).

3.2 Advanced analyses

3.2.1 Factors associated with self-declared behaviours as a cyclist

In order to explore the relationships between different explanatory variables and several self-reported cyclists' behaviours, we developed three binary multiple logistic regression models. We focussed on the following unsafe behaviours: (1) no helmet use, (2) listening to music through headphones while cycling and (3) reading texts/emails or checking social media while cycling. Not wearing a bicycle helmet and sources of distraction, such as listening to music or reading a message on a bicycle, have a negative impact on cyclist safety.

The first two unsafe behaviours mentioned have already been examined in a study using ESRA1 data for 25 countries (Torfs & Meesmann, 2019). In particular, this analysis showed that the odds of not wearing a bicycle helmet decreased with increasing age. Young cyclists were more likely to report that they do not wear a helmet. Cyclists who felt very unsafe in traffic reported more often wearing a helmet while cycling. In addition, cyclists who were in favour of a legal obligation for all cyclists to wear a helmet were more likely to wear a helmet themselves. No association with gender or educational level was found for the reported use of a bicycle helmet. In the model analysing the use of headphones while cycling, the findings related to the age of the cyclists and the support for the corresponding policy measure (ban on using headphones) were similar. However, no association could be established with the safety feeling while cycling. Women are less likely to report listening to music through headphones while cycling than men. The same is true for respondents with a master's degree or higher compared to respondents with primary or no education (Torfs & Meesmann, 2019).

Using these three regression models, it was possible to gain insight into the relationships between unsafe behaviours and explanatory variables and, for two of the models, to compare with the results of the above mentioned analysis based on ESRA1. The regression models based on ESRA2 data on the one hand and ESRA1 data on the other hand differ only slightly. The same countries were considered, except Norway, Japan, India, Serbia, Egypt, Morocco, Nigeria, Kenya and South Africa, which participated in only one of the surveys. In the models based on ESRA2 data, two additional explanatory variables were included: frequency of riding a bicycle and socially desirable responding score.

In each model, the outcome is a binary variable indicating the absence (0 = never) or presence (1 = at least once) of one of the mentioned self-reported behaviours as a cyclist. Only persons riding a bicycle (electric or not electric) at least a few days per month were considered in this analysis (=14 667 out of the 35 036 ESRA2 respondents). Categories in which very few people had been questioned were either assembled with other categories (such as 'no education' or 'primary education' were grouped with 'secondary education' in the category called 'Secondary education or lower') or excluded from the analysis (such as gender=other, which corresponds to 57 persons riding a bicycle at least a few days per month). Finally, the models comprised 14 610 respondents.

Personal characteristics such as gender, age or level of education were included as explanatory factors as were the support for road policy measures and the safety feeling when cycling. The models took also into account the variables 'frequency of cycling' and the 'social desirability score'. This score has been calculated based on the 6 items of question 28 (see Appendix 1). The higher the score, the more likely the respondents are to give a socially desirable response. The country in which the respondents live was also included in the models in order to identify countries with similar results while controlling for other factors. The results at the country level are presented in a separate table (see Table 7).

In these binary multiple logistic regression models, we obtained measures of association in terms of odds ratios (OR) and 95% confidence intervals. If $p<0.05$, the association is considered as significant.

Table 6: Logistic regression models for unsafe behaviours while riding a non-electric or an electric bicycle

Factors (reference category)	Dependent variable: self-reported unsafe behaviour (0=never; 1=at least once)					
	Model 1 Not wearing a helmet		Model 2 Listening to music through headphones (or earbuds)		Model 3 Reading messages/emails or checking social media	
	Odds ratio	(CI 95%)	Odds ratio	(CI 95%)	Odds ratio	(CI 95%)
Gender (Male)						
Female	0.922*	(0.852 - 0.999)	0.849***	(0.782 - 0.922)	0.762***	(0.695 - 0.835)
Age group (18-34 years)						
35-54 years	0.926	(0.842 - 1.018)	0.525***	(0.479 - 0.575)	0.448***	(0.405 - 0.495)
≥ 55 years	0.852**	(0.769 - 0.945)	0.271***	(0.242 - 0.304)	0.196***	(0.171 - 0.224)
Level of education (Secondary education or lower)						
Bachelor s degree or similar	1.007	(0.917 - 1.105)	1.052	(0.956 - 1.158)	1.014	(0.912 - 1.127)
Master s degree or higher	0.842**	(0.749 - 0.946)	1.082	(0.959 - 1.222)	1.063	(0.931 - 1.214)
Frequency of cycling (a few days a month)						
1 to 3 days a week	1.161**	(1.059 - 1.273)	1.231***	(1.117 - 1.356)	1.369***	(1.227 - 1.527)
at least 4 days a week	1.397***	(1.265 - 1.544)	1.176**	(1.063 - 1.301)	1.753***	(1.57 - 1.958)
Support of road safety measures (oppose/no opinion)						
Obligatory use of a helmet by all cyclists	0.340***	(0.310 - 0.373)	-	-	-	-
Ban on listening to music with headphones while cycling	-	-	0.288***	(0.264 - 0.314)	-	-
Safety feeling when cycling (Very safe)						
Rather safe	0.626***	(0.542 - 0.724)	0.840*	(0.719 - 0.981)	0.994	(0.839 - 1.178)
Rather unsafe	0.826**	(0.726 - 0.941)	0.982	(0.859 - 1.123)	1.072	(0.927 - 1.241)
Very unsafe	0.854***	(0.780 - 0.936)	0.918	(0.836 - 1.009)	0.985	(0.888 - 1.093)
Socially desirable responding score	0.964***	(0.955 - 0.972)	0.960***	(0.952 - 0.969)	0.931***	(0.922 - 0.94)
R^2 Nagelkerke (pseudo R^2)	0.179		0.251		0.171	

Note: esra32_sample weight; * p<0.05, ** p<0.01, *** p<0.001. The factor 'safety feeling while cycling' was categorized as follows: 0-2 (very unsafe); 3-4 (rather unsafe); 5-7 (rather safe); 8-10 (very safe). The factor 'country' of models 1, 2 and 3 is presented in the next table.

The results of the three logistic regression models covering the three unsafe behaviours 'not wearing a helmet', 'listening to music through headphones' or 'reading messages/emails, etc.' are presented in Table 6. Compared to the models based on the ESRA1 data, two additional variables were considered: the frequency of cycling and the 'socially desirable responding score'.

Overall, these new models on the use of bicycle helmets and headphones tend to confirm the results obtained on the basis of ESRA1 data. In the models based on ESRA2 data, there are more associations that are statistically significant than in the models based on ESRA1 data. One of the reasons that can be put forward is that the ESRA2 sample is slightly larger.

According to the models based on ESRA2 data, concerning both the use of bicycle helmets and of headphones, women are less likely to engage in such unsafe behaviours. Compared to the male cyclists, the odds of female cyclists are decreased by 8%, respectively 15%. In the models based on ESRA1 data, no significant difference between men and women was found concerning the propensity to wear a helmet. In the model that considers 'reading a message or email or checking social media while cycling', women are also less likely to adopt this behaviour (OR=0.76, p<0.001).

The age effect revealed in the models based on ESRA1 data has been confirmed: persons aged 55 and over are less likely to report that they do not wear a helmet or that they listen to music with headphones while cycling. Compared to cyclists aged 18-34, their odds are decreased respectively by 15% and 73%. People aged 55 and over are significantly less likely to 'read a message/emails or checking social media while cycling' than persons of the youngest age group (OR=0.20, p<0.001).

Respondents with a master's degree or higher are less likely to report not wearing a helmet than respondents with a secondary education or lower (OR=0.84, p<0.01). No association between the level of education and listening to music or reading messages/emails or checking social media was found.

Persons who ride bicycles frequently are more likely to report unsafe behaviours than persons who cycle no more than a few days a month (OR were 1.40 for 'not wearing a helmet', 1.18 for 'listening to music' and 1.75 for 'reading messages/emails or checking social media', p<0.01 or p<0.001).

As already observed in the models based on ESRA1 data, those in favour of safety measures such as 'obligatory use of a helmet for all cyclists' or 'ban on listening music with headphones while cycling' are

considerably more inclined to report that they behave safely in these two areas (OR=0.34; p<0.001, respectively OR=0.29; p<0.001).

It appears that feeling safe or unsafe when cycling is not strongly associated with the likelihood of engaging in unsafe behaviours, except for the helmet question: cyclists who do not feel safe in traffic reported wearing a helmet more often than those who feel safe. Compared to the respondents who indicated that they feel 'very safe' when cycling, the odds for persons who answered that they feel 'rather safe' are decreased by 16% for listening to music while cycling, but were not significantly different for persons who answered that they feel 'rather unsafe' or that they feel 'very unsafe'. No association at all was found regarding the behaviours 'reading a message/emails' or 'checking social media while cycling'.

Finally, respondents with a high socially desirable responding score are less likely to report that they behave in an unsafe way while cycling (OR between 0.93 and 0.96; p<0.001). Apparently, a high socially desirable responding score has an effect on the likelihood of self-reported unsafe behaviours as a cyclist (odds decrease by at least 4%), suggesting that answers related to unsafe behaviours while cycling are subject to social desirability (see also section 3.4 'Limitations of the data').

The odds ratios for each country for the three models described above are presented in Table 7. For each model, the European country closest to the European ESRA average was selected as the reference category: Austria in model 1, The Netherlands in model 2 and Poland in model 3. We proceeded in the same way as in the study carried out by Torfs and Meesmann (Torfs & Meesmann, 2019). In order to identify countries with similar likelihoods of self-reported behaviours, we have grouped them according to their odds ratios and assigned them a colour: OR 0.70 or lower: green; OR from 0.71 to 1.29: white; OR from 1.30 to 1.99: yellow; OR 2.00 or higher: orange.

Table 7: Logistic regression models for unsafe behaviours while cycling: effects of the countries

Country	Dependent variable: self-reported unsafe behaviour (0=never; 1=at least once)					
	Model 1 Not wearing a helmet		Model 2 Listening to music through headphones (or earbuds)		Model 3 Reading messages/email or checking social media	
	Odds ratio	(CI 95%)	Odds ratio	(CI 95%)	Odds ratio	(CI 95%)
AT	1 (Reference)		0.638**	(0.476 - 0.855)	0.627**	(0.447 - 0.880)
BE	2.294***	(1.641 - 3.207)	0.924	(0.688 - 1.243)	1.083	(0.781 - 1.501)
CH	0.568***	(0.426 - 0.756)	0.693*	(0.512 - 0.939)	0.628*	(0.439 - 0.898)
DE	1.168	(0.877 - 1.555)	0.771	(0.578 - 1.027)	0.695*	(0.498 - 0.969)
DK	1.117	(0.847 - 1.473)	1.152	(0.888 - 1.494)	1.133	(0.839 - 1.529)
EL	0.791	(0.582 - 1.076)	2.097***	(1.553 - 2.832)	1.437*	(1.015 - 2.033)
ES	0.784	(0.585 - 1.051)	1.498**	(1.117 - 2.009)	1.082	(0.774 - 1.514)
FI	1.255	(0.942 - 1.673)	1.04	(0.796 - 1.360)	1.575**	(1.164 - 2.132)
FR	1.580**	(1.117 - 2.235)	1.263	(0.909 - 1.754)	1.147	(0.787 - 1.672)
IE	0.654**	(0.478 - 0.895)	1.704***	(1.249 - 2.326)	0.768	(0.527 - 1.118)
IT	1.096	(0.829 - 1.447)	1.298	(0.987 - 1.708)	0.983	(0.710 - 1.360)
NL	2.090***	(1.549 - 2.820)	1 (Reference)		1.248	(0.944 - 1.65)
PL	2.249***	(1.688 - 2.997)	1.442**	(1.115 - 1.864)	1 (Reference)	
PT	0.484***	(0.347 - 0.674)	1.085	(0.763 - 1.542)	0.983	(0.664 - 1.456)
SE	1.108	(0.831 - 1.478)	1.299	(0.995 - 1.696)	1.166	(0.855 - 1.591)
SI	1.415*	(1.068 - 1.874)	0.560***	(0.412 - 0.760)	0.570**	(0.399 - 0.813)
UK	0.552***	(0.396 - 0.770)	1.262	(0.901 - 1.767)	1.052	(0.719 - 1.539)
CA	0.579***	(0.422 - 0.795)	1.690**	(1.231 - 2.319)	1.253	(0.875 - 1.792)
CZ	1.367*	(1.001 - 1.866)	0.962	(0.697 - 1.327)	0.676*	(0.458 - 0.998)
HU	2.501***	(1.838 - 3.402)	0.767	(0.579 - 1.015)	0.491***	(0.347 - 0.696)
IL	0.607*	(0.407 - 0.907)	1.612*	(1.067 - 2.435)	1.014	(0.634 - 1.623)
KR	1.153	(0.850 - 1.564)	2.658***	(1.996 - 3.540)	1.028	(0.731 - 1.445)
US	0.557***	(0.398 - 0.780)	1.265	(0.900 - 1.779)	1.148	(0.779 - 1.690)
AU	0.239***	(0.165 - 0.346)	1.398	(0.984 - 1.986)	0.787	(0.514 - 1.205)
RS	2.709***	(1.985 - 3.697)	1.047	(0.790 - 1.388)	1.827***	(1.356 - 2.461)
JP	0.719*	(0.534 - 0.967)	0.485***	(0.344 - 0.683)	0.771	(0.543 - 1.095)
IN	1.653***	(1.243 - 2.197)	2.541***	(1.965 - 3.285)	1.742***	(1.308 - 2.319)
EG	0.986	(0.735 - 1.324)	3.632***	(2.744 - 4.807)	2.070***	(1.532 - 2.798)
KE	1.550**	(1.155 - 2.080)	3.120***	(2.385 - 4.082)	1.125	(0.830 - 1.525)
NG	0.745*	(0.560 - 0.990)	2.371***	(1.807 - 3.110)	0.614**	(0.435 - 0.867)
MA	0.839	(0.626 - 1.124)	2.399***	(1.819 - 3.164)	2.349***	(1.738 - 3.175)
ZA	0.567***	(0.410 - 0.782)	1.624**	(1.181 - 2.233)	0.685	(0.465 - 1.008)

Note: esra32_sample weight; * p<0.05, ** p<0.01, *** p<0.001

Colours in relation to the odds ratios indicate significant differences compared to the reference country:
0.7 or lower (green); from 0.71 to 1.29 (white); from 1.30 to 1.99 (yellow); 2.00 or higher (orange).

Switzerland, Ireland, Portugal, the United Kingdom, Canada, Israel, the United States, Australia and South Africa are the countries where the cyclists were the most likely to wear a helmet. The countries where cyclists are the least likely to protect themselves with a helmet are Belgium, the Netherlands, Poland, Hungary and Serbia.

The cyclists living in Austria, Switzerland, Slovenia and Japan are most likely to report that they do not use headphones while riding their bicycle. At the other end of the scale, we find Greece, the Republic of Korea, India and four of the five African countries: Egypt, Kenya, Nigeria and Morocco.

Compared to Poland, the "average European country" in terms of the behaviour "reading a message/email or checking social media when cycling", several countries are well below this average (odds decreased by at least 30%): Austria, Switzerland, Germany, Slovenia, Hungary, Nigeria and South Africa. In only two countries, Egypt and Morocco, the cyclists are most likely to report that they "read a message/email" or check social media when cycling".

3.2.2 Attitudes of 'cyclists' defined within the framework of a typology of road users

This section focusses on cyclist attitudes towards policy measures and traffic rules as well as their perception of the causes of accidents and their involvement in road crashes. For the purpose of these analyses, we carried out a typology of road users based on the frequency of cycling or driving a car reported by the ESRA2-respondents. Four groups (or types) have been created:

- 'Cyclists' : persons who cycle at least a few days a month and drive a car no more than a few days a month
- 'Both car drivers & cyclists': persons who drive a car and cycle, both at least 1 day a week
- 'Car drivers': persons who drive a car at least a few days a month and cycle no more than a few days a month
- 'Neither car drivers nor cyclists': persons who drive a car / cycle, both no more than a few days a month

The sample sizes for these four groups are as follows: 4213 'cyclists', 5677 'both car drivers & cyclists', 18 455 'car drivers' and 6691 'neither car drivers nor cyclists'. For more details about this typology, see Appendix 3, Table 11. Moreover, the four types of road users broken down by region is presented in Appendix 3, Table 12.

In the previous chapter, support for specific policy measures, mostly targeting cyclists, was analysed (3.1 Overall results). In these analyses, the points of view of all road users were considered. In this chapter, we examine the views of 'cyclists' and compare them with those of other types of road users. These comparisons are made at the level of the four regions over the world. All results were weighted by the corresponding region: 'Europe20', 'NorthAmerica2', 'AsiaOceania5' and 'Africa5'.

In Appendix 3 (from Figure 24 to Figure 26), we can see the percentage of females, of young persons (in the age group from 18 to 34 years) and of persons living in urban areas among the four types of road users.

- Overall, the proportion of women among cyclists tends to be lower than among car drivers, and in each region, their share is highest among the group of people who never or rarely drive a car or ride a bicycle. In Europe, however, there is no gender difference between the groups 'cyclists' and 'car drivers', but the share of females is significantly lower among the type 'both car drivers and cyclists' than among the type 'car drivers'.
- The group of 'cyclists' tends to be younger than the 'car drivers' group or the group of people who never or rarely drive a car or ride a bicycle. In the Asian and Oceanian region, the difference in the percentage of people aged 18 to 34 among cyclists (59%) and car drivers (34%) is the highest (25 percentage points).
- Finally, a relationship was found in Europe between the level of urbanisation and the types of road users, where the percentage of road users living in an urban area is significantly higher among the cyclists (46%) than among the car drivers (36%). However, in the other regions no such evidence was found.

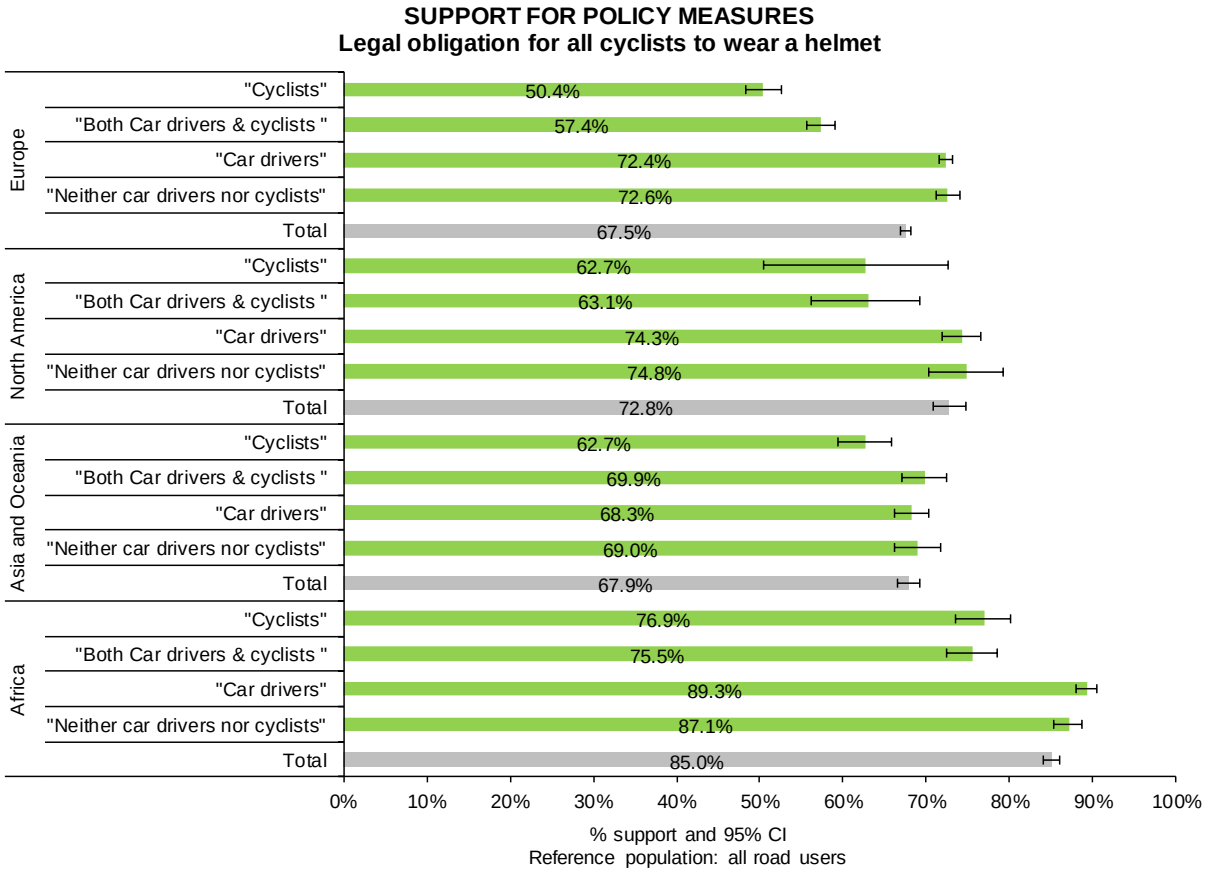


Figure 14: Support for the policy measure "Legal obligation for all cyclists to wear a helmet", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

Overall, the legal requirement for all cyclists to wear a helmet is supported by a large majority of respondents: in Europe, where support is lowest, two thirds are in favour of this measure. However, the group of cyclists seems much less inclined to approve this measure. Since it only applies to cyclists, it is understandable that non-cyclists, who are not forced to change their behaviour, are more supportive.

