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E-Survey of Road users' Attitudes

# Elderly Road Users

ESRA2 Thematic report Nr. 8

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## ESRA2 Thematic report Nr. 8


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# List of Abbreviations

### Region codes

| | |
|---|---|
| Europe20 | Region that includes Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Serbia, Sweden, Slovenia and United Kingdom |
| NorthAmerica2 | Region that includes Canada and United States |
| AsiaOceania5 | Region that includes Australia, Israel, India, Japan and Republic of Korea |
| Africa5 | Region that includes Egypt, Kenya, Morocco, Nigeria and South Africa |

### 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 |

# Summary


## Objective and methodology

The ESRA project (E-Survey of Road users' Attitudes) is a joint initiative of road safety institutes, research organisations, public services and private sponsors, aiming at collecting comparable (inter)national data on road users' opinions, attitudes and behaviour with respect to road traffic risks. The project is funded by the partners' own resources and covers countries all over the world.

The basis 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 different types of road users.

The first edition of the ESRA survey (ESRA1) was carried out in three waves between 2015-2017. Data was gathered from almost 40,000 road users in 38 countries across 5 continents. The present report is based on the second edition of this global survey, which was conducted in 2018 (ESRA2_2018). In this wave, data from more than 35,000 road users were collected across 32 countries. The participating countries in ESRA2_2018 were grouped into four regions for analysis:

- Europe20: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom;
- America2: Canada, USA;
- AsiaOceania5: Australia, India, Israel, Japan, Republic of Korea;
- Africa5: Egypt, Kenya, Morocco, Nigeria, South Afrika.

Hence, the ESRA database is a comprehensive dataset, which enables a wide range of analyses which are useful for understanding road safety risks and the effectiveness of measures. An overview of the project and the results are available on: www.esranet.eu.

This thematic ESRA report on elderly road users focuses on two road safety issues, 1) driver impairment due to alcohol, drugs, prescription medication or driving while drowsy, and, 2) driving over the speed limit. The report includes the analysis of aspects related to self-declared unsafe behaviours in traffic, acceptability of unsafe traffic behaviours (personal and social), attitudes towards driving while impaired and speeding, risk perception of driving while impaired or speeding, support for policy measures, opinions on traffic rules and penalties, and perception of enforcement. In these analyses, the focus is on differences between elderly drivers (aged 65+) and other age groups. In addition, factors that increase the likelihood of a crash involvement for an elderly driver were also investigated.

## Key results for driver impairment

Prior to presenting the results, it is important to note that within the African countries the numbers of 65+ respondents who answered the ESRA2 survey were quite low (with the exception of South Africa), so that the answers of this particular age group in African countries cannot be considered to be representative.

### Self-declared unsafe behaviours in traffic (past 30 days)

The results show that elderly drivers typically report lower or similar rates of risky behaviours related to driver impairment than other age groups, with the exception of Africa5 where elderly drivers consistently report higher rates of risky behaviour.

For driving when potentially over the legal limit for drink-driving, in Europe20 and NorthAmerica2, the rate for elderly drivers is the lowest of all age groups, and in AsiaOceania5, their rate is lower than for all drivers under the age of 45. The results for Africa5 differ in that elderly drivers have the highest reported rate. These same trends are seen for driving 1 hour after using drugs. Additionally, it is

observed that in Europe20 the reported rates of driving after using drugs are lower than for driving while potentially being over the legal limit, while in the other regions the rates appear more similar.

For driving after taking medication that may affect driving ability, elderly drivers report the lowest or near lowest rates except in Africa5 where elderly drivers report the highest rate. This finding, despite higher rates of medication use among the elderly, may indicate that elderly drivers are aware of the potential impairing effects of these medications and choose not to drive when using them.

For driving while drowsy, in Europe20 and NorthAmerica2, elderly drivers reported the lowest rates among age groups. In AsiaOceania5, elderly drivers reported rates similar to other age groups, although higher than drivers aged 45-54, and in Africa5 elderly drivers reported a much higher rate than all other age groups.

### Acceptability of unsafe traffic behaviours

Personal acceptability is very low towards driving while impaired by alcohol, drugs or prescription medication or driving while drowsy, and rates of acceptance in Europe20 and NorthAmerica2 are consistently lower than in AsiaOceania5 and Africa5.

### Attitudes towards unsafe behaviour in traffic

The percentage of respondents who reported most of their friends would drive after drinking alcohol was within a few percentage points across regions. The trend in Europe20 and AsiaOceania5 is a decreasing one with age, with elderly drivers reporting the lowest rates of agreement.

The percentage of respondents who declared one can risk driving under the influence of alcohol for short trips was higher in AsiaOceania5 and Africa5 than Europe20 and NorthAmerica2. In Europe20 and AsiaOceania5, elderly drivers reported the lowest rate in agreement, while in NorthAmerica2, elderly drivers reported a higher rate than drivers aged 35-54 and a lower rate than other age categories.

Age was a factor in the percentage of respondents who declared trust or ability when driving after drinking alcohol in Europe20 and Africa5. While elderly drivers in Europe20 were less likely to agree, in Africa5 elderly drivers were most likely to agree. For driving when a little drunk, age was a factor in all regions except Africa5. Elderly drivers reported the lowest or near lowest rate of agreement. For the ability to drive after drinking a large amount of alcohol, age was a factor in all regions except NorthAmerica2. Elderly drivers reported the lowest rate of agreement in Europe20, the highest rate in Africa5, and for AsiaOceania5 were in the middle of the range reported by age category.

### Risk perception

Risk perception is higher for alcohol causing a crash than for drugs. It may be that some respondents believe the rate of use is higher for alcohol than for drugs rather than the relative risk of driving under the influence of that substance is higher.

The results also show that respondents from Europe20 and NorthAmerica5 are more likely than those from AsiaOceania5 and Africa5 to report alcohol is a factor in road car crashes. In Europe20 and NorthAmerica5, elderly drivers report the highest rate of agreement, while in AsiaOceania5 elderly drivers report among the lowest rates of agreement.

For driving after taking drugs, the results show that respondents from Europe20 and NorthAmerica5 are more likely than those from AsiaOceania5 and Africa5 to report drugs are a factor in road car crashes. In Europe20 and NorthAmerica5, elderly drivers report the highest rate of agreement, while in AsiaOceania5 elderly drivers report among the lowest rates of agreement.

As regards driving while tired, respondents from Europe20 and NorthAmerica5 are again more likely than those from AsiaOceania5 and Africa5 to report the risky behaviour being a factor in road car crashes. Age is a factor in all regions with a higher percentage of elderly driver respondents agreeing in Europe20 and NorthAmerica2. In AsiaOceania5, the trend with age is not consistent but elderly drivers are among the lowest reporting age categories. In Africa5, elderly drivers are the least likely to agree.