Especially in Europe, we observe considerable differences between the types of road users. While car drivers and the group that does not belong to either the cyclists or the car drivers accept with a share of more than 70% the legal obligation for all cyclists to wear a helmet, the share among cyclists was 50% (respectively 57% for those who also often drive a car). In Africa, similar disparities can be observed (the difference between the shares among cyclists and car drivers is 12 percentage points). In North America, the groups do not differ significantly. The confidence intervals for the share of "cyclists" and both "car drivers & cyclists" are quite large, since the number of cases attributed to these two groups is particularly low.

In Appendix 3, Figure 27, we see that the support for a helmet obligation only for children under the age of 12, receives more support, even from cyclists, but the general trend observed previously remains: the group of cyclists is less likely to endorse this measure than the other groups of road users.

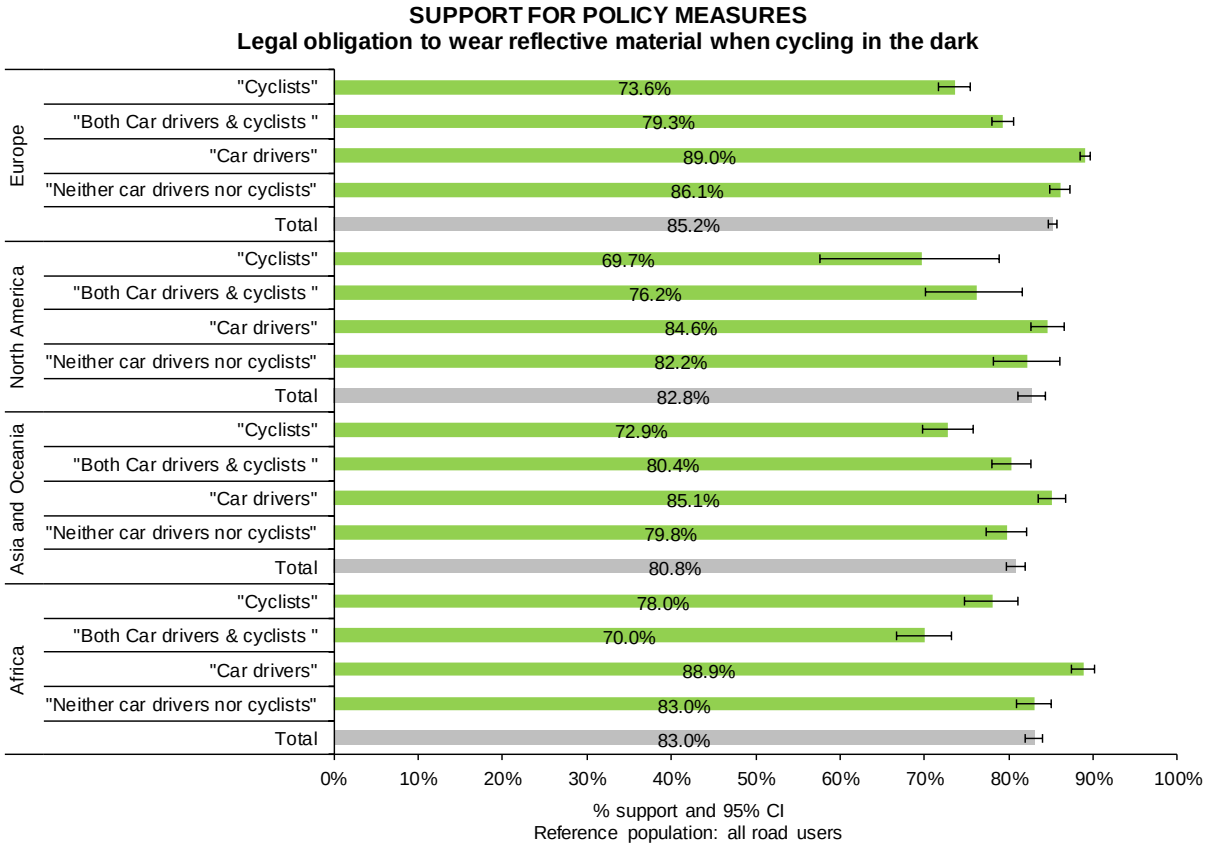


Figure 15: Support for the policy measure "Require all cyclists to wear reflective material when cycling in the dark", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

As observed for the 'legal obligation for all cyclists to wear a helmet', the group of cyclists is significantly less inclined to support the legal obligation to wear reflective material when cycling in the dark than the other types of road users. The fact that this measure only concerns cyclists and not all road users may explain these differences of opinion.

In all regions, we find that cyclists tend to be less favourable than car drivers towards a legal obligation for cyclists to wear reflective material when cycling in the dark. Even in North America, the difference between these two groups is statistically significant. They differ by 15 percentage points.

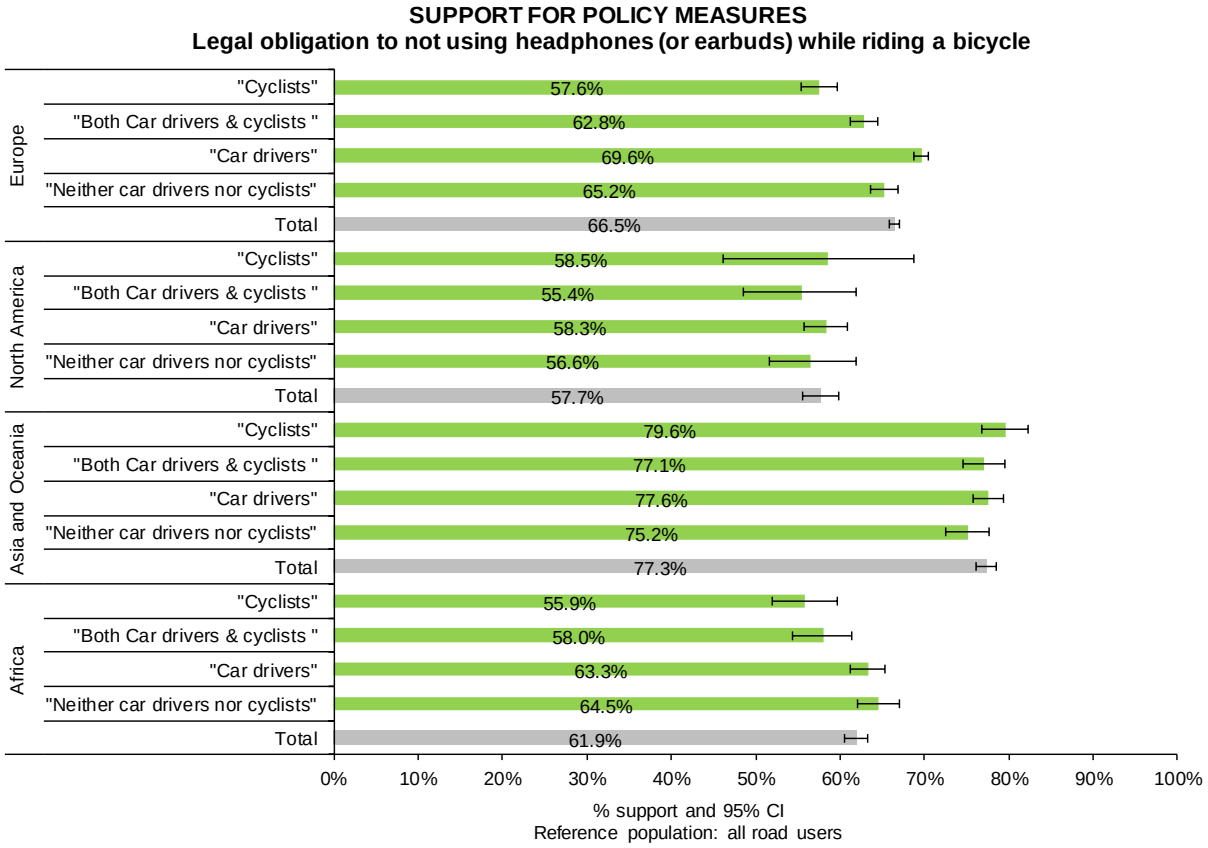


Figure 16: Support for the policy measure "Obligation not to use headphones (or earbuds) while riding a bicycle", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

The ban on listening to music with headphones (or earbuds) while riding a bicycle is overall well accepted by the respondents. In North America, where support is lowest, there are still 58% in favour of this measure.

In Europe as well as in Africa, cyclists are less likely to approve the measures than car drivers, respectively road users that are neither car drivers nor cyclists. In North America and in Asia & Oceania, the differences are statistically not significant.

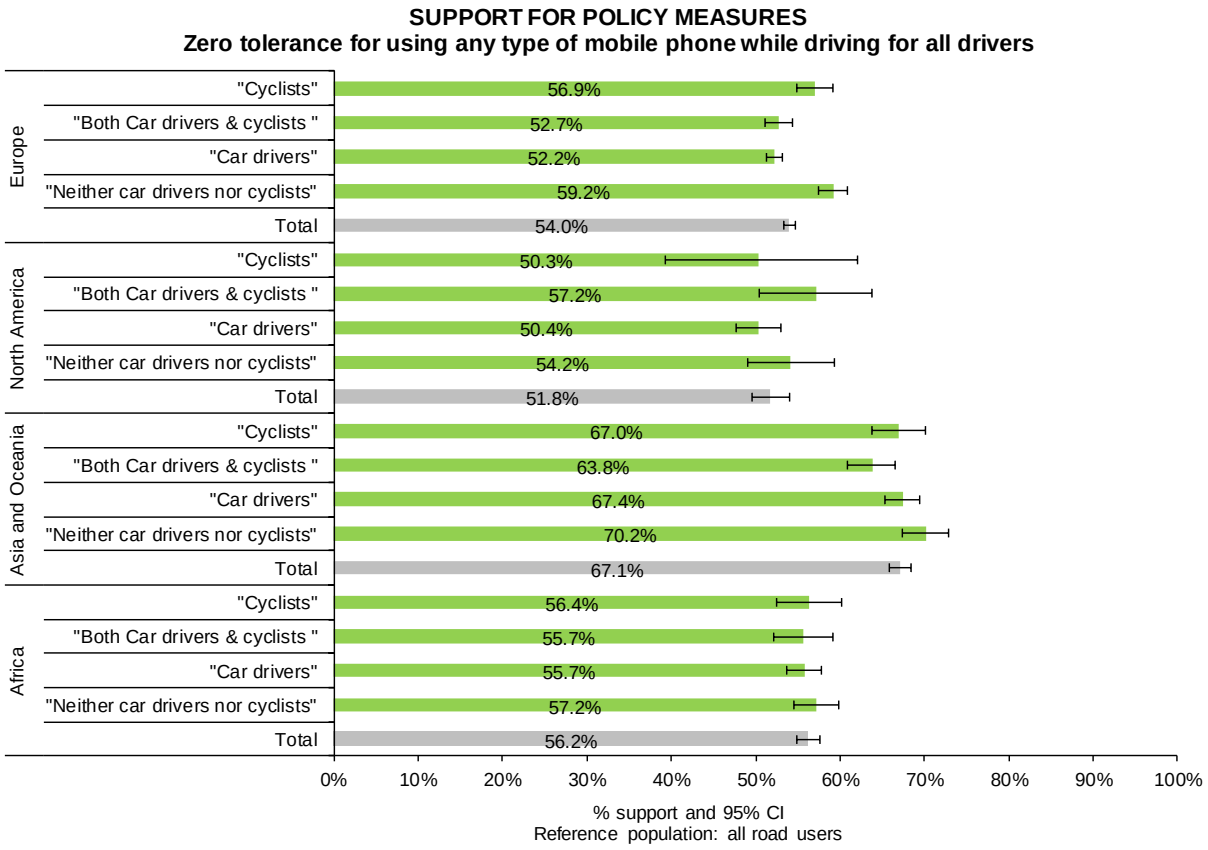


Figure 17: Support for the policy measure "Zero tolerance for using any type of mobile phone while driving (hand-held or hands-free) for all drivers", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

In neither of the four regions, do we observe significant differences between the four types of road users with regard to the measure 'zero tolerance for using any type of mobile phone while driving for all drivers', except in Europe. Cyclists are more in favour of this measure than car drivers. In this case, the measure targets all the drivers, not only the cyclists.

Another measure targeting all road users ('zero tolerance for alcohol (0 ‰) for all drivers') is presented in Appendix 3 (see Figure 28). There are rather small (or no) differences between the four road user groups. In most regions, the largest support is found among the group of road users that are neither car drivers nor cyclists.

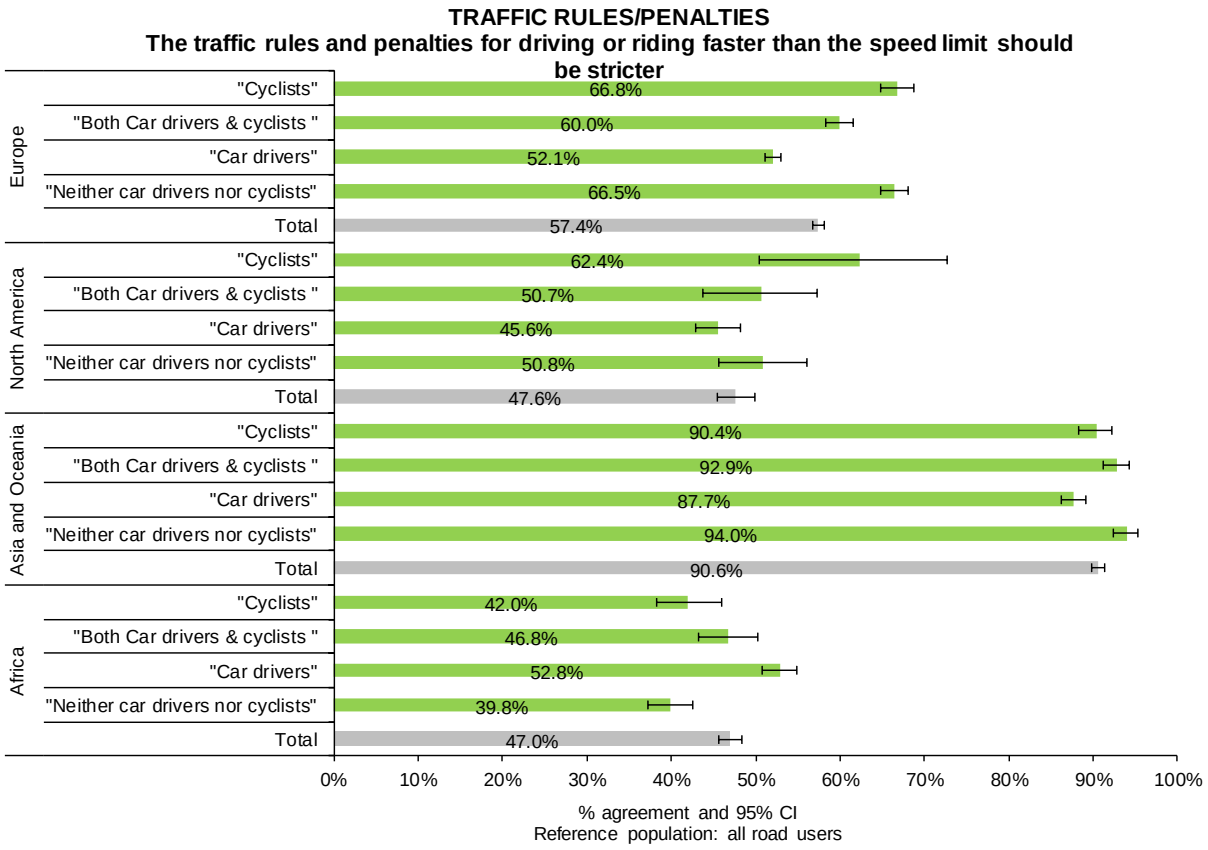


Figure 18: Opinions towards traffic rules and penalties for driving or riding faster than the speed limit, by type of road users and region (% agreement, 'agree' or 'disagree' and 95% confidence interval)

The different types of road users in the four regions have not the same point of view on whether traffic rules and sanctions for driving or riding faster than the speed limit should be stricter or not.

In Europe and North America, the proportion of cyclists who think that the rules should be stricter (67%, respectively 62%) is much higher than that of car drivers (52% in Europe and 46% in North America). In Asia and Oceania, no significant differences between the types of road users can be observed. On the contrary, in Africa, the proportion of car drivers who believe that the rules should be stricter (53%) is higher than that of cyclists (42%).

The results for similar questions related to 'drink-driving/drink-riding' as well as 'using a mobile phone while driving/riding' are shown in Appendix 3 (see Figure 29 and Figure 30).

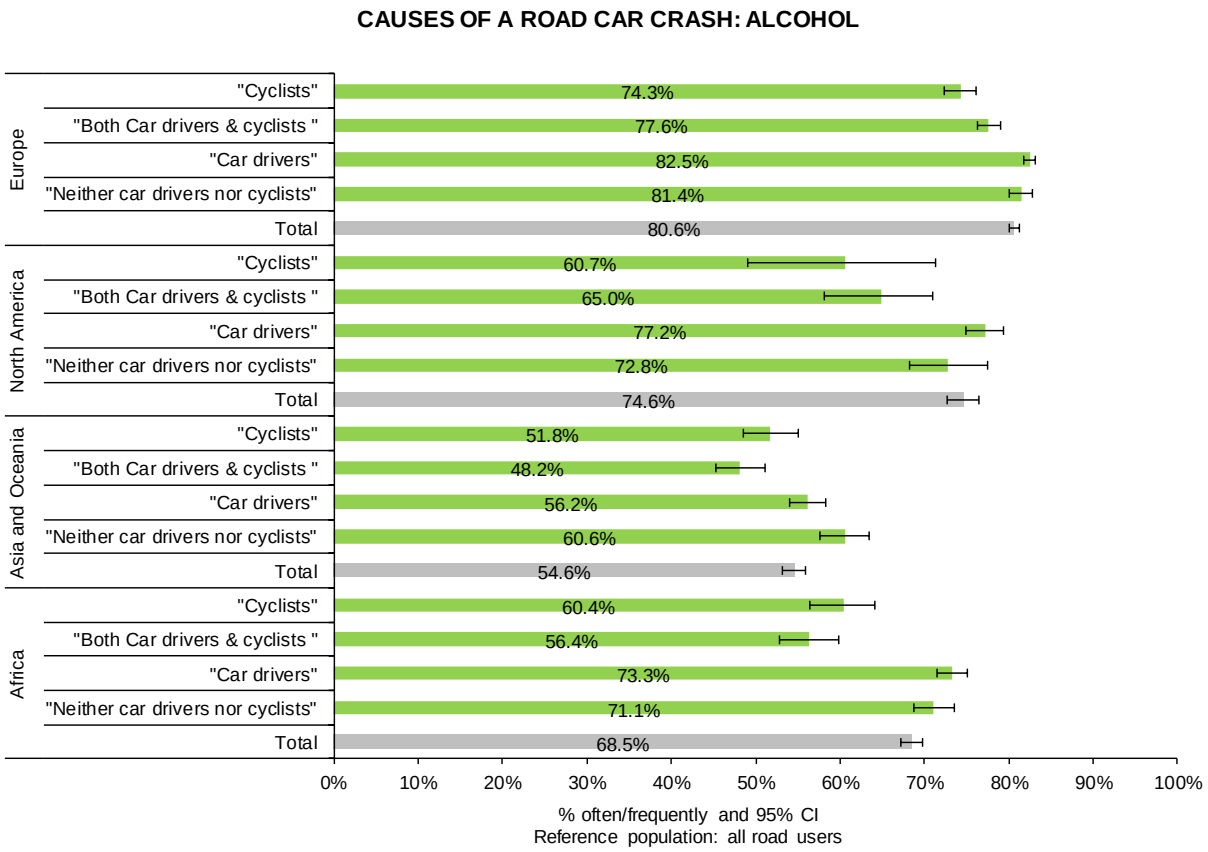


Figure 19: Risk perception of alcohol as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).

Overall, car drivers tend to be more likely than cyclists to perceive alcohol as a possible cause of a road car crash. In Europe for example, 74% of cyclists and 83% of car drivers answered that they believe that alcohol is 'often / frequently' the cause of a road accident.

In Appendix 3, corresponding figures for six other possible causes are presented (see Figure 31 to Figure 36). Trends similar to those described above can be observed.

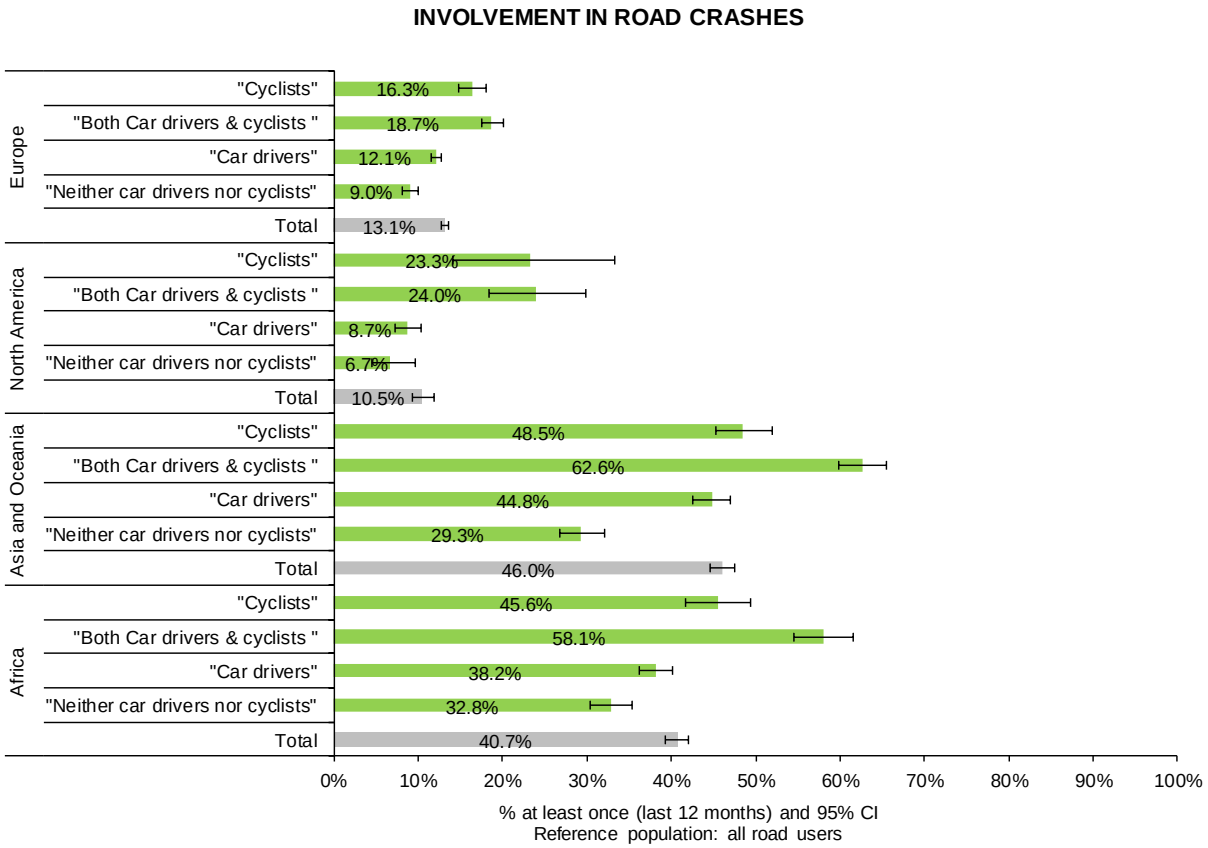


Figure 20: Involvement in road crashes resulting in material damage, injury or death, by type of road users and region (at least once in the last 12 months and 95% confidence interval).

The results shown in Figure 20 present the involvement in road crashes among the four types of road users, at least once in the last 12 months. It should be pointed out that reported road crashes concerned all travel modes. This means that reported crashes for the groups 'cyclists', 'car drivers' or 'car drivers and cyclists' may include crashes in a different travel mode." For example, a 'cyclist' may have been involved in a road crash as a car passenger or a car driver or as a pedestrian.

Nevertheless, it appears that in each region, 'cyclists' as well as 'both car drivers and cyclists' were more often involved in a road crash than 'car drivers' or the group of road users that are 'neither car drivers nor cyclists'. The probability that the first two types mentioned above have had an accident as a cyclist is naturally much higher because they cycle much more often than the other two road user groups. In addition, it is likely that cyclists get more involved in road accidents because they travel mainly on urban roads where the majority of accidents occur.

Furthermore, the graph shows that the involvement in road crashes is significantly higher in the Asian and Oceanian region as well as in Africa. Even car drivers and road users that rarely drive/ride a car/a bicycle are more often implicated in a road crash than cyclists in Europe. The group of road users least involved in road accidents is that of road users that are neither car drivers nor cyclists, followed by car drivers, both living in North America (respectively 7% and 9% experienced at least one road crash in the last 12 months). The group 'both car drivers & cyclists' in Asia and Oceania is the most involved in road accidents (63% have had at least one road crash in the past 12 months).

3.3 Comparison over time and with other findings

Effective monitoring of adopted strategies and deployed preventive solutions is undoubtedly the greatest challenge facing road safety program implementers. Road accident statistics have been used most frequently for this purpose, but in recent years, using the results of roadside observations and population surveys has become more and more current. A good example of such a survey is the international ESRA study which is based on one standardized questionnaire for all participating countries, and which is carried out every 3 years. It provides a unique opportunity to follow the changes taking place in the population of road users, and to conduct relevant international comparisons. This chapter presents examples of questions from the ESRA questionnaire used to assess changes in the cycling population, but first of all, it is worth recalling that:

- a total of 46 countries from five continents were represented in the ESRA surveys, but only 24 of them took part in both surveys (Australia, Austria, Belgium, Switzerland, Germany, Denmark, Greece, Spain, Finland, France, Ireland, Italy, Netherlands, Poland, Portugal, Sweden, Slovenia, United Kingdom, Czech Republic, Israel, Canada, Republic of Korea, United States, Hungary). It is the results of these latter countries that will be detailed in this chapter.
- two ESRA studies have been carried out so far: the first (ESRA1) in 2015-2017 and the second (ESRA2) in 2018. Seventeen countries (Austria, Belgium, Switzerland, Germany, Denmark, Greece, Spain, Finland, France, Ireland, Italy, the Netherlands, Poland, Portugal, Sweden, Slovenia, the United Kingdom) conducted their survey in mid-2015, and seven countries (Australia, the Czech Republic, Israel, Canada, Republic of Korea, United States, Hungary) in the second half of 2016. In practice, this means that in the case of the latter countries the analysis period is shorter by 1 year. Therefore, we have marked these countries with an asterisk in the following three summary tables.
- The research is based on a standardized questionnaire translated into national languages. The ESRA2 questionnaire has been modified based on the experience gained from the 2015-2017 survey. Some of the questions were removed, new ones were added, and the imprecise wording of certain questions was improved. These modifications have reduced the number of questions that can be used to analyze changes over time. In the case of cyclists, three questions are usable, one of them however with some restrictions only. They cover the following topics: frequency of cycling (in the past 12 months), safety perception when riding a bicycle, and support for a legal obligation requiring all cyclists to wear a helmet. While the questions asked on the last two topics were very similar in both surveys, the question on the frequency of cycling was somewhat different in ESRA2. This difference may have some impact on the analysis of changes over time. The exact wording of the questions in ESRA1 and ESRA2 and the collected results will be presented and discussed in the following sections of this chapter. Although the results presented below may suggest certain trends, they do not provide a full description of all relevant developments

3.3.1 Changes in self-declared frequency of cycling

The increase in motorised traffic in cities is connected with many negative consequences (e.g. air pollution, noise, destruction of natural resources, traffic jams, parking problems, road accidents, and their consequences). No wonder that more and more countries are actively supporting sustainable urban mobility planning that promotes a shift towards cleaner ways of travelling around the city. Bicycles are often considered as functional vehicles for short- and medium-distance trips, which characterize most urban journeys, and as alternatives to motorized transport in the context of urban mobility. Changing people's behaviour, shifting travel from the car to more sustainable modes of transport, such as cycling, is one of the most important challenges of our time.

In ESRA1 and ESRA2, the two questions on the frequency of cycling as a mode of transport were formulated as follows:

Survey	Question	Answers
ESRA1	(Q05) During the last 12 months, which of the following transport modes have you been using?	Yes or No
ESRA2	(Q10) During the past 12 months, how often did you use each of the following transport modes in [country]? How often did you ...?	at least 4 days a week - 1 to 3 days a week - a few days a month - a few days a year - never

In both studies, respondents were presented with a set of different means of transport, among which "cycle" non-electric and an electric bicycle/e-bike/pedelec'. To facilitate comparison, the original 5-point scale from the ESRA2 study was dichotomized to two categories "Never" and "At least a few days a year". However, it should be noted that the two questions and the answer options are somewhat different, which probably has a negative impact on the comparability of the results. Table 8 shows the results on cycling frequencies in the countries participating in both surveys. The analyses were realised separately for cycling on conventional bicycles and cycling on electric bicycles. The countries were ranked according to the size of the change. In the countries marked with an asterisk, the changes concern a two-year period.

Table 8: Changes in self-declared frequency of cycling (on non-electric or electric bicycle) among all road users by country

Cycling (non-electric bicycle)				Cycling (an electric bicycle / e-bike / pedelec)			
Country	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**	**Country**	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**
Slovenia	56,4%	80,6%	24,2%	Italy	24,6%	24,6%	0,0%
Greece	46,7%	62,0%	15,3%	Spain	19,0%	24,4%	5,5%
Hungary	35,6%	80,5%	44,9%	Netherlands	16,0%	28,3%	12,3%
Italy	29,7%	63,8%	34,1%	Sweden	15,9%	19,1%	3,2%
Portugal	23,1%	45,6%	22,6%	Switzerland	14,1%	22,3%	8,2%
Canada*	21,7%	47,8%	26,2%	Hungary*	13,9%	16,7%	2,8%
Austria	21,6%	67,1%	45,5%	Poland	13,8%	15,9%	2,1%
Switzerland	20,7%	58,7%	38,0%	Austria	13,7%	17,2%	3,5%
Finland	19,8%	77,2%	57,4%	Denmark	13,0%	18,1%	5,1%
Republic of Korea*	19,6%	53,2%	33,7%	Czech Republic*	11,7%	15,3%	3,6%
Spain	19,1%	53,6%	34,5%	Slovenia	10,8%	12,4%	1,6%
Poland	19,0%	81,7%	62,7%	Belgium	10,8%	17,3%	6,5%
Ireland	18,9%	47,6%	28,8%	Greece	10,6%	11,6%	1,0%
Sweden	16,5%	68,4%	51,9%	Ireland	9,4%	12,5%	3,1%
United Kingdom	14,3%	34,8%	20,5%	Portugal	8,7%	10,7%	2,0%
United States*	13,8%	32,7%	18,9%	France	8,7%	14,0%	5,3%
Czech Republic*	11,8%	58,9%	47,0%	Canada*	7,9%	13,4%	5,5%
Australia*	10,5%	31,7%	21,2%	Germany	7,3%	12,9%	5,6%
Israel*	9,9%	32,4%	22,5%	United Kingdom	6,4%	9,5%	3,1%
France	9,1%	41,9%	32,9%	Finland	5,9%	7,9%	1,9%
Germany	8,5%	64,9%	56,4%	Republic of Korea*	3,1%	9,7%	6,6%
Netherlands	5,8%	74,1%	68,3%	United States*	2,8%	10,0%	7,2%
Denmark	4,0%	71,5%	67,4%	Australia*	0,8%	8,3%	7,5%
Belgium	3,8%	52,5%	48,6%	Israel*	0,4%	10,1%	9,7%
ESRA Mean	**19,2%**	**57,6%**	**38,5%**	**ESRA Mean**	**10,4%**	**15,1%**	**4,7%**
ESRA Mean (3y)	19,8%	61,5%	41,7%	ESRA mean (3y)	12,3%	16,4%	4,1%
ESRA Mean (2y)	17,5%	48,2%	30,6%	ESRA Mean (2y)	5,8%	11,9%	6,1%

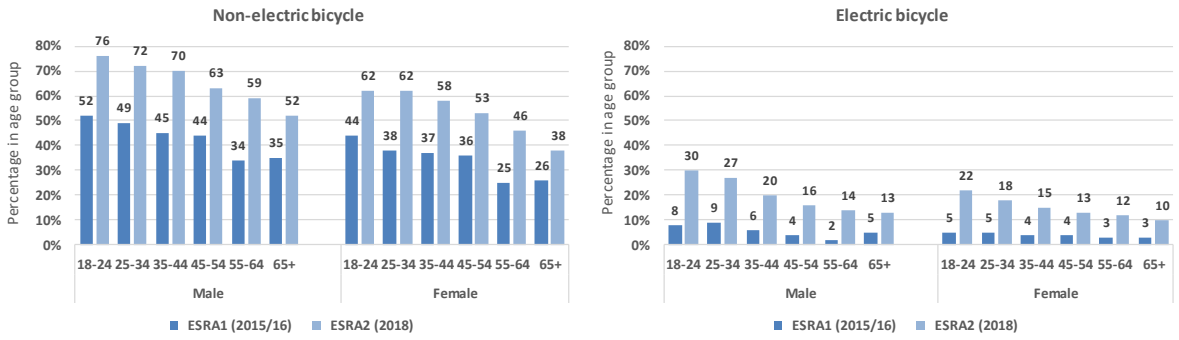
Weighting: Individual countries; Reference population: All road users

According to Table 8, the number of people declaring that they cycle has increased in all ESRA participating countries. However, given the differences highlighted above, the magnitude of the changes between ESRA1 and ESRA2 should be interpreted with caution and be confirmed in other studies The differences between countries are large, both in terms of changes over the last 2-3 years and the

achieved level of cycling as a mode of transport. As for conventional bicycles, the largest changes were noted in Slovenia (+56 percentage points), Greece (+47 percentage points) and Hungary (+37 percentage points). Particularly interesting in this context are the changes in Hungary, as they concern a relatively short period of time (2 years). The smallest changes in cycling frequencies were recorded in Belgium (only +4 percentage points), Denmark (+4 percentage points) and the Netherlands (+6 percentage points). The results of the last two countries (Denmark and the Netherlands) can be explained to some extent by the earlier high cycling rates, the results from Belgium might indicate that the sustainable mobility policy pursued in this country is not yet producing the expected results.

As far as electric bicycles are concerned, the greatest change in riding an electric bicycle at least a few days in the last year was recorded in Italy (+25 percentage points). It is worth noting, however, that in 2015, during the ESRA1 survey, there were no electric bicycle riders in the Italian respondent population at all. A relatively high increase in the number of people using electric bicycles was recorded in Spain (+19 percentage points), the Netherlands and Sweden (+16 percentage points), as well as Switzerland (+14 percentage points). Undoubtedly, the results indicating relatively low popularity of electric bicycles in countries such as the Republic of Korea, the United States, Australia, and Israel are also interesting. As can be seen from the presented summaries, the popularity of electric bicycles is still significantly lower than that of conventional bicycles.

The results of many scientific studies indicate that cycling tends to be very unevenly distributed. Young men do most of the cycling, while women cycle far less, and the elderly hardly cycle at all (Transport for London; 2014). However, countries with high levels of cycling, such as the Netherlands, have a much better gender and age balance. In the Netherlands for example, women cycle a higher proportion of journeys than do men, and cycling remains a major mode of transport into older age (Pucher and Buehler, 2008). To some extent, these tendencies were confirmed by the ESRA surveys. Figure 21 shows the percentage of people by age group reporting that they have used a bicycle as a means of transport in the last 2-3 years. The results are presented separately for women and men and for non-electric and electric bicycles.



Weighting: Individual countries; Reference population: All road users; Response: "At least a few days a year"

Figure 21: Changes in self-declared frequency of cycling (on non-electric or electric bicycles) among all road users by gender and age

As can be seen in Figure 21, there is an increase in the frequency of cycling over all age and gender groups. In all age groups, men use bicycles as a means of transport more frequently than women. We also observe that cycling is more commonly practised by younger age groups. It is likely that in the next few years it will be necessary to establish specifically targeted policies and infrastructures to appeal to specific age groups currently under-represented in cycling. Compared to non-electric bicycles, electric bicycles are relatively rarely used.

3.3.2 Changes in self-declared safety perception when cycling

The results of many studies show that safety concerns remain the key barrier to increased cycling (Transport for London; 2014). People do not ride bicycles, because they are afraid of being in the roadway with their bicycle. In the ESRA surveys, all respondents who used a non-electric or an electric bicycle were asked how safe or unsafe they felt when cycling. The corresponding two questions in ESRA1 and ESRA2 are presented below:

Survey	Question	Answers
ESRA1	(Q17) How (un)safe do you feel when using the following transport modes?	a scale from 0 to 10, where 0 is 'very unsafe" and 10 is "very safe".
ESRA2	(Q16) How safe or unsafe do you feel when using the following transport modes in [country]?	a scale from 0 to 10, where 0 is very unsafe" and 10 is "very safe".

To facilitate comparisons in further analyses, only "very safe" answers were selected (points 9 and 10 on the 11-points response scale). Table 9 shows the results of self-declared perception of safety while cycling in countries participating in the ESRA survey. The analyses were realised separately for cycling on non-electric bicycles and cycling on electric bicycles. The countries were ranked according to the size of the change. In the countries marked with an asterisk, the changes concern a two-year period.

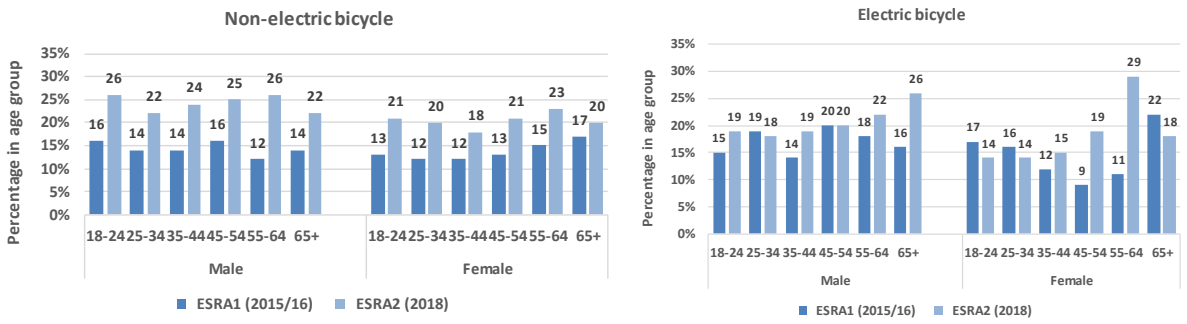
Table 9: Changes in self-declared safety perception while cycling (non-electric and electric bicycle) among cyclists by country (% very safe, scale points 9 and 10)

Cycling (non-electric bicycle)				Cycling (an electric bicycle / e-bike / pedelec)			
Country	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**	**Country**	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**
Austria	19,9%	36,8%	16,9%	Switzerland	16,3%	30,7%	14,4%
Switzerland	16,3%	31,3%	15,1%	Austria	15,7%	32,0%	16,3%
Germany	15,1%	33,1%	18,0%	Slovenia	13,3%	24,7%	11,4%
Hungary*	12,4%	22,9%	10,5%	Canada*	12,8%	19,6%	6,8%
Sweden	12,4%	33,9%	21,5%	Italy	10,8%	10,8%	0,0%
Poland	12,0%	24,6%	12,6%	Netherlands	8,8%	17,2%	8,4%
Portugal	10,5%	17,3%	6,8%	Belgium	6,6%	9,6%	3,0%
France	9,7%	12,5%	2,8%	Czech Republic*	6,5%	18,4%	11,9%
Canada*	8,8%	22,5%	13,6%	Sweden	4,1%	23,9%	19,8%
Czech Republic*	8,7%	16,7%	8,0%	Germany	3,4%	28,7%	25,2%
Spain	8,6%	16,9%	8,2%	France	3,2%	12,2%	9,0%
Slovenia	8,1%	19,2%	11,1%	Poland	2,2%	29,1%	26,9%
Italy	6,0%	17,3%	11,3%	Israel*	1,8%	9,1%	7,3%
United Kingdom	5,6%	13,0%	7,4%	United Kingdom	1,8%	12,2%	10,4%
Denmark	5,4%	38,4%	33,0%	Spain	1,6%	13,8%	12,1%
Ireland	3,9%	11,8%	7,9%	Greece	0,4%	14,0%	13,6%
Finland	2,9%	29,8%	26,9%	Ireland	-0,8%	15,3%	16,1%
Belgium	2,4%	8,0%	5,6%	Republic of Korea*	-4,6%	0,8%	5,5%
Netherlands	1,3%	13,5%	12,2%	Hungary*	-5,2%	11,2%	16,5%
Australia*	0,2%	17,3%	17,1%	Denmark	-5,5%	34,3%	39,7%
Israel*	-0,6%	13,2%	13,8%	Portugal	-7,7%	13,4%	21,1%
Greece	-1,5%	9,3%	10,9%	Finland	-13,2%	27,1%	40,2%
Republic of Korea*	-1,7%	3,3%	5,0%	Australia*	-13,7%	12,9%	26,6%
United States*	-3,8%	20,2%	24,1%	United States*	-18,9%	14,1%	33,0%
ESRA Mean	**6,8%**	**20,1%**	**13,3%**	**ESRA Mean**	**1,7%**	**18,1%**	**16,5%**
ESRA Mean (3y)	8,1%	21,6%	13,4%	ESRA Mean (3y)	3,6%	20,5%	16,9%
ESRA Mean (2y)	3,4%	16,6%	13,2%	ESRA Mean (2y)	-3,1%	12,3%	15,4%

Weighting: Individual countries; Reference population: cyclists: ESRA1 (Q05, answer "Yes"), ESRA2 (Q10, answer" At least a few days a year")

Results collected in the ESRA studies show that one in five of the surveyed cyclists feels very safe while riding a bicycle. In the last 2-3 years, the percentage of cyclists who rated their safety as very high increased in most countries for non-electric bicycles. Only in Israel, Greece, the Republic of Korea and the United States, we observe a slight decrease. The safety perception for riding an electric bicycle improved less markedly and, in eight countries, it has declined. Overall, the safety perception rate increased by 7 percentage points concerning the use of conventional bicycles and by 2 percentage points for electric bicycles. The largest increases in the safety ratings took place in Austria (+20 percentage points for the use of non-electric bicycles and +16 percentage points for the use of electric bicycles) and in Switzerland (+16 and +16 percentage points respectively). Attention should be paid to the countries where the safety perception of the cyclists has declined in the last 2-3 years (e.g. in the United States, Korea and Greece). Particular attention should be paid to the users of electric bicycles, especially in the eight countries where a decrease in safety perception was recorded. Undoubtedly, the changes registered in the United States, Australia and Finland should be checked more closely.