### Enforcement, support for policy measures, traffic rules and penalties

There is a high level of support for policy measures aimed at reducing alcohol related impaired driving. There is a general trend in Europe20, NorthAmerica2 and AsiaOceania5 in higher rates of support as

drivers age with elderly drivers being among the most if not the most supportive. In Africa5, the responses from elderly drivers are much less supportive than the other age categories.

### Key results for driving over the speed limit

#### Self-declared unsafe behaviours in traffic (past 30 days)

For speeding behaviours, elderly drivers report some of the lower rates in Europe20. In NorthAmerica2, elderly drivers reported rates of speeding similar to other age groups. In AsiaOceania5, elderly drivers report among the lowest rates. In Africa5, elderly drivers report the highest rate of speeding among age groups. Percentages of personal acceptability are much lower than the percentages of the corresponding self-declared behaviours, showing that a significant number of drivers engage in risky behaviours related to driving while potentially impaired, even if they consider the behaviour unacceptable.

#### Acceptability of unsafe traffic behaviours

For speeding, the rate of acceptance for this behaviour is higher than for driving while impaired or drowsy, but a majority of respondents still indicate speeding is unacceptable. The level of personal acceptability is lowest for speeding in built-up areas, with greater acceptance for speeding in non built-up areas (but not on motorways/freeways), and even greater acceptance for speeding on motorways/freeways.

Percentages of personal acceptability are much lower than the percentages of the corresponding behaviours, showing that a significant number of drivers engage in risky behaviours related to speeding even if they consider the behaviour unacceptable.

With respect to age, the general trend is that elderly drivers report the lowest or near-lowest level of acceptance of speeding, with the exception of Africa5, where elderly drivers report the highest level of acceptance.

#### Attitudes towards unsafe behaviour in traffic

For the percentage of respondents who reported most of their friends would drive 20 km/h over the speed limit in a residential area, there is a general trend of decreasing agreement with age, although in NorthAmerica2, elderly drivers only report lower rates of agreement than drivers aged under 35.

With respect to trusting oneself when exceeding the speed limit, in Europe20 and NorthAmerica2, elderly drivers reported the lowest level of agreement and near the lowest in AsiaOceania5. In Africa5, elderly drivers reported the highest level of agreement.

The percentage of respondents who reported that respecting speed limits was boring or dull was highest in Europe20 and lowest in NorthAmerica2. In Europe20 and AsiaOceania5, elderly drivers reported the lowest levels of agreement, while in Africa5, elderly drivers reported the highest level.

For the speeding related behaviours, age was a factor in the declaration of trust in ability for exceeding the speed limit and for driving fast through a sharp curve. In Europe20, NorthAmerica2 and AsiaOceania5, elderly drivers consistently reported the lowest level of agreement, except for AsiaOceania5 and driving fast through a sharp curve, where elderly drivers were not the lowest but were close. In Africa5, elderly drivers reported higher levels of agreement.

#### Risk perception

For speeding, respondents from Europe20 and NorthAmerica5 are again more likely than those from AsiaOceania5 and Africa5 to report the risky behaviour being a factor in road car crashes. In Europe20 and NorthAmerica5, elderly drivers report the highest or near highest rate of agreement, while in AsiaOceania5, elderly drivers report among the lowest rates of agreement.

#### Enforcement, support for policy measures, traffic rules and penalties

For policy measures aimed at speeding, in Europe20 and AsiaOceania5, elderly drivers are among the most supportive, while in Africa5 elderly drivers are the least supportive.

### Factors increasing crash risk for elderly drivers

The odds of being involved in a crash are lower for elderly females than for males in the order of magnitude of 23% to 30%. The odds of being involved in a crash increase for drivers aged 75+ compared to drivers aged 65-74 between 56% and 66%. When the data from Africa5 was not included, an increase in the odds of crash involvement is still seen for 75+ drivers, but the increased odds were of a smaller magnitude (20% to 23%) and were not statistically significant at the 95$^{th}$ percentile level.

The impact of region indicates that the odds of crash involvement for elderly drivers are higher in AsiaOceania5 and Africa5 compared to Europe20, and that the odds in NorthAmerica2 are lower than in Europe20. The results for NorthAmerica2 are however not statistically significant.

Less frequent driving is related to lower odds of crash involvement, and semi-urban and rural areas are related to lower odds of crash involvement compared to urban areas. This finding might confirm the literature that indicates a higher crash risk in more complicated urban driving environments.

Results show that a higher rate of reported driving when sleepy is associated with a higher likelihood of crash involvement and a more lenient attitude towards driving after drinking for short trips also increases the odds of crash involvement. Elderly drivers who report always being confident of how to react in traffic situations have lower odds of crash involvement, although this result was only statistically significant when Africa5 was included.

There was no evidence seen that the relationship between age and crash likelihood differs by gender, region or other variables.

### Contextual data

Data from ESRA2 countries confirmed the over-representation of elderly drivers in fatal crashes that is reported in the literature. Reported elevated concerns for the safety of travel as a pedestrian or car driver in a given country were not found to be related to higher rates of road deaths in general amongst elderly drivers.

### Key recommendations

Policy recommendations

- Begin conversations with drivers early in life and focus on fitness to drive rather than focusing strictly on aging. Outreach and communication are essential, as is the provision of information about alternative transportation options and community resources, to those who are required to submit to medical review or those who decide not to pursue licence renewal.
- Modify the licensing process for all drivers to identify the most at-risk drivers due to physical or mental limitations with respect to the driving task and administer tests for assessing their fitness to drive.
- Ensure the existence and availability of alternative transportation options for those for whom a cessation of driving is necessary.

Continue to study the impact of age on crash risk and aim programs at those most at risk. In this study drivers aged 75+ were more at risk than those aged 65-74. Specific recommendations to particular stakeholders include:

- *[To Non-Governmental Organizations (NGOs)]* Contribute to education and awareness raising campaigns and events against impaired driving, driving while drowsy and speeding.
- *[To vehicle manufacturers, other companies and research organisations]* Continue to develop and promote low cost solutions that can be incorporated in vehicles and assist drivers.

The ESRA project has 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 across the world. 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. This will become a solid foundation for a joint international monitoring system on road safety attitudes and behaviour.

# 1. Introduction

In many industrialized countries the segment of the population age 65 and older is growing, and many of these older individuals continue to drive as they age. Therefore, due to aging populations, it is reasonable to assume that, in the next few decades, there will be more seniors driving than ever before. Worldwide, data provided by the United Nations population division (United Nations, 2019) predicts the percentage of the population aged 65+ will increase from 9.3% in 2020 to 15.9% in 2050 and the percentage of the population aged 80+ from 1.9% in 2020 to 4.4% in 2050. In Europe, 19.7% of the population was aged 65+ in 2018, an increase of 2.6 percentage points from 10 years earlier, and the share of the population aged 80+ is projected to increase from 5.6% to 14.6% by 2100 (Eurostat, 2019).

As a consequence, as the population continues to age, with potentially more seniors retaining their driving license, challenges related to elderly drivers will likely become more prevalent in high-income countries, like in Europe or North America, and other countries with similar demographic changes.

When considering the safety related impacts of changes in driving populations, it is important to keep in mind the multifaceted relationship between age and driving. On the one hand, an older driver has many years of driving experience to draw on to supplement their driving ability and skill (Liddle and McKenna 2003). This can make for safer, smarter driving decisions. On the other hand, advancing age can have a negative influence on driving due to declines in functional abilities, and in some circumstances, driving cessation is the safer option (Musselwhite and Shergold 2013; Liddle and McKenna 2003).

It is undeniable that advanced age can have a detrimental effect on the ability to drive safely, and that some drivers ought to cease driving, for their own safety and the safety of others. However, it must be noted that age in itself does not always mean an increased risk of crashes.

For obvious reasons, the ability to see, scan, and interpret the driving environment is crucial for safe driving. However, visual skills become less refined with age. For example, older eyes are less sensitive to light, may have a restricted visual field, may have restricted length of focus, capture fewer fine details, and are less sensitive to motion (Eby et al. 1998).

In addition to slow declines in visual abilities, cognitive skills may also diminish with age. Even in the absence of a diagnosed cognitive impairment such as dementia, older drivers may experience challenges with attention, memory, and/or spatial cognition (Eby et al. 1998). For example, age-related cognitive declines may lead to decreases in secondary looks (e.g., double-checking that there is adequate space to merge) and in situational awareness (e.g., noticing other road users around the roadway, or anticipating events like a pedestrian walking out into the street; Romoser and Fisher 2009).

With age also comes the likelihood of some degree of reduced mobility. Reductions in joint flexibility, muscle strength and/or coordination can begin well in advance of reaching the age that most consider "senior". However, the deterioration of these psychomotor skills is certainly most visible among those of older age, and can have a negative effect on overall driving ability. For example, limited range in the knees, hips, hands, ankles, feet, and/or neck can make driving tasks like pressing the brake, gripping the steering wheel, executing precision movements, or turning to check blind spots difficult or impossible to do without pain (Smiley et al. 2012; Eby et al. 1998).

Finally, the driving ability of elderly people may be further impaired by a number of medications, such as antidepressants, antihistamines and benzodiazepines (Dobbs, 2005). This is important because the frequency and quantity of prescription drug use increase with age. Although some medications may have a positive impact on driving skills (e.g., pain reduction), others have been shown to be associated with at-fault crashes in older adults (McGwin et al., 2000).

The relationship between age and crash risk is generally described as a U-shape curve (Eby and Molnar 2009). This U-shape relationship persists when crashes are represented in terms of deaths per licenced drivers or per vehicle kilometers driven. A study in Canada, for example, revealed 24.7 deaths per 100,000 drivers in the youngest demographic, seniors 65 and older had a death rate of 15.7 per 100,000 drivers, and drivers between the ages of 25 and 64, averaged 9.6 deaths per 100,000 drivers (Robertson

and Vanlaar, 2008). In Europe, the fatality rate per million population was 1.39 times the rate for the entire population in 2015 (European Road Safety Observatory 2017).

However, there is ongoing debate regarding the optimal way to present the relationship between crash risk and advanced age. Some studies warn against presenting crash risk in terms of miles driven because older drivers tend to limit their own driving. Since these older drivers tend to drive fewer miles than other drivers, presenting their crash risks in terms of miles driven can introduce a form of bias that may tend to inflate crash risk (Eby and Molnar 2009; Alvaraz and Fierro 2008; Langford et al. 2006). In general, all drivers with a lower mileage typically have such an increased crash risk (Alvarez and Fierro, 2008; Hakamies-Blomqvist et al., 2004; Langford et al., 2006) because most of their driving occurs on high-risk congested streets, rather than on lower risk roads such as highways and freeways (Janke, 1991). Research that has controlled for driving distance confirms the importance of mileage and found that elderly drivers have crash rates comparable to those of middle-aged drivers, provided that they drive more than 3 000 km per year (Alvarez and Fierro, 2008; Langford et al., 2006).

A recent study (Rolison and Moutari, 2017) confirmed the existence of mileage bias in a study of fatal crash rates and some differences by gender among older age groups. In their study, several units of exposure were used, including a risk-exposure density that considered the average trip time, distance and frequency of trips by age group. Using this measure, drivers aged 60-69 were found to have the lowest fatal crash risk and drivers aged 70+ were found to have increased risks of 9% for males and 22% for females compared to the same gender in the 60-69 age category. For males 70+ the crash risk was still lower than age categories less than 60 years while for females the estimated risk was still lower than age categories less than 40 years.

It is more difficult, however, to avoid a second form of bias that has spurred separate discussions within the broader topic of older driver crash risk. This bias is often referred to as "fragility factor" (Li et al. 2003; Alvarez and Fierro 2008; Langford et al. 2006). Essentially, this means that increasing fragility, which begins at around age 60, accounts for some of the excess death rate of older drivers. In other words, the crash risk for older drivers is inflated when injury or fatal crashes are the only unit of measurement used to calculate the risk. This inflation results from the fact that seniors tend to suffer more consequences than a younger person involved in the same crash and tend to have more of their crashes reported to the police as a result (Evans 2001). Another important caveat in relation to this issue is that in fatal crashes involving older drivers, it is they or their elderly passengers who are most likely to be seriously injured or killed; the opposite often occurs in crashes involving younger drivers. The possibility of this type of bias underscores the need to assess older driver crash risk within a larger paradigm that takes into account crash numbers, crash types, natural age-related declines, and possible medical issues.

This thematic ESRA report aims at describing the differences between elderly (age 65+) and non-elderly drivers in the self-declared behaviours and attitudes related to driving while impaired, driving while exceeding the speed limit and driving while drowsy in a sample from 32 countries worldwide. The intent is to look for evidence that despite possible physical and cognitive related declines in driving ability, the behaviour and attitudes of elderly drivers compensates at least in part, and as a result, elderly drivers as a group are not a particular road safety hazard. Factors that influence these self-declared behaviours are examined within each of the four regions: Europe20, NorthAmerica2, AsiaOceania5, Africa5.

# 2. Methodology

The ESRA project (E-Survey of Road users' Attitudes) is a joint initiative of road safety institutes, research organisations, public services and private sponsors, across 46 countries aiming at collecting comparable (inter)national data on road users' opinions, attitudes and behaviour with respect to road traffic risks. The initiative is funded by the partners' own resources.

ESRA is an extensive online panel survey, using a representative sample (at least N=1,000) of the national adult populations in each participating country. A jointly developed questionnaire 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 all types of road users. The first edition of the ESRA survey (ESRA1) was carried out in three waves between 2015-2017. Data were gathered from almost 40,000 road users in 38 countries across 5 continents.