Research suggests that women disproportionately perceive cycling as a dangerous activity, although they are not in general at higher risk than men (Krizek et al., 2005; Aldred, R. & et.; 2017). Some authors (e.g. Griffin, W. & et.; 2015) also indicate that the lower safety perception in the group of women cannot be explained by factors specific to cycling only (e.g. the way of cycling or subjective assessments of one's own skills), but that gender differences reflect wider differences in risk perception. Results collected during ESRA surveys suggest that this picture of differences in perceptions of safety between women and men may change. Figure 22 shows the percentage of people of different age groups declaring in ESRA1 and ESRA2 that they feel very safe when cycling. The results are presented separately for women and men and for non-electric and electric bicycles.



Weighting: Individual countries; Reference population: cycling: ESRA1 (Q05, answer "Yes"), ESRA2 (Q10, answer" At least a few days a year")

Figure 22: Change in safety perception while cycling (non-electric and electric bicycle) among cyclists by gender and age (% very safe, scale points 9 and 10).

In the non-electric bicycle user group, the results are as expected. In all age groups, there was an increase over time in the number of people who declared feeling very safe riding a bicycle. This is undoubtedly a positive change, but it should not be forgotten that less than 30% of the surveyed cyclists share this opinion. It is also worth noting that it was in the age group 54-64 that the relatively highest increase in the number of cyclists declaring that cycling is very safe was recorded. The largest differences between 2015 and 2018 can be observed among female users of electric bicycles. In the last 2-3 years, the proportion of women indicating that they feel very safe when using an electric bicycle has slightly decreased in the age groups 18-34 and 65+. At the same time, these proportions have increased in the age groups 45-54 and especially 55-64. If these tendencies are confirmed in other studies, then more research will be needed to explain the reasons for these different evolutions.

3.3.3 Changes in support for legal obligation to require all cyclists to wear a helmet

If all cyclists wore helmets, the proportion of cyclists with serious head injuries, medical costs and the likelihood of death could be reduced. For example the meta-analysis of Høye (2018) showed that the use of bicycle helmets reduces head injury by 48%, serious head injury by 60%, traumatic brain injury by 53%, face injury by 23%, and the total number of killed or seriously injured cyclists by 34%. "Bicycle helmet effects may be somewhat larger when bicycle helmet wearing is mandatory than otherwise; however, helmet wearing rates were not found to be related to bicycle helmet effectiveness" (Høye, 2018, p. 85). A frequently raised argument against mandatory bicycle helmet legislation is that it may discourage some people from cycling. According to Olivier (2014), this assumption cannot be totally rejected although the evidence is weak or mixed. In the ESRA survey, the opinions of cyclists on mandatory helmet use were collected. The respondents were asked if they supported a legal obligation requiring all cyclists to wear a helmet. For further analyses, the following two questions were used:

Survey	Question	Answer
ESRA1	(Q12) Do you support each of the following measures? Having a law requiring all cyclists to wear a helmet	support (pro) – oppose (contra) – no opinion
ESRA2	(Q18) Do you oppose or support…. a legal obligation to require all cyclists to wear a helmet?	a scale from 1 to 5, where 1 is "oppose" and 5 is "support".

To facilitate comparison, the original 5-point scale from the ESRA2 study was dichotomized to two categories: "Support" (point 4-5 on a scale) and "Oppose/neutral" (point 1-3). Before presenting the results, it is worth recalling that seven countries participating in the ESRA survey (Australia, Austria, Czech Republic, Israel, Slovenia, Spain, Sweden[2]) imposes an obligation to wear a helmet for cyclists. They usually apply to younger riders (e.g. the Czech Republic has introduced an obligation to wear a helmet for cyclists up to 18 years of age, Slovenia up to 14 years, Spain up to 16 years of age and for everyone in an undeveloped area, Sweden up to 15 years). Due to the selection criteria in the ESRA surveys (i. e. persons aged 18+), younger cyclists were not included in these studies. In practice, this means that only in Israel and Spain are adult cyclists required by law to wear helmets when travelling outside built-up areas.

Table 10 shows the results concerning the support for a legal obligation requiring all cyclists to wear a helmet. The data were prepared separately for cycling on non-electric bicycles and cycling on electric bicycles. The countries were ranked according to the size of the changes over time. In the countries marked with an asterisk, the changes concern a two-year period.

[2] In Canada and the United States, such laws apply only to certain states.

Table 10: Changes in support for a legal obligation to require all cyclists to wear a helmet among cyclist by country

Cycling (non-electric bicycle)				Cycling (an electric bicycle / e-bicycle / pedelec)			
Country	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**	**Country**	**Change**	**ESRA2 (2018)**	**ESRA1 (2015-2016)**
Hungary*	20,6%	55,5%	34,9%	Italy	75,7%	75,7%	0,0%
Spain	19,9%	82,8%	62,8%	Hungary*	32,0%	58,5%	26,5%
Greece	16,8%	82,0%	65,2%	Portugal	29,6%	84,2%	54,7%
Belgium	16,3%	48,8%	32,5%	Denmark	27,1%	62,5%	35,3%
Slovenia	15,8%	58,3%	42,5%	France	25,2%	59,0%	33,8%
Israel*	15,4%	82,2%	66,8%	Canada*	23,4%	77,1%	53,7%
Ireland	15,3%	81,2%	65,9%	Slovenia	20,4%	59,9%	39,4%
Poland	14,3%	58,1%	43,7%	Belgium	18,4%	49,0%	30,7%
United Kingdom	13,8%	76,1%	62,3%	Ireland	16,7%	78,5%	61,7%
Australia*	12,8%	78,1%	65,3%	Finland	15,4%	53,8%	38,4%
Finland	12,8%	59,0%	46,2%	Greece	14,7%	80,9%	66,1%
Czech Republic*	12,7%	62,8%	50,2%	Australia	14,4%	74,0%	59,7%
Germany	12,2%	47,8%	35,5%	Spain	13,5%	87,4%	73,9%
Austria	11,5%	52,0%	40,5%	United Kingdom	12,4%	73,2%	60,8%
Denmark	10,3%	51,5%	41,1%	Sweden	11,3%	58,1%	46,8%
France	10,1%	57,4%	47,2%	Czech Republic*	9,7%	64,2%	54,5%
Sweden	8,9%	55,0%	46,1%	Netherlands	9,3%	20,0%	10,7%
Switzerland	8,5%	59,8%	51,3%	Austria	6,4%	49,4%	42,9%
Portugal	6,6%	80,7%	74,2%	Switzerland	6,2%	61,8%	55,5%
Canada*	6,1%	71,8%	65,6%	Germany	3,8%	48,5%	44,7%
Netherlands	4,9%	19,7%	14,8%	Israel*	3,3%	74,7%	71,3%
Italy	4,5%	71,8%	67,3%	Republic of Korea*	-3,1%	66,3%	69,4%
United States*	-0,6%	64,0%	64,7%	United States*	-4,7%	66,1%	70,7%
Republic of Korea*	-2,5%	62,3%	64,8%	Poland	-10,2%	52,6%	62,8%
ESRA Mean	11,1%	63,3%	52,1%	**ESRA Mean**	15,5%	64,0%	48,5%
ESRA Mean (3y)	11,9%	61,3%	49,4%	ESRA Mean (3y)	17,4%	62,0%	44,6%
ESRA Mean (2y)	9,2%	68,1%	58,9%	ESRA Mean (2y)	10,7%	68,7%	58,0%

Weighting: Individual countries; Reference population: cycling: ESRA1 (Q05, answer "Yes"), ESRA2 (Q10, answer" At least a few days a year")

Support for the proposal to introduce legislation requiring cyclists to wear a helmet varies widely: around 80% of the respondents in countries like Spain, Greece, Ireland, Israel, Portugal or Spain, and only 20% in the Netherlands. Over the last 2-3 years, the support of this measure for riders of non-electric bicycles has increased in most countries (up to 21 percentage points, in Hungary). Only in two countries, in the United States and Korea, has the support for mandatory use of helmets decreased. Regarding the users of electric bicycles, Italy (+75 percentage points), Hungary (+32 percentage points), Portugal (+30 percentage points), Denmark (+27 percentage points) and France (+25 percentage points) recorded the highest increase in support for the introduction of an obligation for all cyclists to wear a helmet. Support for this solution declined again in the US and Korea. Undoubtedly, it is also worth noting the opinions of cyclists from Portugal, Hungary and especially Poland. In these countries, there is growing support for the introduction of an obligation to wear a helmet for conventional bicycle riders and, at the same time, there is decreasing support for the introduction of the same preventive solution for those who use electric bicycles. Finally, it should be noted that mandatory helmet use is more strongly supported by people who have not cycled in the last year than by those who have.

The results of the ESRA survey indicate that the number of people using bicycles as a means of transport is increasing in the road user population. The direction of change is in line with sustainable mobility policies, but the pace of change is probably not satisfactory for all.

Unfortunately, the structure of the questions in the ESRA questionnaire makes it impossible to analyse the changes in the way cycling is used, nor does it allow to discern the factors motivating people to

give up their car and choose cycling as a means of transport. This problem should be more taken into account when implementing new strategies. Since a feeling of insecurity in road traffic is an important factor discouraging people from using bicycles, changes in the perception of safety can therefore be a useful indicator of whether the implemented measures are effective.

3.3.4 Comparison with other findings

We have seen in chapter 3.1.3 that the perceived safety as a cyclist is rated – at regional level – between 5 and 7 on a scale ranging from 0 'very unsafe' to 10 'very safe'). Compared to the other means of transport, these scores are rather low.

In this section, we investigate whether the subjective feeling of being safe/unsafe in traffic correlates with objective measurement data of road safety, like the number of road fatalities. Using the ESRA1 data, Furian et al. (2016) compared the mean levels of perceived safety as a cyclist with the percentage of cyclist fatalities within all road fatalities in the different countries and found out that in countries where there is a relative high proportion of cyclist fatalities, the respondents tend to feel rather safe, and the other way around (R^2=0.5261). This is mainly due to the fact that in countries where there is a high percentage of cyclists killed, there is also a high proportion of people who ride bicycles and consequently a rather high proportion of people who feel safe on bicycles. The number of distance-related cycling fatalities provides even a more precise measure of objective safety, but it is not available for all countries. In an OECD/ITF study realised in 2018, such data were compiled for 14 countries (Santacreu, 2018).These countries include Norway, which has not participated in ESRA2.

In Figure 23, we compare the mean scores of perceived safety as a cyclist and the number of cycling fatalities per billion km for the 13 countries for which we have data on both dimensions.

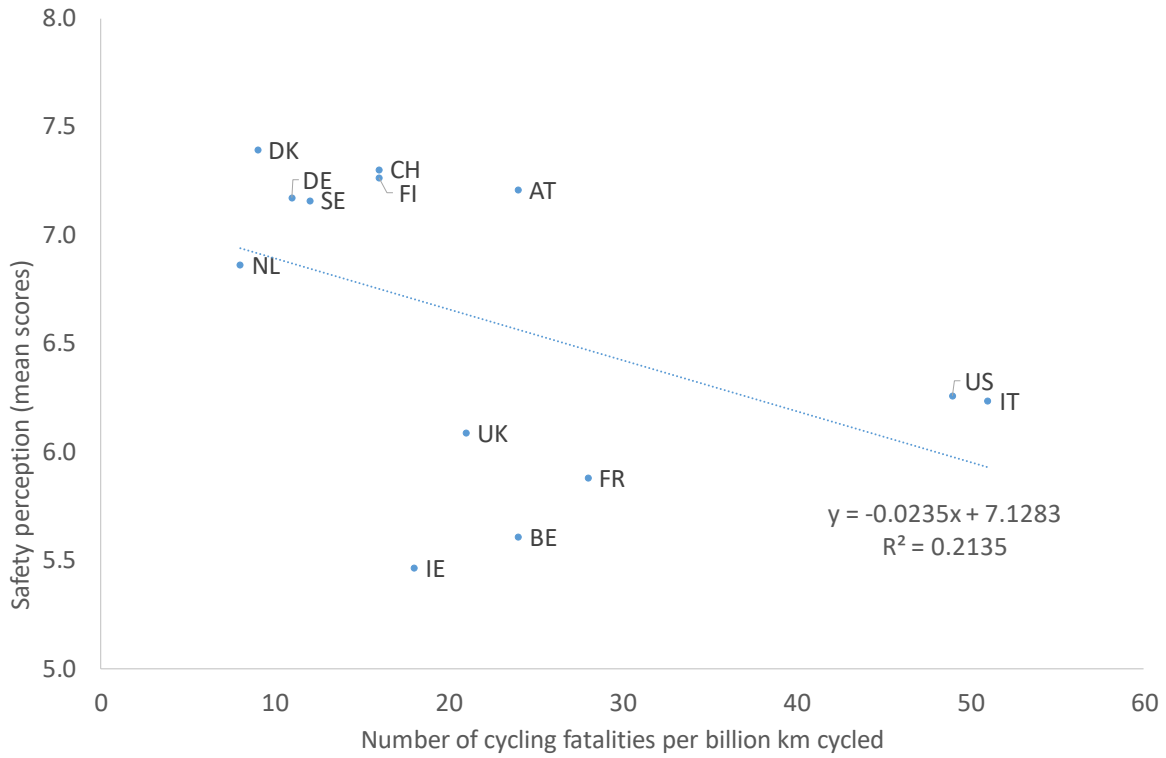


Figure 23: Relationship between safety perception when cycling and cycling fatalities per billion km cycled in different countries

As shown in Figure 23, a tendency can be observed among the countries: the lower the number of fatalities per billion km, the higher the scores of safety perception as a cyclist. The correlation coefficient is -0.46. In countries with a low number of cycling fatalities per billion km (the Netherlands, Denmark, Germany, Sweden, Switzerland and Finland), the mean scores on the feeling of safety as a cyclist is

rather high. At the other extreme, in the United States and in Italy, where the number of distance-related bicycle fatalities is high, the level of perceived safety is rather low. In four countries, the levels of perceived safety are particularly low compared to their distance-related fatality rates (Ireland, the United Kingdom, Belgium and France). In contrast, in Austria, the percentage of respondents feeling safe as a cyclist is rather high compared to the number of cycling fatalities per billion km.

Obviously, there are several factors other than objective safety that influence the perception of being safe/unsafe in traffic. Furian et al. (2016) also mention personal experience, observation and interpretation of traffic situations, social norms, personality traits, level of information, the built environment, traffic volume, etc.

3.4 Limitations of the data

In general, self-report data are vulnerable to a number of biases, including (Choi & Pak, 2005; Krosnick and Presser, 2010): the desirability bias – the tendency of respondents to provide answers which present a favourable image of themselves, e.g. individuals may over-report good behaviour or under-report bad, or undesirable behaviour; bias through misunderstanding of questions (e.g. questions with difficult words, long questions); or recall error – unintentional faulty answers due to memory errors.

Results of logistic regression were adjusted for the Social Desirability Scale (SDS), but descriptive results were not. The effect of the SDS on the self-declared behaviours was negative (OR between 0.93-0.955 for both models) showing that the higher the score of the SDS, the lower the likelihood of declaring an unsafe behaviour. These results indicate that the real percentages of unsafe behaviours may be higher than the reported percentages of the self-declared behaviours.

Despite the advantages of online surveys, the representativeness of the surveyed populations may be a problem, mainly for countries with low rates of internet use. That is the case for some of the countries in the ESRA2 survey where the percentage of the population using the internet is low (lower than 30% in Kenya and Nigeria, and lower than 50% in India and Egypt).

The number of African respondents aged 65 or older was so low that the answers of this particular age group in African countries cannot be considered to be representative.

Although the logistic regression analysis identifies several explanatory variables that predict the self-declared behaviour, the associations between explanatory and dependent variables are correlational and the causal direction of influence between variables is not indicated by the analysis.

4 Summary and discussion

We formulated 8 main research questions in the Introduction. Below, we summarise the main findings on these questions:

How do regions and countries differ in shares of conventional and electric cycling?

- The region with the highest proportion of persons declaring that they cycle is Asia-Oceania: 65% of the respondents have used a conventional (non-electric) bicycle and 29% an electric bicycle at least a few days during the past 12 months. In this region, we also find the largest percentages of respondents cycling (with or without an electric assistance) at least 4 days a week.
- The countries with the highest percentages of users of conventional bicycles are all European: in Poland, Slovenia and Hungary, at least 80% of the respondents used this mode of transport at least a few days during the past 12 months. In addition, the Netherlands, Hungary and Denmark have the largest proportions of frequent conventional bicycle riders (20% or more cycling at least 4 days a week).
- The use of electric bicycles is more widespread in Asia-Oceania and Africa than in Europe and North America. The highest percentages of respondents who reported using an electric bicycle at least a few days during the past 12 months are found in Egypt (36%), India (33%) and Nigeria (32%). However, the proportions of frequent electric bicycle riders are the highest in the Netherlands (9.2%), followed by India (6.4%) and Egypt (5.6%).

How do regions and countries differ in self-declared unsafe cycling behaviour?

- Cycling with headphones at least once in the last 30 days is the unsafe behaviour (out of the five analysed) with the greatest regional differences: 53% reported doing so in Africa, compared to 29% in Europe (a difference of 24 percentage points).
- There are also large regional disparities in the self-reported behaviours 'cycling next to the cycle path' (difference of 21 percentage points between Asia-Oceania, 57%, and North America, 36%) and 'cycling without a helmet' (difference of 20 percentage points between the same two regions).
- While the behaviour of 'cycling when you think you've had too much to drink' does not show any significant regional differences, there is a great variability between countries, especially within Europe, where the highest percentages were observed in Sweden, Belgium and Denmark (almost 30%) and the lowest in Greece and Portugal (below 10%).
- In jurisdictions where the use of helmet is mandatory for all cyclists (Australia, Nigeria and South Africa, some states of Canada and the United States as well as Spain and Israel when riding outside built-up areas), the percentage of persons reporting cycling without a helmet is markedly lower (between 30% and 54%) than in most other countries. The countries with the highest percentages of cyclists who report that they are not wearing a helmet are all European (i. e. the Netherlands, Hungary, Belgium: all above 82%).
- Besides, we observe great national disparities in terms of 'cycling on the road next to the cycle lane', particularly in Europe. While 26% of the respondents from the Netherlands reported this behaviour, more than twice as many declared to do so in Greece (66%) or Sweden (54%).

How do regions and countries differ in risk perception concerning cycling?

- There are relevant differences between the regions and countries in the proportion of respondents who indicated that they feel safe when using a bicycle. The highest safety perception average score was found in Asia-Oceania (near 7 points on the scale ranging from 0=very unsafe to 10=very safe for both types of bicycles), and the lowest in Africa (5.8 points for using a conventional bicycle and 5.1 points for using an electric bicycle).

- The countries with the highest safety perception average scores among people using conventional bicycles are all European, with Denmark at the top (7.4 points). The country outside the European region with the highest score is India (7.1 points). The countries with the lowest scores are Greece (4.5 points), the Republic of Korea (4.8 points) and South Africa (5.0 points).
- The highest safety perception average scores for the use of an electric bicycle were again recorded in Europe, in Denmark and Germany (both 7.0 points), followed by the Netherlands and Switzerland (both 6.9 points). India ranks at the fifth position with 6.8 points. The lowest scores are found in Israel (4.1 points), South Africa (4.4 points), Nigeria and the Republic of Korea (both 4.6%)

How do regions and countries differ in their support for cycling safety measures?

- The four policy measures proposed to the respondents are supported by all regions, ranging from 58% approval for banning the use of headphones while cycling in North America to 87% approval for mandatory helmet use for cyclists under the age of 12 in Africa.
- The policy measure with the largest variation in national support is the legal requirement that all cyclists should wear a helmet, particularly in Europe (difference of 64 percentage points between Ireland, 87%, and Netherland, 23%) and in Asia-Oceania (difference of 46 percentage points between Israel, 87% and Japan, 41%).
- In all countries that have introduced a mandatory helmet use for all cyclists (Australia, Nigeria, South Africa, as well as Spain and Israel when riding outside built-up regions), the percentage of people in favour of this measure is very high (at least 84%).
- The Netherlands and Japan are the only two countries where the majority of respondents do not agree with a legal requirement for all cyclists to wear a helmet.

What are the main differences between males and females as well as between age groups?

- Men ride bicycles (conventional or electric) more often than women, and young adults more often than elderly people.
- Overall, men are more likely than women to report unsafe behaviours. However, more women than men in Asia-Oceania reported cycling at least once in the past 12 months when they may have been drinking too much.
- The percentage of respondents who report unsafe behaviours while cycling tends to decrease with age. Such patterns can be observed for most regions with regard to wearing headphones or reading text messages/checking social media while cycling. This age effect is not clearly visible as far as 'cycling without a helmet' is concerned.
- Women tend to be more supportive of policy measures aimed at cyclists, but the differences are not particularly large and sometimes - depending on the measure and region - not statistically significant.
- Overall, we observe that the older the respondents, the higher the support for policy measures (at least in the European region). However the strength of the age group effect is rather small.

Which explanatory variables are associated with self-reported listening to music, or reading messages/checking social media while cycling or cycling without a helmet?

- Logistic regression models confirmed previous observations regarding the effects of gender and age: women and older cyclists are less likely to report unsafe behaviours.
- Persons who ride bicycles frequently are more likely to report unsafe behaviours than persons who cycle no more than a few days a month. The odds for persons cycling at least 4 days a week, compared to those that rarely cycle, are increased by 40% for 'not wearing a helmet',

by 18% for 'listening to music' and by 75% for 'reading messages/emails or checking social media'.

- Cyclists in favour of safety measures such as 'obligatory use of a helmet for all cyclists' or 'ban on listening music with headphones while cycling' are considerably more inclined to report that they behave safely in these two areas than cyclists who were not supporting these measures (OR=0.340; p<0.001, respectively OR=0.288; p<0.001).
- It appears that feeling safe or unsafe when cycling is not strongly associated with the likelihood of engaging in unsafe behaviours, except for the helmet question: cyclists who do not feel safe in traffic reported wearing a helmet more often than those who feel safe.
- Respondents with a high socially desirable responding score are less likely to report that they behave in an unsafe way while cycling than respondents with a low score (OR between 0.931 and 0.964; p<0.001). Apparently, a high socially desirable responding score has an effect on the likelihood of reporting unsafe behaviours as a cyclist (odds decreased by at least 4%), suggesting that answers related to unsafe behaviours while cycling are subject to social desirability.
- Switzerland, Ireland, Portugal, the United Kingdom, Canada, Israel, the United States, Australia and South Africa are the countries where the cyclists were the most likely to wear a helmet. The countries where cyclists were the least likely to protect themselves with a helmet are Belgium, the Netherlands, Poland, Hungary and Serbia.
- The cyclists living in Austria, Switzerland, Slovenia and Japan are most likely to report that they do not use headphones while riding their bicycle. At the other end of the scale, we find Greece, the Republic of Korea, India and four of the five African countries: Egypt, Kenya, Nigeria and Morocco.
- Compared to Poland, the "average European country" in terms of the behaviour "reading a message/email or checking social media when cycling", several countries are well below this average (odds decreased by at least 30%): Austria, Switzerland, Germany, Slovenia, Hungary, Nigeria and South Africa. In only two countries, Egypt and Morocco, are the cyclists more likely to report that they "read a message/email" or check social media when cycling".

How do respondent groups identified as (mainly) 'cyclists' and (mainly) 'car drivers' differ in their support for cycling measures, their perception of accident causes and involvement in crashes?

- 'Cyclists' defined within the road users' typology in this study as 'persons who cycle at least a few days a month and drive a car no more than a few days a month' are much less inclined to approve policy measures aiming at cyclists than 'car drivers' (persons who drive a car at least a few days a month and cycle no more than a few days a month). Since these measures only oblige cyclists, it is understandable that non-cyclists, who are not forced to change their behaviour, are more supportive.
- With regard to the acceptance of a legal requirement for all cyclists to wear a helmet, there are considerable differences between the types of road users especially in Europe. While 'car drivers' accept this measure with a share of 72%, the share among 'cyclists' is 50% (respectively 57% for those who also often drive a car).
- In Europe and North America, the proportion of 'cyclists' who think that the traffic rules should be stricter is higher than that of 'car drivers'. In Asia and Oceania, no significant differences

can be observed. On the contrary, in Africa, the proportion of 'car drivers' who believe that the rules should be stricter is higher than that of 'cyclists'.

- Overall, 'car drivers' are more likely than 'cyclists' to perceive alcohol, drugs, hand-held mobile phones, inattentiveness, fatigue, etc. as possible causes of a road car crash.
- In all regions, 'cyclists' felt that they were more often involved in a road crash than 'car drivers'.

What are the changes over time (between 2015/2016 and 2018) noted in the perception of safety while cycling and in the support for mandatory helmet use for all cyclists?

- The percentage of people who rated their safety while cycling as very high has increased slightly in most countries, particularly with regard to conventional bicycles. However, only one-fifth of the cyclists surveyed feel very safe when riding a bicycle (with or without electric assistance).
- Over the last 2-3 years, the support for mandatory helmet use for all cyclists has grown in most countries. Only the United States, the Republic of Korea and Poland recorded a decrease in support.

Discussion

In the last few decades, bicycle use has increased in many cities and regions of the world (Pucher & Buehler, 2017; Pelzer, 2010). The ESRA results have also shown a general rise in cycling in different countries around the world. This increase applies to both conventional and electric bicycles. According to ESRA, the use of electric bicycles is more widespread in Asia-Oceania and Africa than in Europe and North America. The highest percentages of respondents who reported using an electric bicycle at least a few days during the past 12 months are found in Egypt (36%), India (33%) and Nigeria (32%). So far, the vast majority of electric bicycles were sold in the Asia Pacific region. In China, for example, the number of electric bicycles sold has risen sharply in recent years, from about 10 million in 2005 to over 25 million in the early 2010s. Between 1998 and 2012, nearly 90 million cars and nearly 200 million electric bicycles were sold in China (Ling et al, 2015). In Europe, sales of electric bicycles are increasing and are expected to continue to grow while sales of conventional cycles remain stable (Jones et al., 2016).

Over the past three decades, there has also been a growing interest in cycling from transport and city planners and researchers, as well as from mobility and health professionals (e.g. Pucher & Buehler, 2017). Cycling is seen as a transport mode that provides health, mobility and environmental benefits. It also presents little or no danger to other road users. When cities promote a travel mode shift from the private car to more sustainable modes of transport, such as cycling, they must however ensure that these are safe options (European Commission, 2013). According to a recent study of the International Transport Forum, modal shift away from private motor vehicles could significantly improve road safety in dense urban areas. It would also bring public health benefits associated with increased physical activity and improved air quality. Areas where people cycle the most also have the lowest total road mortality" (ITF, 2019, page 8). Since cycling has been the subject of a variety of research studies in recent years, there is a growing body of knowledge about policies that make cycling safe and attractive (OECD, ITF, 2013; Santacreu, 2018; Pucher & Buehler, 2017; Schepers et al., 2017).

Safe infrastructure

Infrastructural measures play a predominant role in making cycling safe and attractive. A promising strategy, based on the experience of the Netherlands, is to reduce cyclists' exposure to high-speed motor vehicles (Schepers et al., 2017). This can be achieved in particular through the implementation of the following measures: separated cycle paths, traffic calming (e.g. by introducing speed limits of 30 or 20 km/h in residential areas and urban core zones) and intersection treatments.

A safe cycling infrastructure may also be important in eliminating undesirable cycling behaviours. The ESRA results reveal that only 26% of the cyclists in the Netherlands reported 'cycling on the road next to the cycle lane', while more than twice as many declared to do so in Greece (66%) or Sweden (54%). This particular result with Dutch cyclist placed at the very end of this scale makes sense in view of the

relatively large cycling path network in the Netherlands. In 2017 the road network in the Netherlands has a total road network of about 143.000 km (data from Central Bureau Statistics), and in 2019 the cycling network has a length of 35.000 (Lith, 2019). In other words, for every kilometre of roadway for motorised traffic there is also 250 meter for separate cycling path for cyclists. This particular ratio of road length and cycle path length (4:1) is unique to the Netherlands. It is the result of a long tradition of cycling policies and investments in cycling infrastructure that date back to the early twenties and thirties of the 20st Century. In a flat country with a moderate climate, and having fairly small to moderate distances between residential and industrial areas, the bicycle became a popular and economically necessary travel instrument for the growing Dutch workforce in the early twenties and thirties.

In further interpreting the ESRA2 behavioural differences on cycling on roads, it is likely that besides the length of cycling paths, other factors such as the width of cycle lanes, the density of motor vehicle traffic or the maximum speed limit for motorised traffic play a role. However, assessing all these factors lies outside the scope of the present study.

Objective and subjective cycling safety

According to an online survey on the psychological determinants and barriers of a travel mode shift, the largest obstacle deterring road users from cycling more frequently, is traffic safety (ISAAC project, 2019). Improving road safety objectively and subjectively is therefore a key element in achieving a modal shift towards more cycling, especially for people who rarely use a bicycle (ISAAC project, 2019). A well-designed infrastructure, awareness-raising campaigns and adequate legislation all contribute to improving traffic safety for cyclists. Furthermore, the ISAAC project indicates that a good way to promote bicycle use is to change people's attitudes towards cycling (ISAAC project, 2019).

As outlined above, investments in cycling infrastructure, as well as the perception of road safety are key elements in encouraging cycling. Therefore, it would be useful to develop a set of indicators for monitoring the actual (objective) and the perceived (subjective) road safety in the different countries. The feeling of being safe/unsafe in traffic is influenced by objective safety, but also by other factors such as personal experience, observation and interpretation of traffic situations, social norms, personality traits, level of information, the built environment, traffic volume, etc. (Furian et al., 2016).

With regard to safety perception the ESRA results show that one in five of the surveyed cyclists feels very safe when they ride a bicycle. Over the last years, the percentage of cyclists who rated their safety as very high has increased moderately. There are, however, large disparities across the countries: Denmark, Finland, Switzerland, Sweden, Germany, Austria, India and the Netherland are the countries with the highest safety perception for the use of a conventional or an electric bicycle. The countries with the lowest safety perception are Greece, the Republic of Korea, South Africa, Israel and Nigeria. Also, the predicted positive relationship between subjective and objective risk was confirmed by present results; comparing the safety perception scores with the number of cycling fatalities per billion km (objective risk) showed that the lower the objective risk, the higher the safety perception and the other way around.

Risky behaviour

The safety of the cyclists in the various countries not only depends on the infrastructure, but also on their own behaviour. Cyclists commit a variety of violations, respectively engage in different unsafe behaviours, such as riding with headphones or riding after drinking too much alcohol.

The ESRA results reveal for example that riding a bicycle while distracted is particularly widespread in the African region. The three countries with the highest proportions of persons reporting that they cycled while listening to music through headphones (at least once in the last 30 days) are all African (Egypt, 62%, Kenya, 53% and Morocco, 50%) while the corresponding lowest proportions are found in Japan (14%) and Slovenia (15%). Morocco and Egypt also have the highest proportions of cyclists reporting that they read a text message or check social media while cycling (41%, resp. 39%). This behaviour is reported by only 11% of the Slovenian or Hungarian cyclists.

Cycling after drinking too much alcohol (at least once in the last 30 days) did not show any significant regional differences, but a rather great variability between countries, especially within Europe, where the highest percentages were observed in Sweden, Belgium and Denmark (almost 30%) and the lowest in Greece and Portugal (below 10%).

From the answers provided by the respondents in the 32 countries, it appears that most bicycle trips are made without helmets. The countries with the highest percentages of cyclists who report that they are not wearing a helmet when cycling are all European (i.e. the Netherlands, Hungary, Belgium: all above 82%). It is interesting to point out that the modal share of cycling in these countries is considerably higher than in most other countries.

While wearing a helmet does not prevent the occurrence of accidents, it can, however, reduce their severity. According to a meta-analysis, the use of bicycle helmets reduces serious head injury by 60% and the total number of killed or seriously injured cyclists by 34% (Høye, 2018).

Targeted awareness-raising campaigns are one of the possible measures to promote safer cycling behaviour. Of course, legislation and enforcement also have a role to play. In this regard the ESRA2 results have shown that in jurisdictions where the use of helmet is mandatory for all cyclists (i. e. Australia, Nigeria and South Africa, some states of Canada and the United States as well as Spain and Israel when riding outside built-up areas), the percentage of persons reporting cycling without a helmet is markedly lower (between 30% and 54%) than in most other countries. On the basis of the ESRA results, we observe wide divergences in the support for mandatory bicycle helmet use among countries where such legislation does not exist. For example, this measure is supported by more than 85% of the road users in Ireland, Greece and Portugal, and by only 41% in Japan and 23% in the Netherlands.

A long tradition of having separate cycling paths and cycling without a helmet in the Netherlands and Japan is part of the explanation why the support for mandatory bicycle use is rather low in these two countries. In the Netherlands, there are fears that the introduction of mandatory helmet use could reduce the interest in cycling and diminish the health benefits provided by cycling (Fietsersbond, 2018).

Recommendations

Various measures targeting cyclists, bicycles, potential collision partners, motor vehicles, as well as road infrastructure can be taken to increase cyclist safety. The measures presented below were proposed in the works of Morris et al. (2018), Shinar (2017), Schepers et al. (2017), Goodwin et al. (2015), OECD/ITF (2013) and Walter et al. (2012).

According to the OECD/ITF (2013) policy should focus on improving the inherent safety of the traffic system, not simply securing cyclists in an inherently unsafe system. According to Schepers et al. (2017), the following measures (among others) from the Dutch Sustainable Safety systems approach were key to the achievement of the country's high level of cycling safety: the establishment of a road hierarchy with large traffic-calmed areas where through traffic is kept out, separated bicycle paths along distributor roads and intersection treatments.

In terms of infrastructure, ambitious plans are needed to create a safe and attractive cycling environment. Space should be reallocated to this purpose in urban development. High quality networks should be developed and the design of junctions strongly focused on security aspects.

Another important approach in favour of cycling is to ensure that motor vehicles (namely cars, goods vehicles, coaches and busses) are equipped with electronic devices, in particular bicycle detection systems or brake assist systems.

Furthermore, there are several other measures that can contribute to increase cyclist safety, such as encouraging cyclists to enhance their conspicuity by wearing fluorescent and retroreflective materials, if possible at the level of the ankles and knees, i.e. the moving joints of a cycling person. Cyclists should also be motivated to ensure that their bicycles are in good condition with lights in working order. It is also worth raising awareness of the specific dangers of behaviours such as riding impaired, distracted or at an excessive speed etc. In addition, it seems necessary to instruct motorists and cyclists on how they should interact safely with each other and to inform them of relevant laws.

Finally, two further aspects should be mentioned. Firstly, recommendations about proper rules (i.e. speed limits) for slow and rapid electric bicycles and rules on the interactions between the conventional and electric bicycles should be developed. Secondly, bicycle helmet use ought to be promoted, i.e. through information, incentives and/or enforcement of helmet laws. This last measure does not help to prevent bicycle accidents, but can significantly reduce the proportion of cyclists with serious head injuries.

Closing remarks

The initial aim of ESRA was to develop a system for gathering reliable and comparable information about people's attitudes towards road safety in a number of European countries. This objective has been achieved and the initial expectations have even been exceeded. ESRA has become a global initiative which already conducted surveys in 46 countries across six continents. The outputs of the ESRA project have become building blocks of national and international road safety monitoring systems.

The ESRA project has also demonstrated the feasibility and the added value of joint data collection on road safety attitudes and performance by partner organizations in a large number of countries. The intention is to repeat this initiative on a triennial basis, retaining a core set of questions in every wave allowing the development of time series of road safety performance indicators.

List of tables

List of figures

Overview appendix

References

Adminaité-Fodor & Jost, G. (2020). *How safe is walking and cycling in Europe?* PIN Flash Report 38. Brussels, Belgium: European Transport Safety Council (ETSC). Retrieved from https://etsc.eu/how-safe-is-walking-and-cycling-in-europe-pin-flash-38/ [19.02.2020].

Adminaité, D., Allsop, R. & Jost, G. (2015). *Making walking and cycling on Europe's roads safer.* PIN Flash Report 29. Brussels, Belgium: European Transport Safety Council (ETSC). Retrieved from https://etsc.eu/wp-content/uploads/etsc_pin_flash_29_walking_cycling_safer.pdf [26.08.2019].

Aldred, R. & Dales, J. (2017). Diversifying and normalising cycling in London, UK: An exploratory study on the influence of infrastructure. *Journal of Transport & Health* 4, 348–362. https://doi.org/10.1016/j.jth.2016.11.002

Choi, B.C.K., Pak, A.W.P. (2005). A catalog of biases in questionnaires. Preventing Chronic Disease, 2 (1), A13.

Crocker, P., Zad, O., Milling, T., Lawson, K.A. (2010). Alcohol, bicycling, and head and brain injury: a study of impaired cyclists' riding patterns R1. *American Journal of Emergency Medicine,* 28, 68–72.

European Commission, Eurobarometer. (2013). *Attitudes of Europeans towards urban mobility*. Retrieved from https://ec.europa.eu/transport/sites/transport/files/themes/urban/doc/ump/flash-eurobarometer-ump-2013.pdf [07.11.2019].

European Commission. (2013). *Commission staff working document: Targeted action on urban road safety*. SWD(2013) 525 final. Brussels. Retrieved from https://ec.europa.eu/transport/sites/transport/files/themes/urban/doc/ump/swd%282013%29525-communication.pdf [07.11.2019].

Fietsersbond (2018). Waarom een helmplicht (geen) zin heeft. *Fietsen123*, Webpage posted 11 december 2018,accessed March 13th 2020 at: https://www.fietsen123.nl/fietsnieuws/waarom-een-helmplicht-geen-zin-heeft

Furian, G., Brandstätter, C., Kaiser, S. & Witzik, A. (2016). *Subjective safety and risk perception. ESRA thematic report no. 5. ESRA project (European Survey of Road users' safety Attitudes)*. Vienna, Austria: Kuratorium für Verkehrssicherheit. Retrieved from https://www.esranet.eu/en/deliverables-publications/ [15.10.2019].

Goldenbeld, C., Houtenbos, M., Ehlers, E., De Waard D. (2012). The use and risk of portable electronic devices while cycling among different age groups. *Journal of Safety Research,* 43, 1–8. https://doi.org/10.1016/j.jsr.2011.08.007

Goodwin, A., Thomas, L., Kirley, B., Hall, W., O'Brien, N., & Hill, K. (2015). Countermeasures that work: *A highway safety countermeasure guide for State highway safety offices, Eighth edition*. (Report No. DOT HS 812 202). Washington, DC: National Highway Traffic Safety Administration. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/812478_countermeasures-that-work-a-highway-safety-countermeasures-guide-.pdf [12.09.2019].

Griffin, W. & Haworth, N. (2015). Male and female cyclist and driver perceptions of crash risk. In *TRB 94th Annual Meeting Compendium of Papers*, Transportation Research Board, Washington DC, United States, 15-3879.

Høye, A. (2018). Bicycle helmets – To wear or not to wear? A meta-analysis of the effects of bicycle helmets on injuries. *Accident Analysis & Prevention*, 117 (1), 85-97. https://doi.org/10.1016/j.aap.2018.03.026

ISAAC project. (2019). *Stimulating safe walking and cycling within a multimodal transport environment. Determinants and barriers of walking, cycling and using Personal eTransporters: a survey in nine European cities*. Deliverable No D1.1.2. Retrieved from: https://www.polisnetwork.eu/wp-content/uploads/2019/05/d1.1.2-a-survey-in-nine-european-cities.pdf [07.11.2019].