The present report is based on the first wave of the second edition of this global survey (ESRA2_2018). It was conducted in 32 countries in 2018. In total the ESRA2_2018 survey collected data from more than 35,000 road users. The participating countries in ESRA2_2018 were:

- Europe20: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom;
- America2: Canada, USA;
- AsiaOceania5: Australia, India, Israel, Japan, Republic of Korea;
- Africa5: Egypt, Kenya, Morocco, Nigeria, South Afrika.

The project has been initiated and is coordinated by the Vias institute (BE). Twelve institutes: BASt (DE), bfu (CH), CTL (IT), IATSS (JA), IFSTTAR (FR), ITS (PO), KFV (AT), NTUA (EL), PRP (PT), SWOV (NL), TIRF (CA) and Vias institute (BE) – combined their expertise and resources to analyse the common data and to disseminate the results. The results of the ESRA2_2018 survey will be published in a Main Report and fifteen thematic reports (Table 1).

**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 |

There are also country fact sheets in which the main results per country are compared with a regional average. An overview of the project and the results are available on www.esranet.eu.

The present report summarizes the ESRA2_2018-results with respect to elderly road users related to driving while impaired, exceeding the speed limit and driving while drowsy. An overview of the data collection method and the sample per country can be found in ESRA2 Methodology.

The report includes the analysis of several aspects related to driving while impaired, exceeding the speed limit or driving while drowsy: self-declared behaviours, acceptability (personal and social), attitudes (behaviour beliefs and attitudes, and perceived behaviour control), risk perception, support for policy measures, opinions of traffic rules and penalties, and perception of enforcement.

Most of the questions of the survey were presented on Likert scales, which were dichotomized for the analysis. A description of the scales and the correspondent dichotomization are presented in the beginning of each section.

For the descriptive analysis, all the results are presented by region (Europe20, NorthAmerica2, AsiaOceania5 and Africa5) and age group. 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 population size of each country in the total set of countries from this region. More information about the weighting is available in Appendix 2: ESRA2 weights. Note that in the African countries a lower percentage of people has access to, and use, the internet (in Kenya and Nigeria less than 30%). Within the African countries the numbers of 65+ respondents who answered the ESRA2 survey were quite low (with the exception of South Africa), so that the answers of this particular age group in African countries cannot be considered to be representative.

Due to the nominal nature of the data, the Chi-square Test for Independence was used to assess if the observed differences are statistically significant. The strength of the association between variables was assessed through the Cramer's V coefficient.

Binary logistic regression models were also estimated to explore what factors increase or decrease the likelihood of an elderly driver being involved in a crash while driving.

# 3. Results

## 3.1 Descriptive results

This section includes the descriptive statistics of questions related to risky driving behaviours and attitudes focusing on driving while impaired, exceeding the speed limit and driving while drowsy. Impairment may be due to alcohol, drugs or prescription medication that carries a warning that driving ability may be negatively influenced.

The description includes the results of self-declared unsafe behaviours in traffic, acceptability of unsafe traffic behaviours (personal and social), attitudes towards unsafe traffic behaviours, risk perception, support for policy measures, opinions on traffic rules and penalties, and perception of enforcement.

The focus is on the differences in response rates between elderly (65+ age group) and non-elderly drivers.

Due to the large number of survey respondents, a p-value of 0.01 or less was used as an indicator of statistical significance. However, within the African countries the numbers of 65+ respondents who answered the ESRA2 survey were quite low, 118 in total, so that the answers of this particular age group in African countries cannot be considered to be representative.

### 3.1.1 Self-declared unsafe behaviours in traffic

To assess self-declared behaviours in traffic, car drivers were asked '*Over the last 30 days, how often did you as a car driver …?*'. Seven items of interest were included:

- …drive when you may have been over the legal limit for drinking and driving;
- …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 (except motorways/freeways);
- …drive faster than the speed limit on motorways/freeways;
- …drive when you were so sleepy that you had trouble keeping your eyes open.

All questions were answered on a Likert scale from 1 (never) to 5 (almost always) - The percentages of 'at least once' (answers 2 to 5) are presented in the results.

The results show elderly drivers typically report lower or similar rates of risky behaviours than other age groups, with the exception of Africa5, where elderly drivers consistently report higher rates of risky behaviour.

Figure 1 shows that age is a significant factor in the reported rate of driving when potentially over the BAC legal limit for all regions (p-value<0.01, Cramer's V<0.14). In Europe20 and NorthAmerica2, the rate for elderly drivers is the lowest of all age groups and lowest between regions (9.7% and 4.7% respectively). In AsiaOceania5, the rate for elderly drivers is lower than for all drivers under the age of 45 at 14.1%. The results for Africa5 differ in that elderly drivers have the highest reported rate and the highest rate between regions (32.4%).

Age is also a significant factor in all regions in the reported rate of driving 1 hour after using drugs (p-value<0.01, Cramer's V<0.22). In Europe20 and NorthAmerica2, the rate for elderly drivers is the lowest of all age groups and lowest between regions (1.8% and 6.3% respectively). In AsiaOceania5, the rate for elderly drivers is lower than for all drivers under the age of 45 at 18.2%. The results for Africa5 differ in that elderly drivers have the highest reported rate and the highest rate between regions (44.7%).

For driving after taking medication that may affect driving ability, reported rates again depend on age in all regions (p-value<0.01, Cramer's V<0.14). In Europe20, the rate for elderly drivers is the lowest of all age groups at 13.3%. In NorthAmerica2, elderly drivers report the second lowest rate at 11.9% and the lowest rate between regions. In AsiaOceania5, the rate for elderly drivers is lower than for all drivers under the age of 45 at 22.7%. The results for Africa5 differ in that elderly drivers have the highest reported rate and the highest rate between regions (36.7%).

For speeding behaviours, in Europe20, age is a significant factor in all three environments (p-value <0.01) and elderly drivers report some of the lower rates of speeding (49.8% to 64.6%) although the strength of association with age is not large (Cramer's V<0.11). In NorthAmerica2, age is a significant factor for speeding on motorways/freeways and elderly drivers reported similar rates of speeding (74.6%) as the 25-34 and 35-44 age groups while higher than the other age groups (Cramer's V 0.13). In AsiaOceania5, age is a significant factor for speeding outside built-up areas and on motorways/freeways and elderly drivers report among the lowest rates (41.2% and 44.4% respectively) (p-value<0.01, Cramer's V<0.09). In Africa5, age is a significant factor for speeding inside built-up areas and on motorways/freeways and in both cases elderly drivers report the highest rate of speeding (57.6% and 61.0% respectively) (p-value<0.01, Cramer's V<0.10). Across regions, Europe20 and NorthAmerica2 generally report higher rates of speeding across all three environments and age groups than AsiaOceania5 and Africa5.

For driving while drowsy, age was a significant factor in all regions (p-value <0.01). In Europe20 and NorthAmerica2, elderly drivers reported the lowest rates among age groups and across regions (10.7% and 10.96% respectively) and the strength of association was moderate (Cramer's V 0.17 and 0.21 respectively). In AsiaOceania5, elderly drivers reported rates similar to other age groups at 23.6% although higher than drivers aged 45-54. In Africa5, elderly drivers reported a much higher rate (46.0%) than all other age groups and regions.

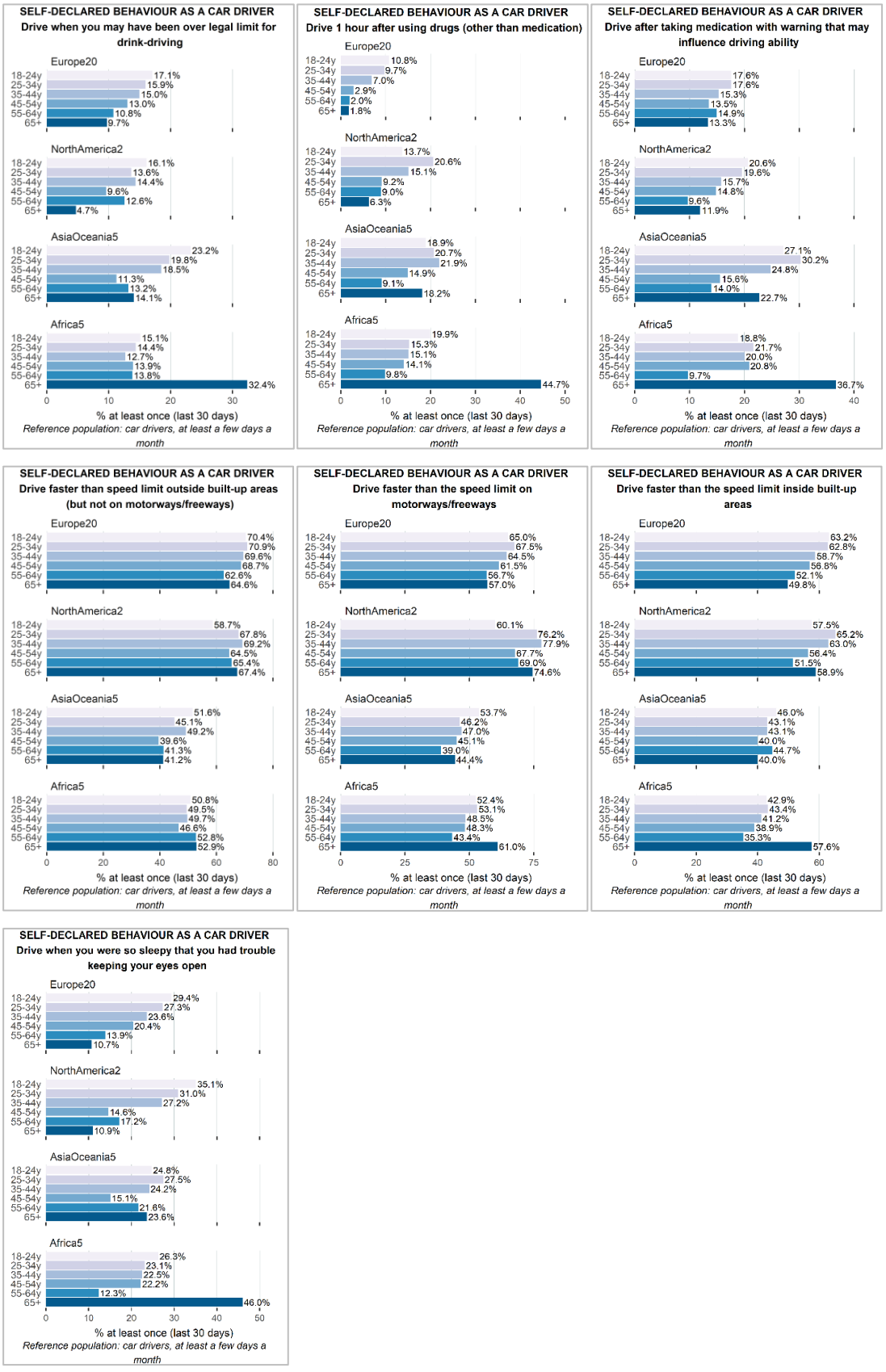


**Figure 1: Self-declared behaviours as a car driver in the past 30 days, by region and age.**

### 3.1.2 Acceptability of unsafe traffic behaviours

To assess the level of personal acceptability of behaviours, the respondents were asked to answer the question:

- How acceptable do you, personally, feel it is for a car driver to…?

The question was answered on a Likert scale from 1 (unacceptable) to 5 (acceptable). The percentages of acceptability (answers 4 or 5) are shown in the results.

Results from Figure 2 show that levels of personal acceptability are very low towards driving while impaired by alcohol, drugs or prescription medication or driving while drowsy. Rates of acceptance in Europe20 and NorthAmerica2 are consistently lower than AsiaOceania5 and Africa5 (p-value <0.01). For speeding, the rate of acceptance is higher than for driving while impaired or drowsy, but a majority of respondents still indicate speeding is personally unacceptable. The level of personal acceptability is lowest for speeding in built-up areas with greater acceptance for speeding in non built-up areas (but not on motorways/freeways) and even greater acceptance for speeding on motorways/freeways.

Percentages of personal acceptability are much lower than the percentages of the corresponding self-declared behaviours (Figure 2), showing that a significant number of drivers engage in risky behaviours related to driving while potentially impaired or drowsy or speeding even if they consider the behaviour unacceptable.

The level of personal acceptability is roughly the same for alcohol, drugs and prescription medication indicating that drivers understand that impairment from any of these causes constitutes a risk factor.

Age is a significant factor in the reported personal acceptance of driving when potentially over the legal limit for all regions (p-value<0.01, Cramer's V<0.11). In Europe20 and AsiaOceania5, the rate for elderly drivers is the lowest of all age groups (0.6% and 2.4% respectively). In NorthAmerica2, elderly drivers reported the second lowest rate at 0.4%, which is the lowest rate amongst regions for elderly drivers. The results for Africa5 differ in that elderly drivers have the highest reported rate and the highest rate between regions (12.4%).

Age is a significant factor in the reported personal acceptance of driving within one hour of using drugs in Europe20, NorthAmerica2 and AsiaOceania5 (p-value<0.01, Cramer's V<0.13). In all three of these regions elderly drivers reported the lowest rate at 0.4% for Europe20 and AsiaOceania5 and 1% for NorthAmerica2. In Africa5, the reported rate for elderly drivers was much higher at 5.7%.

For speeding behaviours, age is a significant factor across all regions and in all three environments (p-value<0.01, Cramer's V<0.15). The general trend is that elderly drivers report the lowest or near-lowest level of acceptance, with the exception of Africa5, where elderly drivers report the highest level of acceptance (10.4% to 16.15). The lowest levels of acceptance for speeding amongst elderly drivers is inside built-up areas (1.6% to 10.4%). Acceptance of speeding outside built-up areas and on motorways/freeways ranged from 4.2% to 17.1% among elderly drivers.