ITF (2019), *Road Safety in European Cities: Performance Indicators and Governance Solutions*, International Transport Forum Policy Papers, No. 67, OECD Publishing, Paris. Retrieved from: https://www.itf-oecd.org/sites/default/files/docs/road-safety-european-cities-performance-indicators.pdf [07.11.2019].

Jones, T., Harms, L., Heinen, E. (2016). Motives, perceptions and experiences of electric bicylce owners and implications for health, wellbeeing and mobility. *Journal of Transport Geography*. https://www.sciencedirect.com/science/article/pii/S0966692316301934?via%3Dihub

Juhra, C., et al. (2012). Bicycle accidents – Do we only see the tip of the iceberg? A prospective multi-centre study in a large German city combining medical and police data." *Injury*, 43, 2026–2034. https://doi.org/10.1016/j.injury.2011.10.016

Li, G., Baker, S. P., Sterling, S., Smialek, J. E., Dischinger, P. C., Soderstrom, C. A. (1996). A comparative analysis of alcohol in fatal and nonfatal bicycling injuries. *Alcohol Clin Exp Res*. 20(9), 1553–1559.

Li, G., Baker, S. P., Smialek, J. E., Soderstrom, C. A. (2001). Use of Alcohol as a Risk Factor for Bicycling Injury. *JAMA*. 285(7), 893-896. https://jamanetwork.com/journals/jama/fullarticle/193571

Ling, Z., Cherry, C. R., Yang, H., Jones, L. R. (2015). From e-bike to car: A study on factors influencing motorization of e-bike users across China. *Transportation Research Part D,* 41, 50-63. https://doi.org/10.1016/j.trd.2015.09.012 2001

Kwan, I. & Mapstone, J. (2006). Interventions for increasing pedestrian and cyclist visibility for the prevention of death and injuries. Cochrane Database Syst Rev. 2006;(4).

Lesisz, R. (2004). Honderd jaar fietsen in Nederland 1850-1950. Over het begin van de fietscultuur. Thesis in Dutch language. Universiteit van Wrocław, Poland. Accessed November 2019 at: https://fietspadenstichting.nl/honderd%20jaar%20fietscultuur.pdf

Lith, J. van (2019). Nederland telt bijna 35.000 km fietspad. Verkeerskunde, Webpage 27 December 2019, accessed 13 March 2020 at: https://www.verkeerskunde.nl/artikel/nederland-telt-bijna-35000-km-fietspad

Meesmann, U. & Torfs, K. (2019). *ESRA2 survey methodology. ESRA2 report Nr. 1. ESRA project (E-Survey of Road users' Attitudes)*. Brussels, Belgium: Vias institute. Retrieved from https://www.esranet.eu/en/deliverables-publications/ [18.10.2019].

Meesmann, U., Torfs, K., Nguyen, H., & Van den Berghe, W. (2017). *Do we care about road safety? Key findings from the ESRA1 project in 38 countries. ESRA project (E-Survey of Road users' Attitudes).*

Brussels, Belgium: Vias institute. Retrieved from https://www.esranet.eu/en/deliverables-publications/ [18.10.2019]

Morris, A. P, et al. (2018). *SAFERWHEELS. Study on Powered Two-Wheeler and Bicycle Accidents in the EU*. Luxembourg: Publications Office of the European Union. Retrieved from https://repository.lboro.ac.uk/articles/SaferWheels_study_on_powered_two-wheeler_and_bicycle_accidents_in_the_EU_-_Final_report/9354305 [15.10.2019].

OECD/ITF (2013). *Cycling, Health and Safety.* OECD Publishing/ International Transport Forum. http://dx.doi.org/10.1787/9789282105955-en [16/09/2019]

Olivier, J., Wang, J., Walter, S. & Grzebieta, R. (2014) Anti-helmet arguments: lies, damned lies and flawed statistics. *Journal of the Australasian College of Road Safety*, Volume 25, No.4, 2014

Pelzer, P. (2010). Bicycling as a way of life: a comparative case study of bicycle culture in Portland, OR and Amsteram. 7th Cycling and Society Symposium. Oxford. https://www.ris.uu.nl/ws/files/31021264/Bicycling_as_a_way_of_life.pdf

Pucher, J., & Buehler, R. (2017). Cycling towards a more sustainable transport future. Transport Reviews, 37(6), 689-694. https://www.tandfonline.com/doi/full/10.1080/01441647.2017.1340234

Pucher, J., & Buehler, R. (2008). Making cycling irresistible: lessons from the Netherlands, Denmark and Germany. *Transport Reviews*, 28(4), 495-528. http://www.cycle-helmets.com/irresistible.pdf

Santacreu, A. (2018), *Cycling Safety.* Paris: International Transport Forum. Retrieved from https://www.itf-oecd.org/sites/default/files/docs/cycling-safety-roundtable-summary.pdf [17/09/2019].

Schepers, P., Twisk, D., Fishman, E., Fyhri, A., & Jensen, A. (2017). The Dutch road to a high level of cycling safety. *Safety science*, 92, 264-273.

Shinar D. (2017). *Traffic safety and Human behaviour.* Emerald Publishing Limited. Retrieved from https://doi.org/10.1108/978-1-78635-221-720162029 [17/09/2019].

Torfs, K., Meesmann, U. (2019). How do vulnerable road users look at road safety? International comparison based on ESRA data from 25 countries*. Transportation Research Part F: Traffic Psychology and Behaviour,* 63, 144-152. https://doi.org/10.1016/j.trf.2019.04.001.

Transport for London (2014) Attitudes towards cycling Annual report 2014.

UNdata, United Nations Statistics Division, 2019. *Population statistics on gender and age per country.* Available at: http://data.un.org/Data.aspx?d=POP&f=tableCode:22%20 [13/06/2019].

Walter, E., Achermann Stürmer, Y., Scaramuzza, G. Niemann, S., Cavegn, M. (2012). *Fahrradverkehr*. Bern, Schweiz: Beratungsstelle für Unfallverhütung. Retrieved from http://www.bfu.ch/sites/assets/Shop/bfu_2.092.01_bfu-Sicherheitsdossier%20Nr.%2008%20–%20Fahrradverkehr.pdf [26.08.2019].

WHO (2018). *Global status report on road safety 2018*. Switzerland: World health Organisation. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf?ua=1 [04.04.2019].

Wood, J. M., et al. (2012). Using reflective clothing to enhance the conspicuity of bicyclists at night. *Accident Analysis and Prevention*, 45, 726-730. https://doi.org/10.1016/j.aap.2011.09.038

Appendix 1: ESRA2_2018 Questionnaire

Introduction

In this questionnaire, we ask you some questions about your experience with, and your attitudes towards traffic and road safety. When responding to a question, please answer in relation to the traffic and road safety situation in [COUNTRY]. There are no right or wrong answers; what matters is your own experience and perception. Thank you for your contribution!

Socio-demographic information

Q1) In which country do you live? _____

Q2) Are you ... male – female – other (only in country who officially recognizes another gender)

Q3a) In which year were you born? Dropdown menu

Q3b) In which month were you born? Dropdown menu

Q4_1) What is the highest qualification or educational certificate that you have obtained? none - primary education - secondary education - bachelor's degree or similar - master's degree or higher

Q4_2) What is the highest qualification or educational certificate that your mother has obtained? none - primary education - secondary education - bachelor's degree or similar - master's degree or higher - I don't know

Q5a) Which of the following terms best describes your current professional occupation? white collar or office worker (excluding executive)/employee (public or private sector) →Q5b - blue collar or manual worker/worker →Q5b - executive →Q5b - self-employed/independent professional →Q5b - currently no professional occupation →Q5c

Q5b) Do you have to drive or ride a vehicle for work? (Please indicate the job category that is most appropriate for you) yes, I work as a taxi, bus, truck driver, … - yes, I work as a courier, mailman, visiting patients, food delivery, salesperson, … - no

Q5c) You stated that you currently have no professional occupation. Which of the following terms best describes your current situation? I am … a student - unemployed, looking for a job – retired - not fit to work - a stay-at-home spouse or parent - other

Q6) What is the postal code of the municipality in which you live? _____

Q7) In which region do you live? Drop down menu

Q8a) How far do you live from the nearest bus stop, light rail stop, or metro/underground station? less than 500 metres → Q8b - between 500 metres and 1 kilometre → Q8b - more than 1 kilometre → skip Q8b

Q8b) What is the frequency of your nearest bus stop, light rail stop, or metro/underground station? at least 3 times per hour - 1 or 2 times per hour - less than 1 time per hour

Mobility & exposure

Q9) Do you have a car driving licence or permit (including learner's permit)? yes - no

Q10) During the past 12 months, how often did you use each of the following transport modes in [country]? How often did you ...? at least 4 days a week - 1 to 3 days a week - a few days a month - a few days a year - never
Items (random): walk minimum 100m (pedestrian; including jogging, inline skate, skateboard, …) - cycle (non-electric) - cycle on an electric bicycle/e-bike/pedelec - drive a moped (≤ 50 cc or ≤ 4 kW; non-electric - drive a motorcycle (> 50 cc and > 4 kW non-electric) - drive an electric moped (≤ 4 kW) - drive an electric motorcycle (> 4 kW) - drive a powered personal transport device such as an electric step, hoverboard, solowheel,… - drive a car (non-electric or non-hybrid) - drive a taxi - drive a bus as a driver - drive a truck/lorry - drive a hybrid or

electric car - take a taxi or use a ride-hail service (e.g. Uber, Lyft) - take the train - take the bus - take the tram/streetcar - take the subway - take the aeroplane - take a ship/boat or ferry - be a passenger in a car - use another transport mode

Q11) Over the last 30 days, have you transported a child (<18 years of age) in a car? yes - no
Items: below 150cm - above 150cm

Self-declared safe and unsafe behaviour in traffic

Q12_1a) Over the last 12 months, how often did you as a CAR DRIVER …?
You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Items (random):

- drive after drinking alcohol
- drive faster than the speed limit outside built-up areas (but not on motorways/freeways)
- read a text message or email while driving

Q12_1b) Over the last 30 days, how often did you as a CAR DRIVER …?
You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Items (random):

- drive when you may have been over the legal limit for drinking and driving
- drive after drinking alcohol
- drive 1 hour after using drugs (other than medication)
- drive after taking medication that carries a warning that it may influence your driving ability
- drive faster than the speed limit inside built-up areas
- drive faster than the speed limit outside built-up areas (but not on motorways/freeways)
- drive faster than the speed limit on motorways/freeways
- drive without wearing your seatbelt
- transport children under 150cm without using child restraint systems (e.g. child safety seat, cushion)
- transport children over 150cm without wearing their seatbelts
- talk on a hand-held mobile phone while driving
- talk on a hands-free mobile phone while driving
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while driving
- drive when you were so sleepy that you had trouble keeping your eyes open

Q12_2) Over the last 30 days, how often did you as a CAR PASSENGER …? You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Item:

- travel without wearing your seatbelt in the back seat

Q12_3) Over the last 30 days, how often did you as a MOPED DRIVER OR MOTORCYCLIST …? You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Items (random):

- ride when you may have been over the legal limit for drinking and driving
- ride faster than the speed limit outside built-up areas (but not on motorways/freeways)
- ride a moped or motorcycle without a helmet
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while riding a moped or motorcycle

Q12_4) Over the last 30 days, how often did you as a CYCLIST …? You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Items (random):

- cycle when you think you may have had too much to drink

- cycle without a helmet
- cycle while listening to music through headphones
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while cycling
- cycle on the road next to the cycle lane

Q12_5) Over the last 30 days, how often did you as a PEDESTRIAN …? You can indicate your answer on a scale from 1 to 5, where 1 is "never" and 5 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable for all items: at least once (2-5) - never (1)
Items (random):

- listen to music through headphones as a pedestrian while walking in the streets
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while walking in the streets
- cross the road when a pedestrian light is red
- cross the road at places other than at a nearby (distance less than 30m) pedestrian crossing

Acceptability of safe and unsafe traffic behaviour

Q13_1) Where you live, how acceptable would most other people say it is for a CAR DRIVER to….? You can indicate your answer on a scale from 1 to 5, where 1 is "unacceptable" and 5 is "acceptable". The numbers in between can be used to refine your response.
Binary variable: acceptable (4-5) – unacceptable/neutral (1-3)
Items (random):

- drive when he/she may be over the legal limit for drinking and driving
- drive 1 hour after using drugs (other than medication)
- drive faster than the speed limit outside built-up areas (but not on motorways/freeways)
- not wear a seatbelt while driving
- transport children in the car without securing them (child's car seat, seatbelt, etc.)
- talk on a hand-held mobile phone while driving
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while driving

Q14_1) How acceptable do you, personally, feel it is for a CAR DRIVER to…? You can indicate your answer on a scale from 1 to 5, where 1 is "unacceptable" and 5 is "acceptable". The numbers in between can be used to refine your response.
Binary variable: acceptable (4-5) – unacceptable/neutral (1-3)
Items (random)

- drive when he/she may be over the legal limit for drinking and driving
- drive 1 hour after using drugs (other than medication)
- drive after taking a medication that may influence the ability to drive
- drive faster than the speed limit inside built-up areas
- drive faster than the speed limit outside built-up areas (but not on motorways/freeways)
- drive faster than the speed limit on motorways/freeways
- not wear a seatbelt while driving
- transport children in the car without securing them (child's car seat, seatbelt, etc.)
- talk on a hand-held mobile phone while driving
- talk on a hand-free mobile phone while driving
- read a text message/email or check social media (e.g. Facebook, twitter, etc.) while driving
- drive when they're so sleepy that they have trouble keeping their eyes open

Attitudes towards safe and unsafe behaviour in traffic

Q15) To what extent do you agree with each of the following statements? You can indicate your answer on a scale from 1 to 5, where 1 is "disagree" and 5 is "agree". The numbers in between can be used to refine your response.
Binary variable: agree (4-5) – disagree/neutral (1-3)
Items (random):
Normative believes & subjective norms (including injunctive norms from Q13)

- Most of my friends would drive after having drunk alcohol.
- Most of my friends would drive 20 km/h over the speed limit in a residential area.

Behaviour believe & attitudes

- For short trips, one can risk driving under the influence of alcohol.
- I have to drive fast; otherwise, I have the impression of losing time.

- Respecting speed limits is boring or dull.
- For short trips, it is not really necessary to use the appropriate child restraint.
- I use a mobile phone while driving, because I always want to be available.
- To save time, I often use a mobile phone while driving.

Perceived behaviour control (here: self-efficacy)

- I trust myself to drive after having a glass of alcohol.
- I have the ability to drive when I am a little drunk after a party
- I am able to drive after drinking a large amount of alcohol (e.g. half a liter of wine).
- I trust myself when I drive significantly faster than the speed limit.
- I am able to drive fast through a sharp curve.
- I trust myself when I check my messages on the mobile phone while driving.
- I have the ability to write a message on the mobile phone while driving.
- I am able to talk on a hand-held mobile phone while driving.

Habits

- I often drive after drinking alcohol.
- Even when I am a little drunk after a party, I drive.
- It sometimes happens that I drive after consuming a large amount of alcohol (e.g. a liter of beer or half a liter of wine).
- I often drive faster than the speed limit.
- I like to drive in a sporty fast manner through a sharp curve.
- It happens sometimes that I write a message on the mobile phone while driving.
- I often talk on a hand-held mobile phone while driving.
- I often check my messages on the mobile phone while driving.

Intentions

- I will do my best not to drive after drinking alcohol in the next 30 days.
- I will do my best to respect speed limits in the next 30 days.
- I will do my best not to use my mobile phone while driving in the next 30 days.

Quality control items

- Indicate number 1 on the answering scale.
- Indicate number 4 on the answering scale.

Subjective safety & risk perception

Q16) How safe or unsafe do you feel when using the following transport modes in [country]? You can indicate your answer on a scale from 0 to 10, where 0 is "very unsafe" and 10 is "very safe". The numbers in between can be used to refine your response.
Items (random) = Items indicated by the respondent in Q10 are displayed.

Q17) How often do you think each of the following factors is the cause of a road crash involving a car? You can indicate your answer on a scale from 1 to 6, where 1 is "never" and 6 is "(almost) always". The numbers in between can be used to refine your response.
Binary variable: often/frequently (4-6) - not that often/not frequently (1-3)
Items (random)

- driving after drinking alcohol
- driving after taking drugs (other than medication)
- driving faster than the speed limit
- using a hand-held mobile phone while driving
- using a hands-free mobile phone while driving
- inattentiveness or day-dreaming while driving
- driving while tired

Support for policy measures

Q18) Do you oppose or support a legal obligation to …? You can indicate your answer on a scale from 1 to 5, where 1 is "oppose" and 5 is "support". The numbers in between can be used to refine your response.
Binary variable: support (4-5) – oppose/neutral (1-3)
Items (random)

- install an alcohol "interlock" for drivers who have been caught drunk driving on more than one occasion (technology that won't let the car start if the driver's alcohol level is over the legal limit)
- have zero tolerance for alcohol (0,0 ‰) for novice drivers (licence obtained less than 2 years)
- have zero tolerance for alcohol (0,0 ‰) for all drivers

- install Intelligent Speed Assistance (ISA) in new cars (which automatically limits the maximum speed of the vehicle and can be turned off manually)
- install Dynamic Speed Warning signs (traffic control devices that are programmed to provide a message to drivers exceeding a certain speed threshold)
- have a seatbelt reminder system for the front and back seats in new cars
- require all cyclists to wear a helmet
- require cyclists under the age of 12 to wear a helmet
- require all moped drivers and motorcyclists to wear a helmet
- require pedestrians to wear reflective material when walking in the streets in the dark
- require cyclists to wear reflective material when cycling in the dark
- require moped drivers and motorcyclists to wear reflective material when driving in the dark
- have zero tolerance for using any type of mobile phone while driving (hand-held or hands-free) for all drivers
- not using headphones (or earbuds) while walking in the streets
- not using headphones (or earbuds) while riding a bicycle

Q19_1) What do you think about the current traffic rules and penalties in your country for driving or riding under the influence of alcohol? agree – disagree
Items:

- The traffic rules should be stricter.
- The traffic rules are not being checked sufficiently.
- The penalties are too severe.

Q19_2) What do you think about the current traffic rules and penalties in your country for driving or riding faster than the speed limit? agree – disagree
Items: Q19_1

Q19_3) What do you think about the current traffic rules and penalties in your country for using a mobile phone while driving or riding? agree – disagree
Items: Q19_1

Enforcement

Q20_1) On a typical journey, how likely is it that you (as a CAR DRIVER) will be checked by the police for… You can indicate your answer on a scale from 1 to 7, where 1 is "very unlikely" and 7 is "very likely". The numbers in between can be used to refine your response.
Binary variable: likely (5-7) – unlikely/neutral (1-4)
Items (random)

- … alcohol, in other words, being subjected to a Breathalyser test
- … the use of illegal drugs
- … respecting the speed limits (including checks by a police car with a camera, fixed cameras, mobile cameras, and section control systems)
- … wearing your seatbelt
- … the use of hand-held mobile phone to talk or text while driving

Q21_1) In the past 12 months, how many times have you been checked by the police for using alcohol while DRIVING A CAR (i.e., being subjected to a Breathalyser test)? never – 1 time – at least 2 times - I prefer not to respond to this question
Binary variable: at least once - never (removing "I prefer not to respond to this Q)

Q22_1) In the past 12 months, how many times have you been checked by the police for the use of drugs (other than medication) while DRIVING A CAR? never – 1 time – at least 2 times - I prefer not to respond to this question
Binary variable: at least once - never (removing "I prefer not to respond to this Q)

Involvement in road crashes

Introduction: The following questions focus on road crashes. With road crashes, we mean any collision involving at least one road vehicle (e.g., car, motorcycle, or bicycle) in motion on a public or private road to which the public has right of access. Furthermore, these crashes result in material damage, injury, or death. Collisions include those between road vehicles, road vehicles and pedestrians, road vehicles and animals or fixed obstacles, road and rail vehicles, and one road vehicle alone.