For driving while drowsy, age was a significant factor in all regions (p-value<0.01, Cramer's V<0.15). In Europe20, elderly drivers reported the lowest rates of acceptance among age groups and across regions (0.5%). In NorthAmerica2, elderly drivers reported the second lowest rate at 0.4%, which is the lowest rate amongst regions for elderly drivers. In AsiaOceania5, elderly drivers reported the third lowest rate which was lower than that of drivers under the age of 45 at 4.1%. In Africa5, elderly drivers reported a much higher rate (14.6%) than all other age groups and regions.

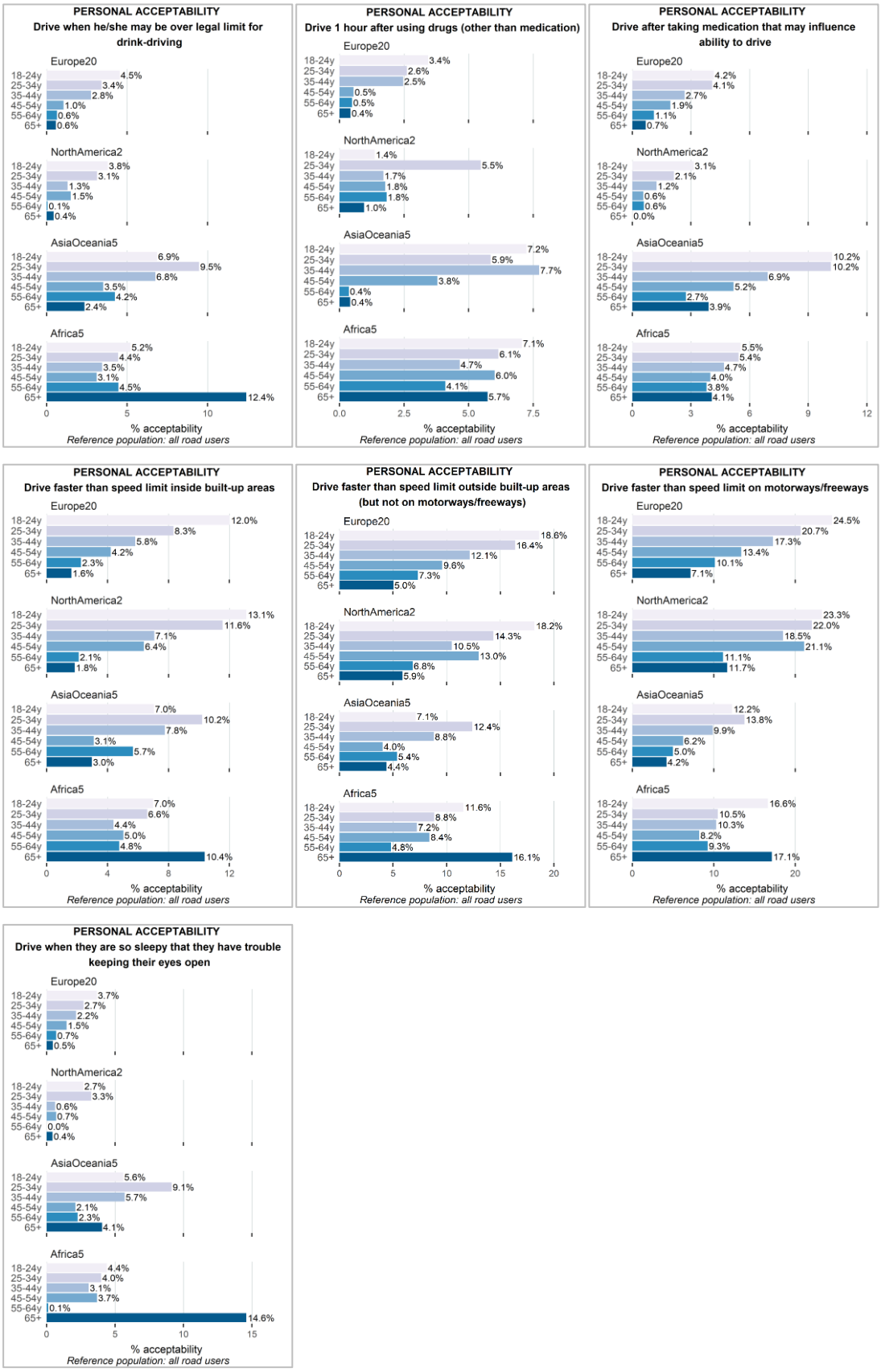


**Figure 2: Acceptability of unsafe traffic behaviours, by region and age.**

### 3.1.3 Attitudes towards unsafe behaviour in traffic

Attitudes towards unsafe behaviours concerning driving while impaired and exceeding the speed limit were assessed by asking the level of agreement with statements related to normative beliefs (extent to which other people who are important to oneself think they should not perform a particular behaviour) and subjective norms (belief that an important person or group will approve of a particular behaviour):

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

and behaviour beliefs and 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'

and perceived behaviour control:

- 'I trust myself driving 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. a litre of beer or half a litre of wine)
- 'I trust myself when I drive significantly faster than the speed limit'
- 'I am able to drive fast through a sharp curve'

All questions were answered on a Likert scale from 1 (disagree) to 5 (agree). The percentages of agreement (answers 4 or 5) are shown in the results.

*Normative beliefs and subjective norms*

Age is a significant factor in the percentage of respondents who reported most of their friends would drive after drinking alcohol in Europe20 and AsiaOceania5 (p-value<0.01, Cramer's V<0.11) but not in NorthAmerica2 or Africa5. In Europe20 and AsiaOceania5, the rate for elderly drivers is the lowest of all age groups (3.9% and 5.7% respectively). The reported rates for elderly drivers were 10.1% in NorthAmerica2 and 14.4% in Africa5.

For the percentage of respondents who reported most of their friends would drive 20 km/h over the speed limit in a residential area, age was a factor in all regions with the exception of Africa5 (p-value<0.01, Cramer's V<0.11). In Europe20, elderly drivers report the lowest rate (10.2%) which is also the lowest rate between regions. In NorthAmerica2, elderly drivers reported the third lowest rate (18.0%) which is lower than for drivers under the age of 35. Elderly drivers in AsiaOceania5 reported the highest rate for elderly drivers when comparing between regions at 21.4%, which was lower than for drivers under the age of 45 in AsiaOceania5.

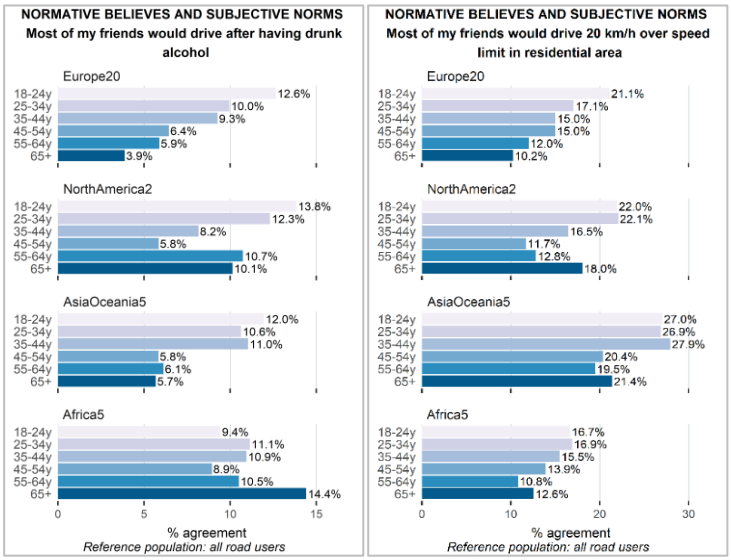


**Figure 3: Normative beliefs and subjective norms, by region and age**

*Behaviours, beliefs and attitudes*

The percentage of respondents who declared one can risk driving under the influence of alcohol for short trips was higher in AsiaOceania5 and Africa5 than Europe20 and NorthAmerica2 (p-value<0.01, Cramer's V 0.09). Age was a significant factor in all regions except Africa5 (p-value<0.01). In Europe20 and AsiaOceania5, elderly drivers reported the lowest rate of agreement at 1.2% and 3.6% respectively (Cramer's V<0.13), while in NorthAmerica2 elderly drivers reported a higher rate (2.3%) than drivers aged 35-54 and a lower rate than other age categories (Cramer's V 0.14).

With respect to speeding, the percentage of respondents who declared they have to drive fast to avoid the impression of losing time was dependent on age in all regions (p-value<0.01, Cramer's V<0.20). In Europe20 and NorthAmerica2, elderly drivers reported the lowest level of agreement (2.3% and 0.7% respectively) and near the lowest in AsiaOceania5 (7.4%). In Africa5, elderly drivers reported the highest level of agreement at 22.3% with the next highest level of agreement at 11.25% for drivers aged 18-24.

The percentage of respondents who reported that respecting speed limits was boring or dull was highest in Europe20 (12.3%) and lowest in NorthAmerica2 (8.3%) (p-value<0.01). Age was a significant factor in Europe20, AsiaOceania5 and Africa5 but not NorthAmerica2 (p-value<0.01, Cramer's V <0.11). In Europe20 and AsiaOceania5, elderly drivers reported the lowest levels of agreement (10.4% and 5.7% respectively), while in Africa5, elderly drivers reported the highest level of agreement and the highest for elderly drivers across regions (16%). NorthAmerica2 reported the lowest level for elderly drivers at 4.5%)

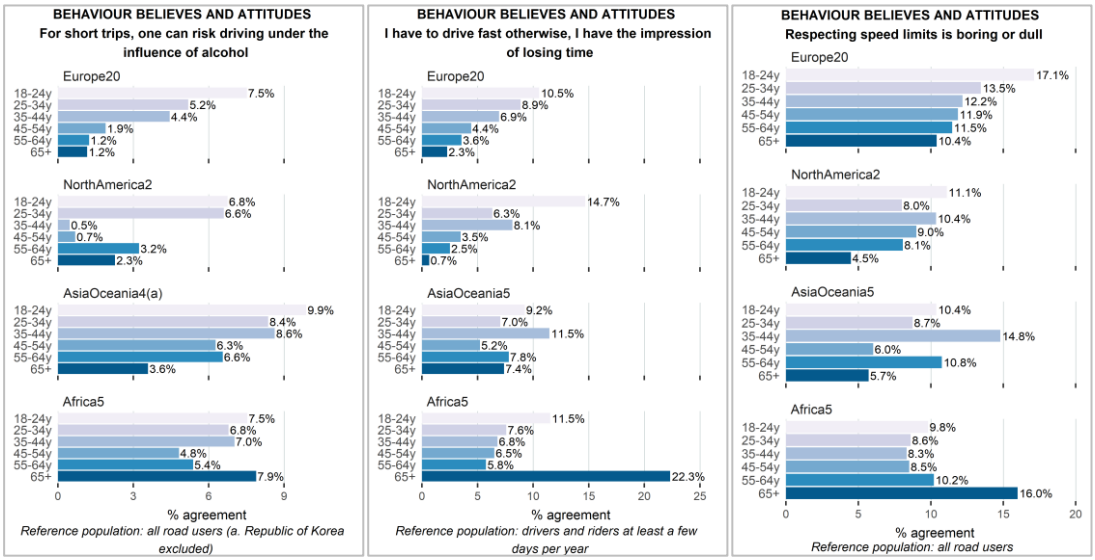


**Figure 4: Behaviour beliefs and attitudes, by region and age.**

*Perceived behaviour control*

Age was a significant factor in the percentage of respondents who declared trust or ability when driving after drinking alcohol in Europe20 and Africa5 (p-value<0.01, Cramer's V<0.07). While elderly drivers in Europe20 were less likely to agree (10.6%), in Africa5 elderly drivers were most likely to agree and reported the highest rate across regions (18.4%). Elderly drivers in AsiaOceania5 reported the lowest rate of agreement (4.9%) among elderly drivers.

For driving when a little drunk, age was a significant factor in all regions except Africa5 (p-value<0.01, Cramer's V<0.10). Elderly drivers reported the lowest rate of agreement in Europe20 (2.2%) and NorthAmerica2 (1.7%) and the second lowest rate of agreement is AsiaOceania5 (6.9%).

For the ability to drive after drinking a large amount of alcohol, age was a significant factor in all regions except NorthAmerica2 (p-value<0.01, Cramer's V<0.10). Elderly drivers reported the lowest rate in Europe20 (1.5%), the highest rate in Africa5 (5.7%) and in AsiaOceania5 were in the middle of the range reported by age category (3.2%). Elderly drivers in NorthAmerica2 reported the second lowest rate amongst elderly drivers (1.7%).

For the speeding related behaviours, age was a significant factor in all regions in the declaration of trust in ability for exceeding the speed limit (p-value<0.01, Cramer's V<0.15) and for driving fast through a sharp curve (p-value<0.01, Cramer's V<0.14). In Europe20, NorthAmerica2 and AsiaOceania5, elderly drivers consistently reported the lowest level of agreement except for AsiaOceania5 and driving fast through a sharp curve where elderly drivers were not the lowest but were close. Rates of agreement for elderly drivers ranged from 3.5% to 12.4% in these regions. In Africa5, elderly drivers reported higher levels of agreement, over 20%, and elderly drivers reported the highest rates.