Q23_1a) In the past 12 months, how many times have you personally been involved in road crashes in which you or somebody else had to be taken to the hospital? ___ times (number; max. 10) if 0 → Q23_2a; if >0 → Q23_1b → Q23_2a
Binary variable: at least once - never

Q23_1b) Please indicate the transport modes you were using at the time of these crashes.
Items indicated by the respondent in Q10 are displayed; Threshold = 'at least a few days a year'.
Number to be indicated after each transport mode; note the sum should be equal to the number indicated in Q23_1a

Q23_2a) In the past 12 months, how many times have you personally been involved in road crashes with only minor injuries (no need for hospitalisation) for you or other people? ___ times (number; max. 10) if 0 → Q23_3a; if >0 → Q23_2b → Q23_3a
Binary variable: at least once - never

Q23_2b) = Q23_1b

Q23_3a) In the past 12 months, how many times have you personally been involved in road crashes with only material damage?
___ times (number; max. number 10) if 0 → skip Q23_3b; if >0 → Q23_3b → next Q
Binary variable: at least once - never

Q23_3b) = Q23_1b

Vehicle automation

I2) Introduction: The following questions focus on your opinion about automated passenger cars. We talk about two different levels of vehicle automation:
Semi-automated passenger cars: Drivers can choose to have the vehicle control all critical driving functions, including monitoring the road, steering, and accelerating or braking in certain traffic and environmental conditions. These vehicles will monitor roadways and prompt drivers when they need to resume control of the vehicle.
Fully-automated passenger cars: The vehicle controls all critical driving functions and monitoring all traffic situations. Drivers do not take control of the vehicle at any time.

Q24) How interested would you be in using the following types of automated passenger car? You can indicate your answer on a scale from 1 to 7, where 1 is "not at all interested" and 7 is "very interested". The numbers in between can be used to refine your response.
Binary variable: interested (5-7) - not interested/neutral (1-4)
Items:

- semi-automated passenger car
- fully-automated passenger car

Q25_1) How likely do you think it is that the following benefits will occur if everyone would use a semi-automated passenger car? You can indicate your answer on a scale from 1 to 7, where 1 is "very unlikely" and 7 is "very likely". The numbers in between can be used to refine your response.
Binary variable: likely (5-7) – unlikely/neutral (1-4)
Items (random):

- fewer crashes
- reduced severity of crash
- less traffic congestion
- shorter travel time
- lower vehicle emissions
- better fuel economy
- time for functional activities, not related to driving (e.g. working)
- time for recreative activities, not related to driving (e.g. reading, sleeping, eating)

Q25_2) How likely do you think it is that the following benefits will occur if everyone would use a fully-automated passenger car? You can indicate your answer on a scale from 1 to 7, where 1 is "very unlikely" and 7 is "very likely". The numbers in between can be used to refine your response.
Items (random) = Q25_1

Bonus question to be filled in by national partner

Q26) .....? You can indicate your answer on a scale from 1 to 5, where 1 is "…." and 5 is "….". The numbers in between can be used to refine your response.
Items (random; 4 items)

Q27) .....? You can indicate your answer on a scale from 1 to 5, where 1 is "…." and 5 is "….". The numbers in between can be used to refine your response.
Items (random; 4 items)

Social desirability scale

Introduction: The survey is almost finished. The following questions have nothing to do with road safety, but they are important background information. There are no good or bad answers.

Q28) To what extent are the following statements true? You can indicate your answer on a scale from 1 to 5, where 1 is "very untrue" and 5 is "very true". The numbers in between can be used to refine your response.
Items (random):

- I always respect the highway code, even if the risk of getting caught is very low.
- I would still respect speed limits at all times, even if there were no police checks.
- I have never driven through a traffic light that had just turned red.
- I do not care what other drivers think about me.
- I always remain calm and rational in traffic. (if needed pop-up: rational = non-emotional)
- I am always confident of how to react in traffic situations.

Appendix 2: ESRA2 weights

The following weights are used to calculate representative means on national and regional level. They are based on UN population statistics (United Nations Statistics Division, 2019). The weighting took into account small corrections with respect to national representativeness of the sample based on gender and six age groups (18-24y, 25-34y, 35-44y, 45-54y, 55-64y, 65y+). For the regions, the weighting also took into account the population size of each country in the total set of countries from this region.

Individual country weight	Individual country weight is a weighting factor based on the gender*6 age groups (18-24y, 25-34y, 35-44y, 45-54y, 55-64y, 65y) distribution in a country as retrieved from the UN population statistics.
Europe20 weight	European weighting factor based on all 20 European countries participating in ESRA2_2018, considering individual country weight and population size of the country as retrieved from the UN population statistics.
NorthAmerica2 weight	North American weighting factor based on all 2 North American countries participating in ESRA2_2018, considering individual country weight and population size of the country as retrieved from the UN population statistics.
AsiaOceania5 weight	Asian and Oceanian weighting factor based on all 5 Asian and Oceanian countries participating in ESRA2_2018, considering individual country weight and population size of the country as retrieved from the UN population statistics.
Africa5 weight	African weighting factor based on all 5 African countries participating in ESRA2_2018, considering individual country weight and population size of the country as retrieved from the UN population statistics.

Appendix 3:

Table 11: Typology of road users based on the frequency of cycling or driving a car

Cycling frequency (conventional and electric bicycles)	Car driving frequency (electric and non-electric cars)					Total
	At least 4 days a week	1 to 3 days a week	A few days a month	A few days a year	Never	
At least 4 days a week	1643	787	457	260	964	4111
1 to 3 days a week	2309	938	381	209	748	4585
A few days a month	3263	949	565	288	906	5971
A few days a year	3680	919	512	488	1238	6837
Never	6375	1889	868	576	3824	13532
Total	17270	5482	2783	1821	7680	35036

Sample data

1 "Cyclists": cycling at least a few days a month and driving a car no more than a few days a month

2 "Both car drivers & cyclists": driving a car and cycling, both at least 1 day a week

3 "Car drivers" : driving a car at least a few days a month and cycling no more than a few days a month

4 "Neither car drivers nor cyclists": driving a car / cycling, both no more than a few days a month

Table 12: Types of road users by region

Types of road users	Europe	North America	Asia and Oceania	Africa
"Cyclists"	10.3%	3.6%	17.3%	12.6%
"Both car drivers & cyclists "	17.5%	10.5%	22.0%	15.4%
"Car drivers"	55.2%	68.2%	39.3%	44.6%
"Neither car drivers nor cyclists"	17.0%	17.8%	21.5%	27.4%
Total	100.0%	100.0%	100.0%	100.0%

Weighting: regional weights (Europe20; NorthAmerica2, AsiaOceania5 and Africa5)

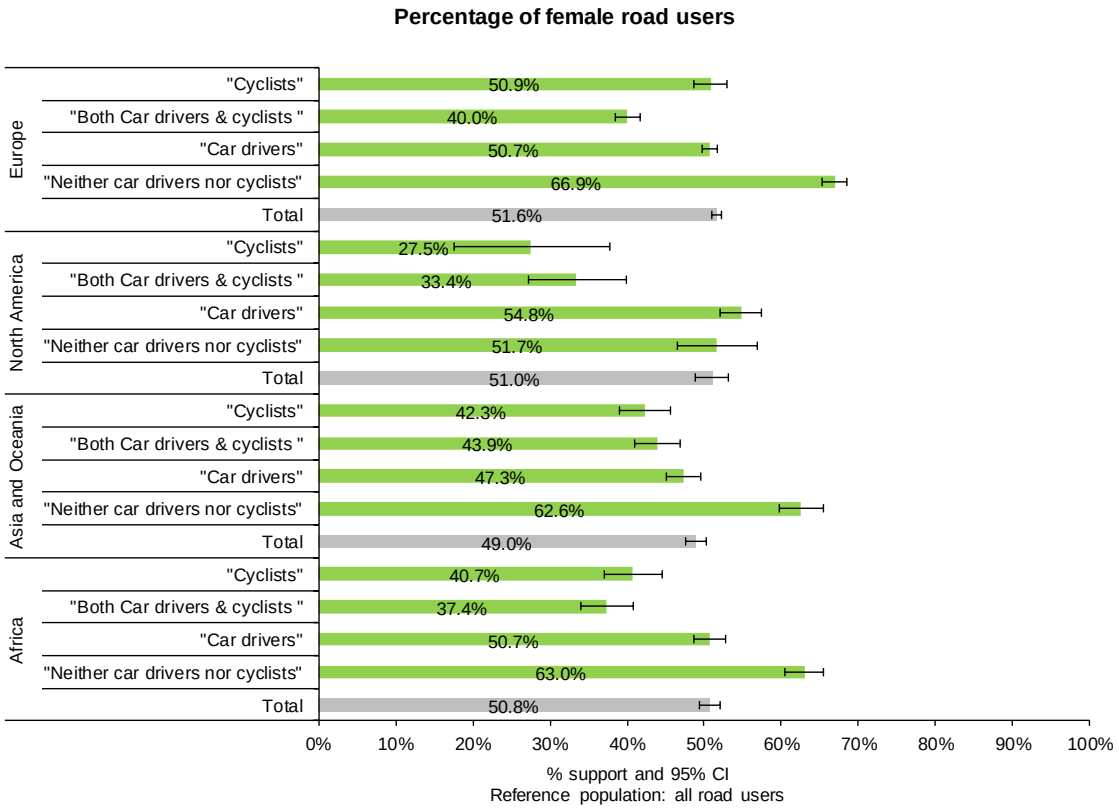


Figure 24: Percentage of female road users, by type of road users and region

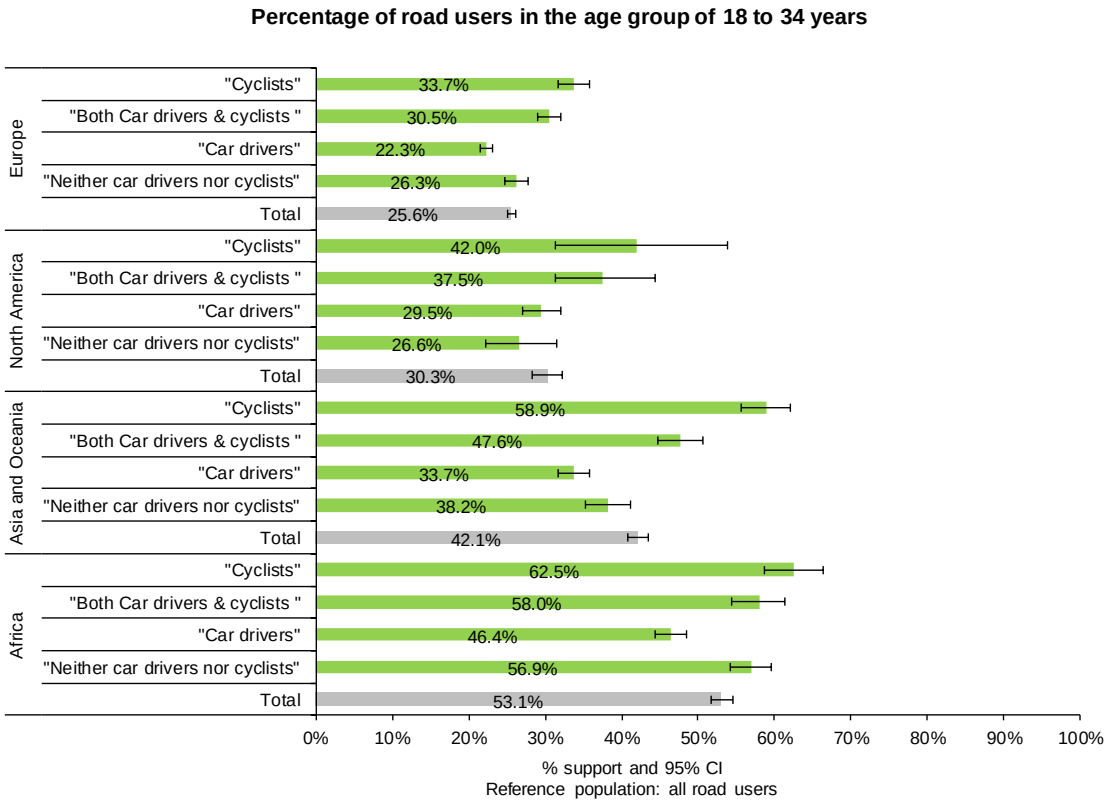


Figure 25: Percentage of road users in the age group of 18 to 34 years, by type of road users and region

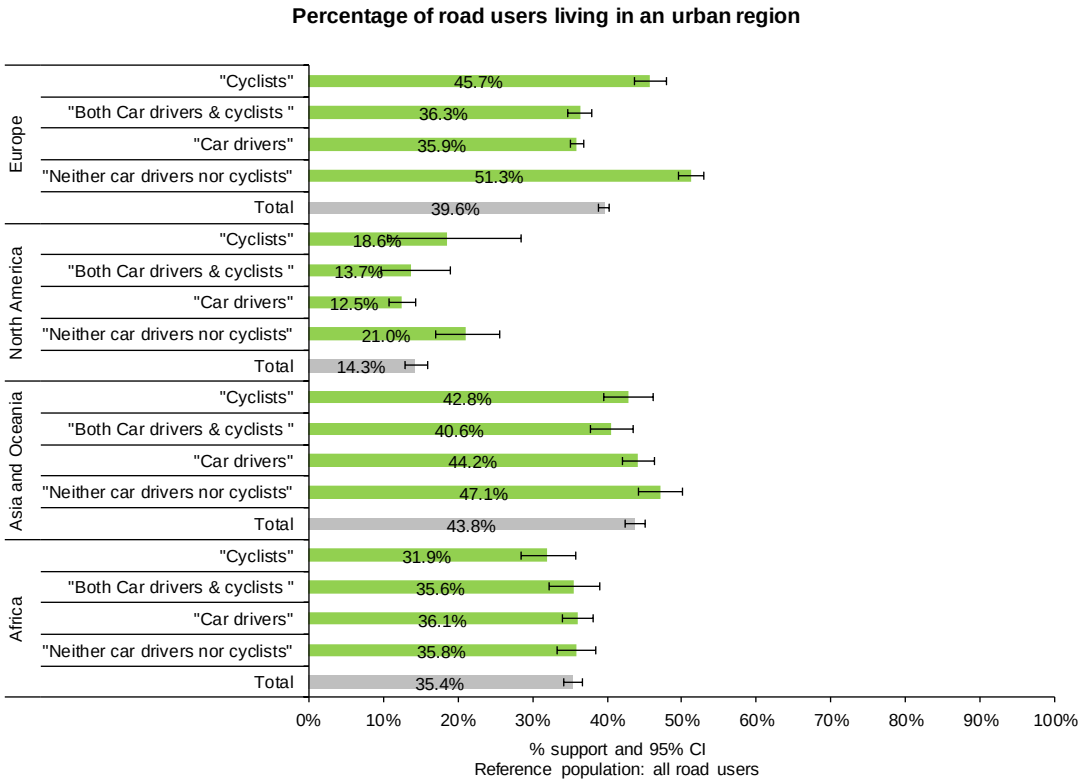


Figure 26: Percentage of road users living in an urban area, by type of road users and region

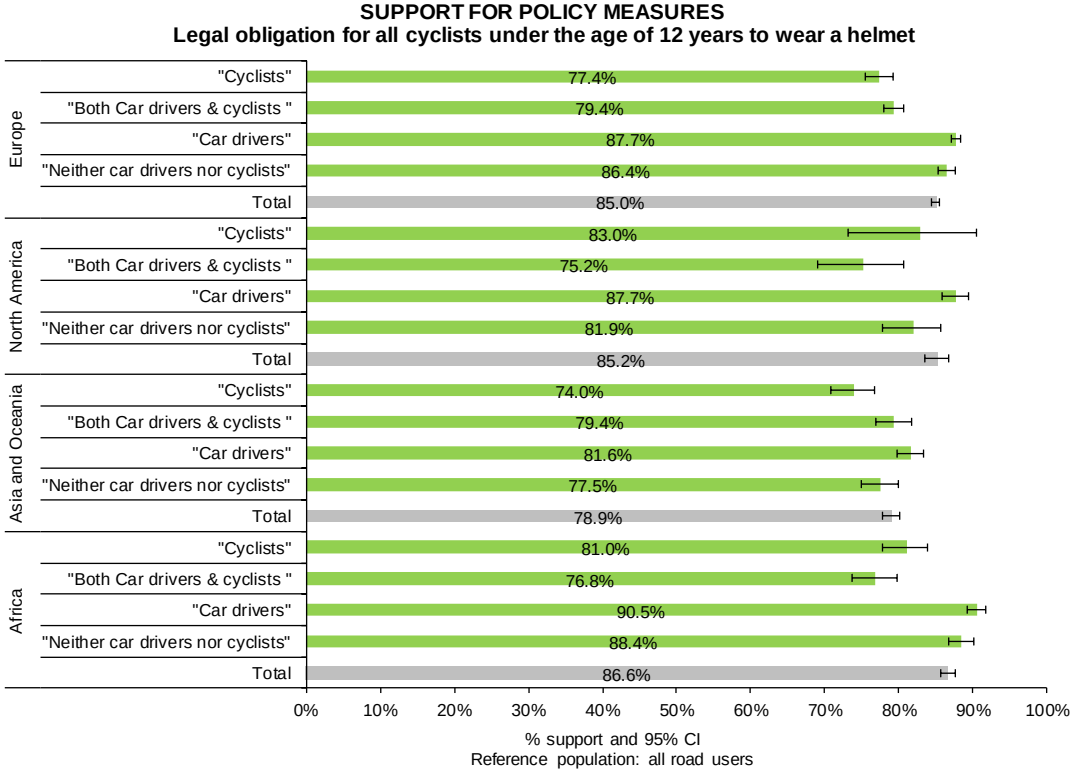


Figure 27: Support for the policy measure "Require all cyclists under the age of 12 years to wear a helmet", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

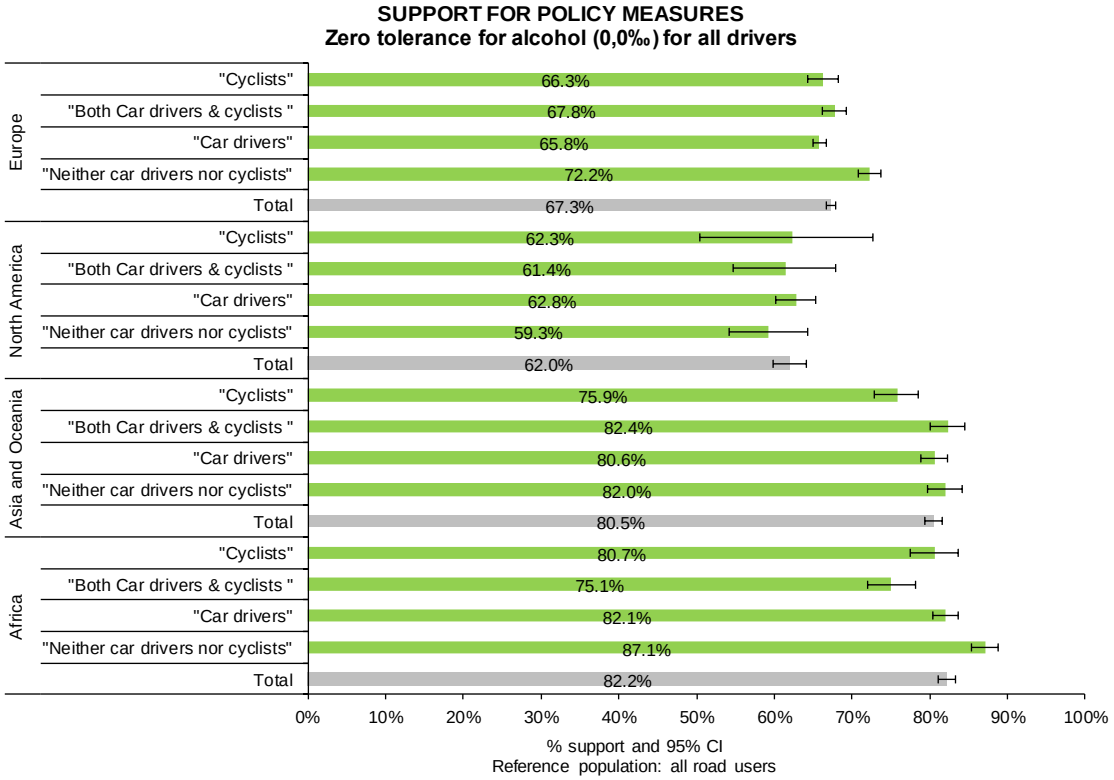


Figure 28: Support for the policy measure "Zero tolerance for alcohol (0,0‰) for all drivers", by type of road users and region (% support; scores 4 & 5 on a 5 point scale from 1 'oppose' to 5 'support' and 95% confidence interval)

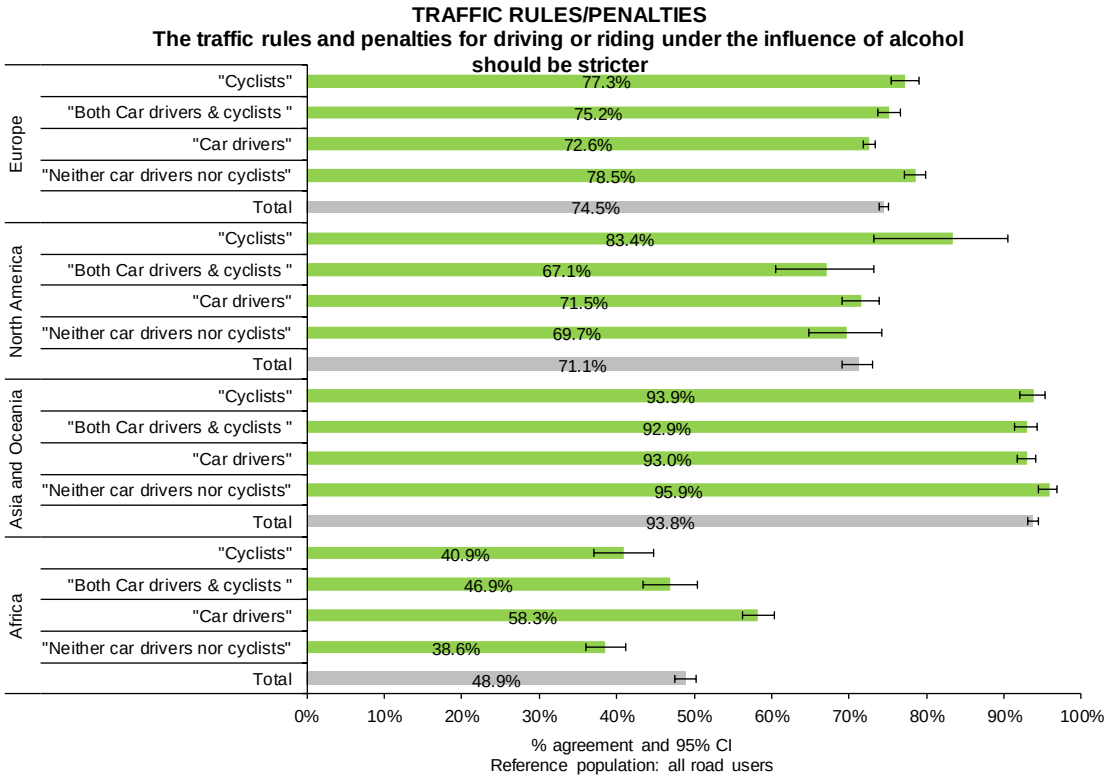


Figure 29: Opinions towards traffic rules and penalties for driving or riding under the influenc of alcohol, by type of road users and region (% agreement, 'agree' or 'disagree' and 95% confidence interval)

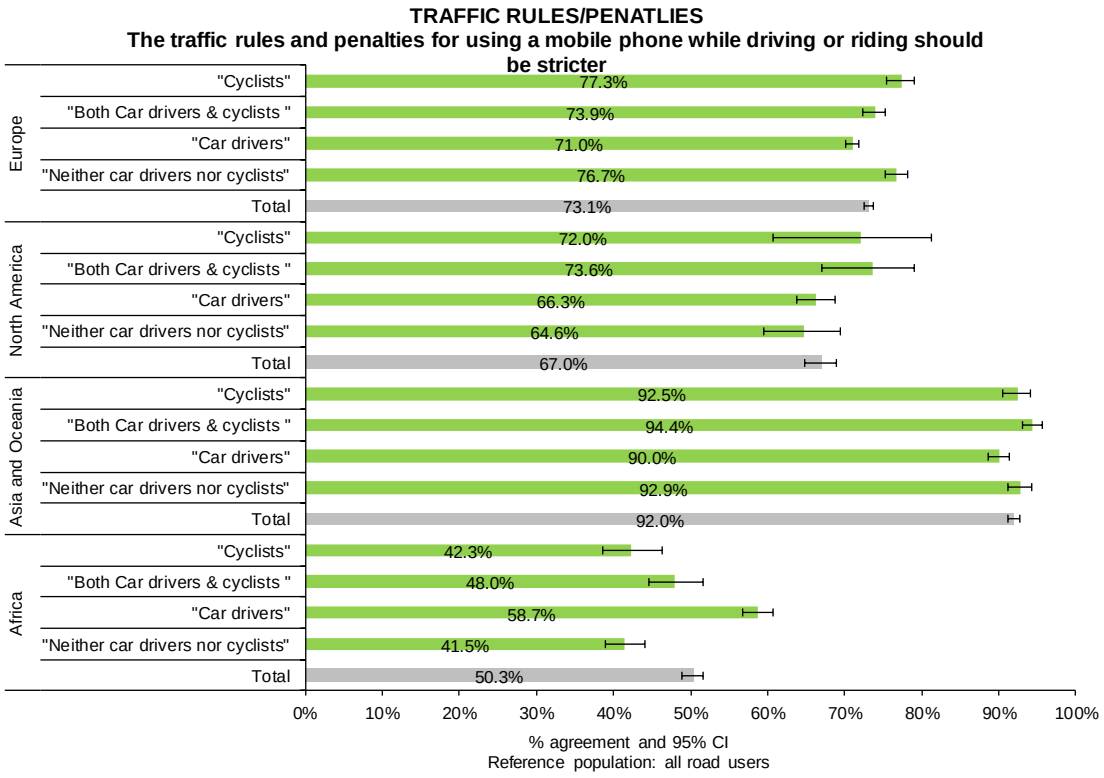


Figure 30: Opinions towards traffic rules and penalties for using a mobile phone while driving or riding, by type of road users and region (% agreement, 'agree' or 'disagree' and 95% confidence interval)

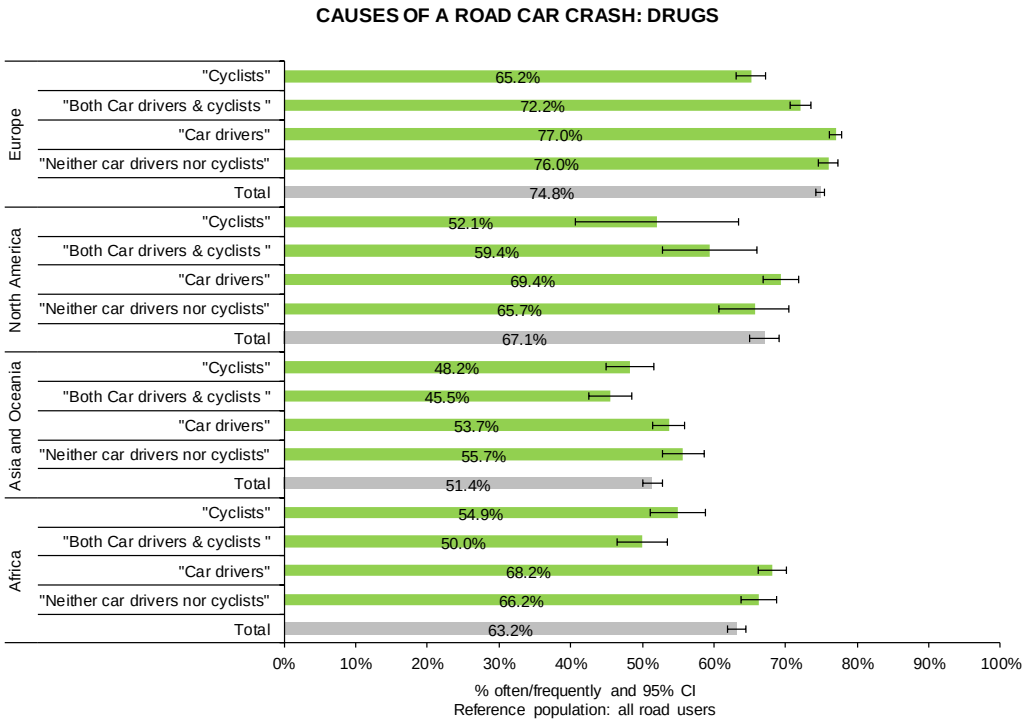


Figure 31: Risk perception of drugs as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).

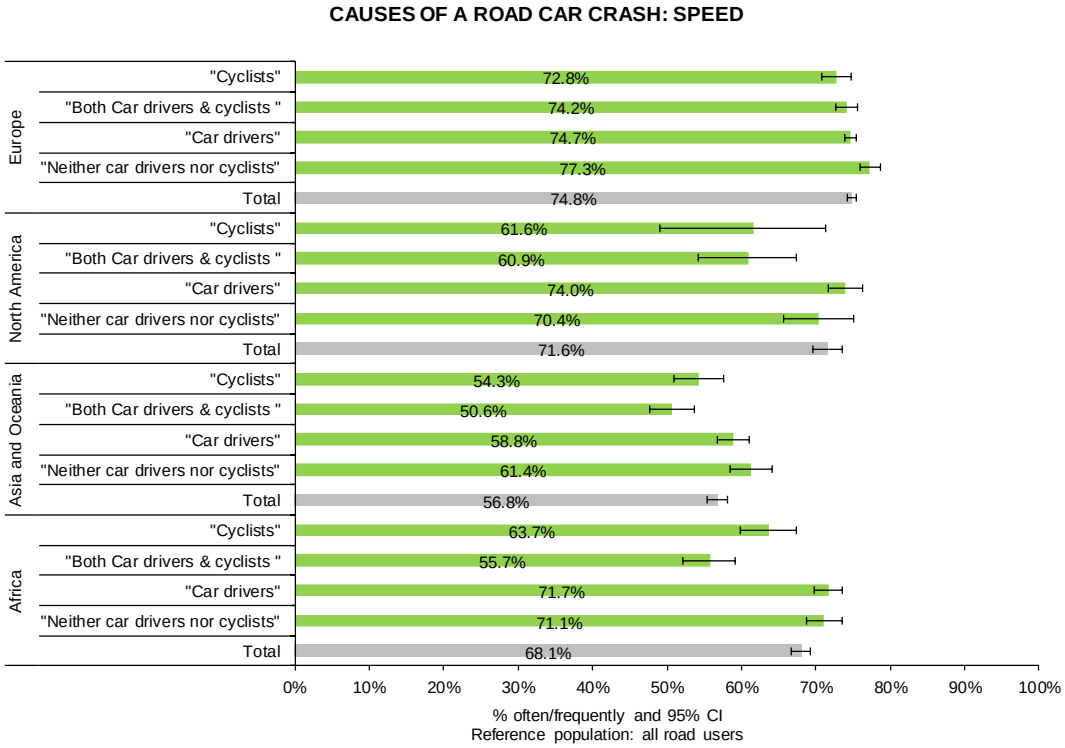


Figure 32: Risk perception of speed as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval

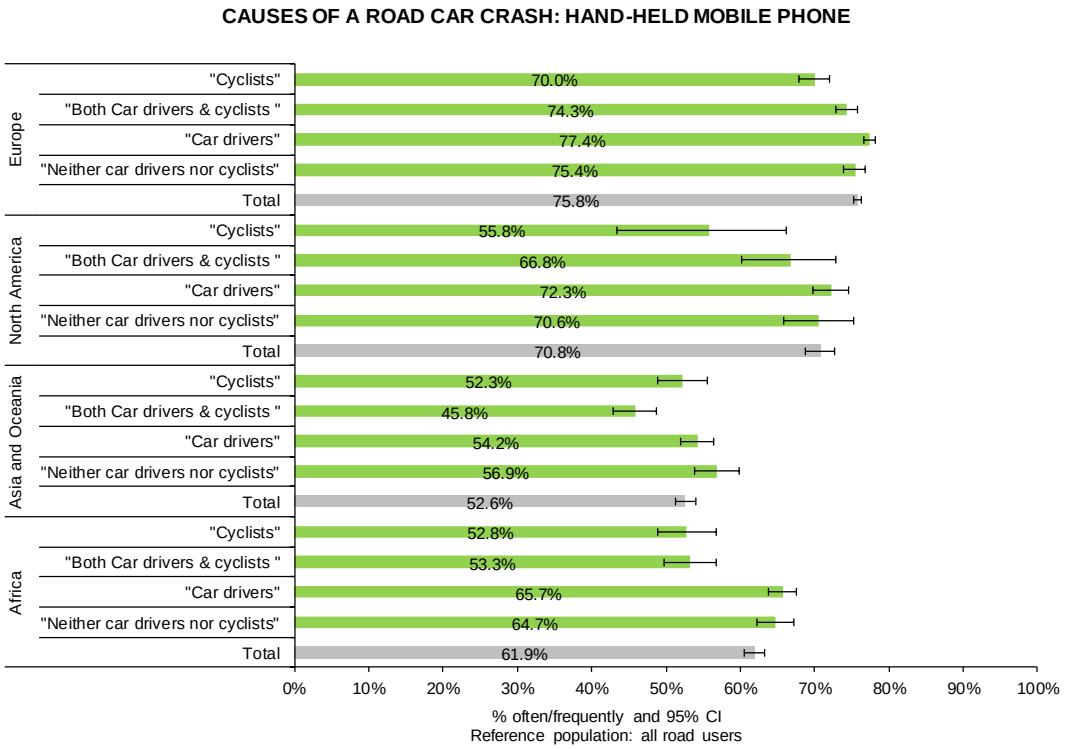


Figure 33 Risk perception of the use of a hand-held mobile phone while driving as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).

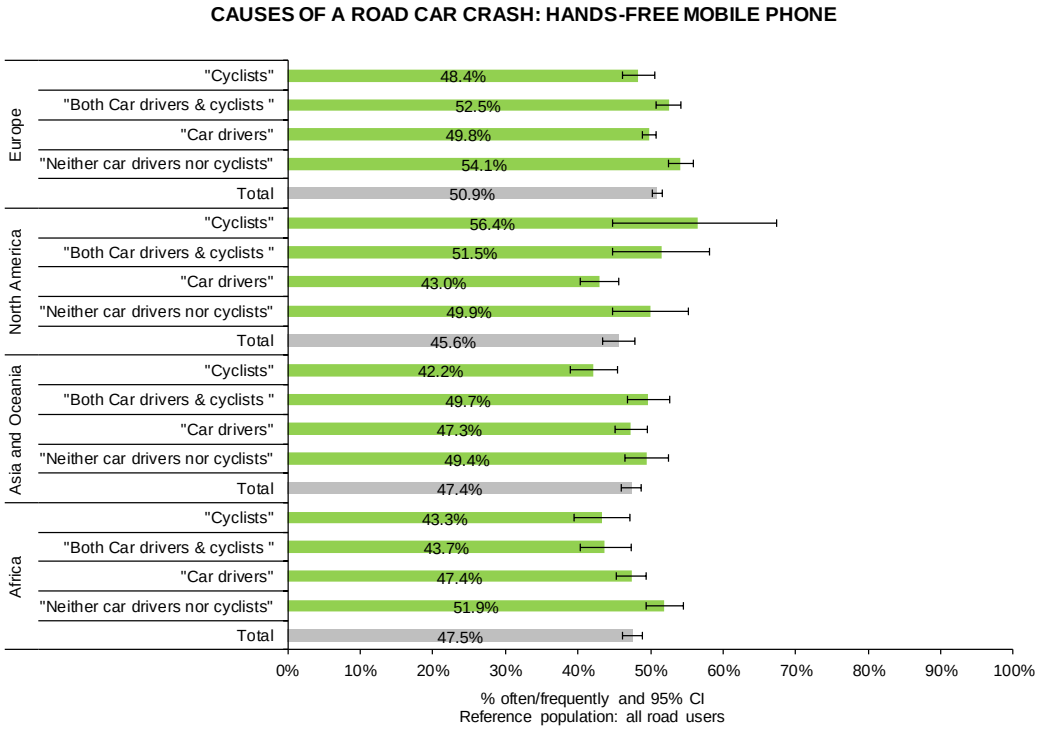


Figure 34: Risk perception of the use of a hands-free mobile phone while driving as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).

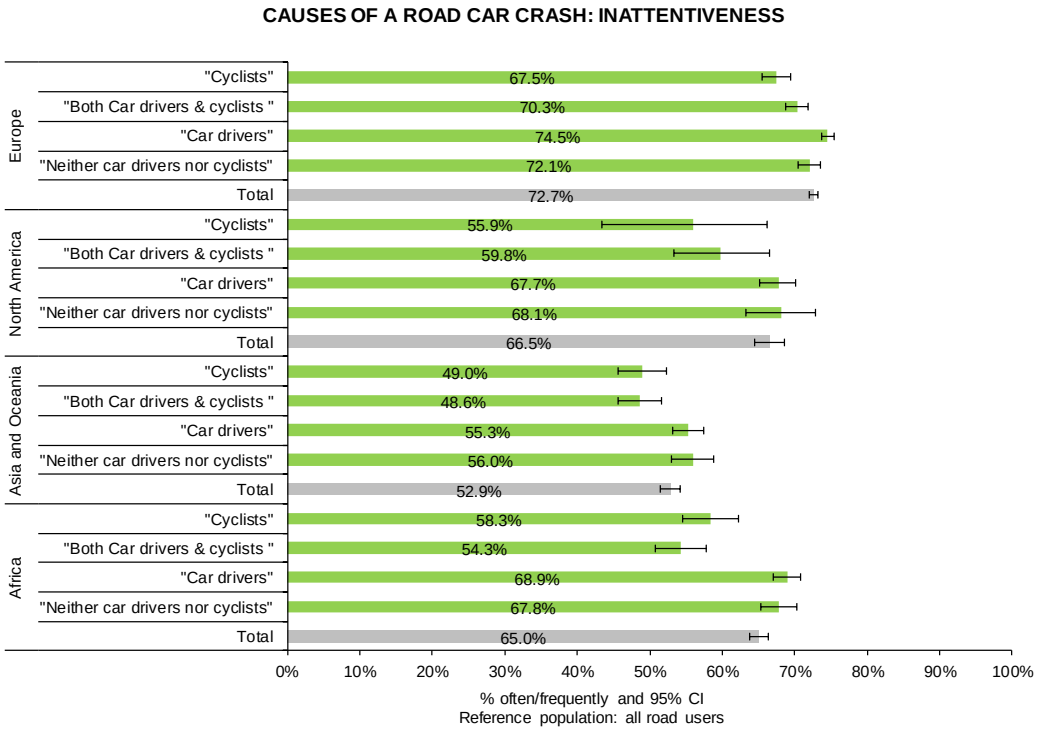


Figure 35 Risk perception of inattentiveness as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).

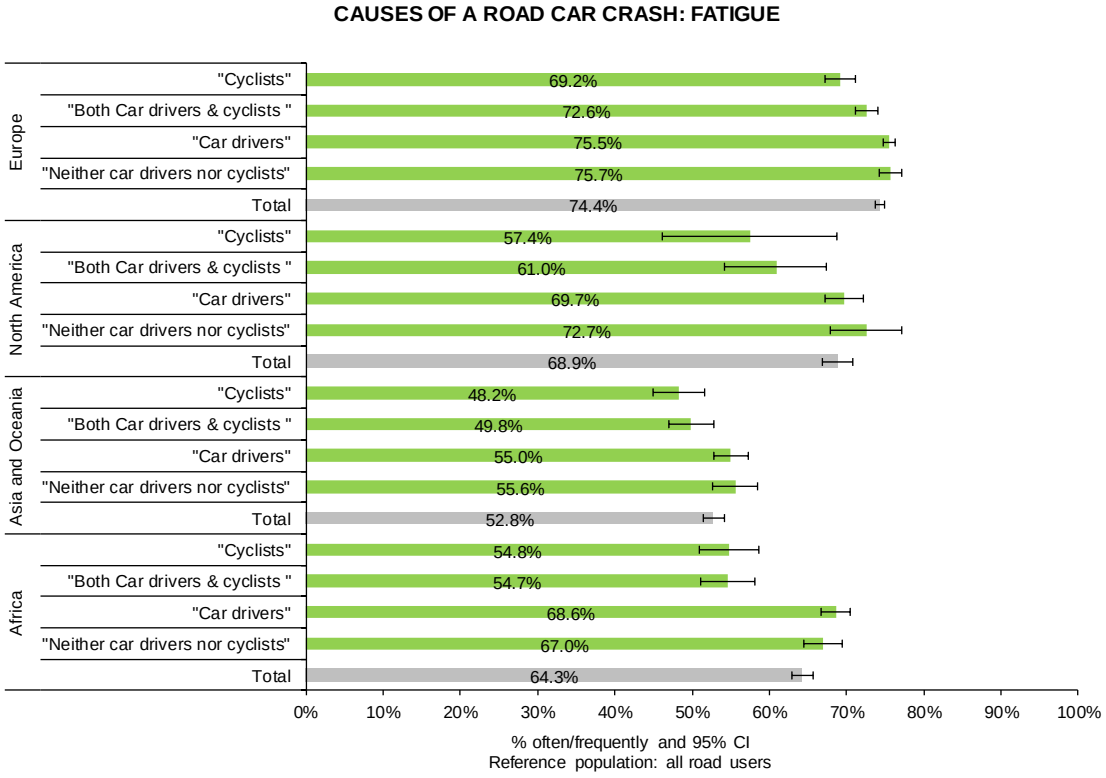


Figure 36: Risk perception of fatigue as a cause of a road car crash by type of road users and region, (% often/frequently; scores 4 to 6 on a 6-point scale from 1 'never' to 6 '(almost) always' and 95% confidence interval).