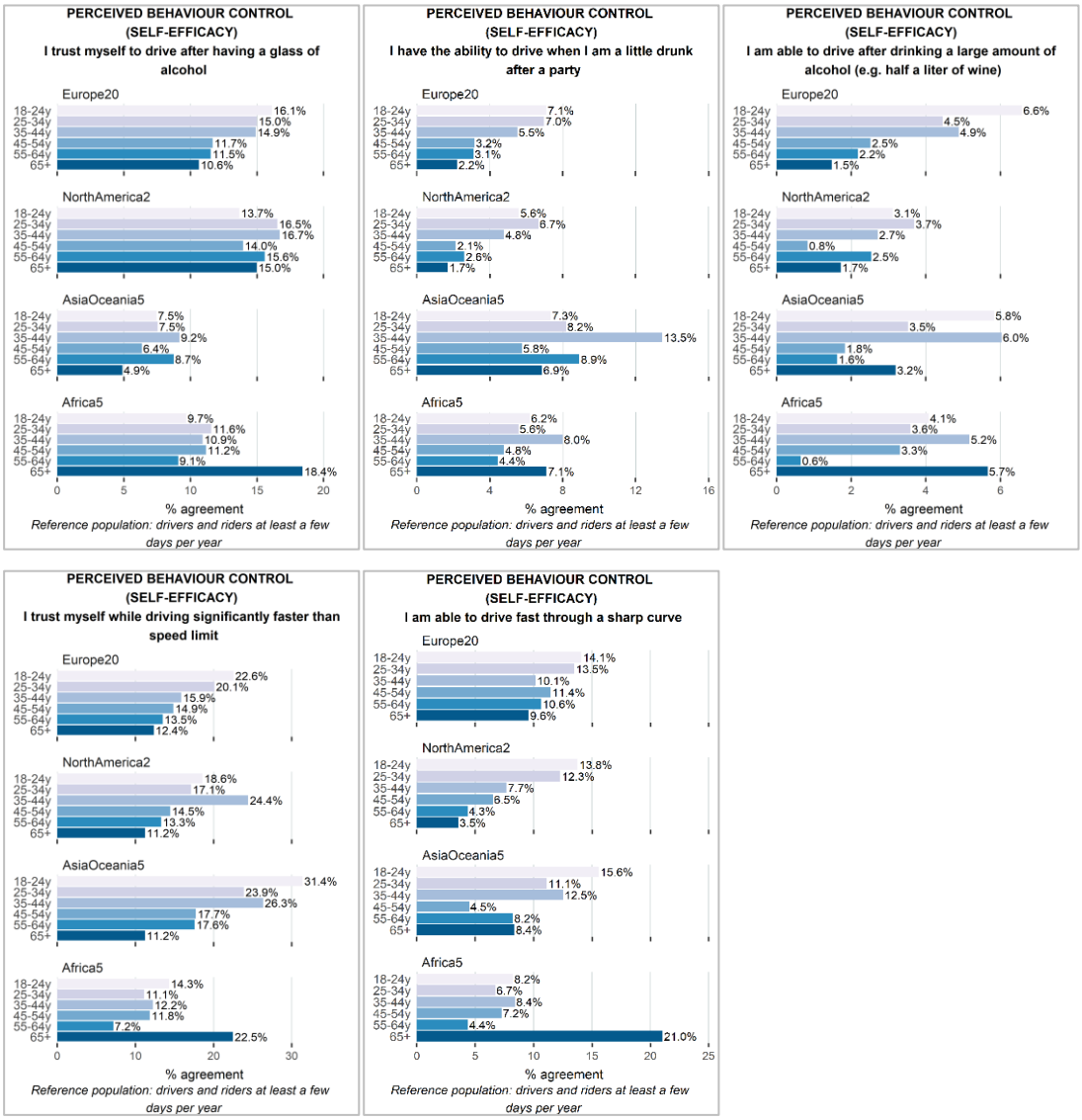


**Figure 5: Perceived behavioural control, by region and age.**

### 3.1.4 Risk perception

To assess the risk perception of driving while impaired or drowsy, participants were asked '*How often do you think each of the following factors is the cause of a road crash involving a car?* '. Several items related to risky behaviours while driving a car were included: 'driving after drinking alcohol', 'driving after taking drugs (other than medication)', 'driving faster than the speed limit' and 'driving while tired'. The scale of answers ranged from 1 (never) to 6 ((almost) always). The percentages of often/frequently (answers 4 to 6) are shown in the results.

Results from Figure 6 show that their risk perception is higher for alcohol causing a crash than drugs. It may be that some respondents believe that the rate of use is higher for alcohol than for drugs rather than the relative risk of driving under the influence of that substance is higher.

The results also show that respondents from Europe20 and NorthAmerica2 are more likely than AsiaOceania5 and Africa5 to report alcohol is a factor in road car crashes (p-value<0.01, Cramer's V 0.22). Age is a significant factor in all regions with the exception of Africa5 (p-value<0.01, Cramer's V<0.12). In Europe20 and NorthAmerica5, elderly drivers report the highest rate of agreement (85.2% and 80.6% respectively), while in AsiaOceania5, elderly drivers report among the lowest rates of agreement at 50.6% and the lowest rate for elderly drivers between regions.

For driving after taking drugs, the results show that respondents from Europe20 and NorthAmerica2 are more likely than those from AsiaOceania5 and Africa5 to report that drugs are a factor in road car crashes (p-value<0.01, Cramer's V 0.19). Age is a significant factor in all regions, with the exception of AsiaOceania5 (p-value<0.01, Cramer's V<0.16). In Europe20 and NorthAmerica2, elderly drivers report the highest rate of agreement (82.0% and 77.5% respectively), while in Africa5, elderly drivers report the lowest rate of agreement at 52.9%. Elderly drivers in AsiaOceania5 report the lowest level amongst drivers at 50.0%.

For speeding, respondents from Europe20 and NorthAmerica2 are again more likely than AsiaOceania5 and Africa5 to report the risky behaviour being a factor in road car crashes (p-value<0.01, Cramer's V 0.14). Age is a significant factor in all regions with the exception of AsiaOceania5 (p-value<0.01, Cramer's V<0.12). In Europe20 and NorthAmerica2, elderly drivers report the highest or near highest rate of agreement (77.6% and 79.9% respectively), while in Africa5, elderly drivers report the lowest rates of agreement at 60.0%. Elderly drivers in AsiaOceania5 report the lowest level amongst elderly drivers at 55.9%.

For driving while tired, respondents from Europe20 and NorthAmerica5 are more likely than those in AsiaOceania5 and Africa5 to report that the risky behaviour is a factor in road car crashes (p-value<0.01, Cramer's V 0.17). Age is a significant factor in all regions (p-value<0.01, Cramer's V<0.13) with a higher percentage of elderly driver respondents agreeing in Europe20 (79.1%) and NorthAmerica2 (76.1%). In AsiaOceania5, the trend with age is not consistent but elderly drivers are among the lowest reporting age categories (54%). In Africa5, elderly drivers are the least likely to agree at 54.4%.

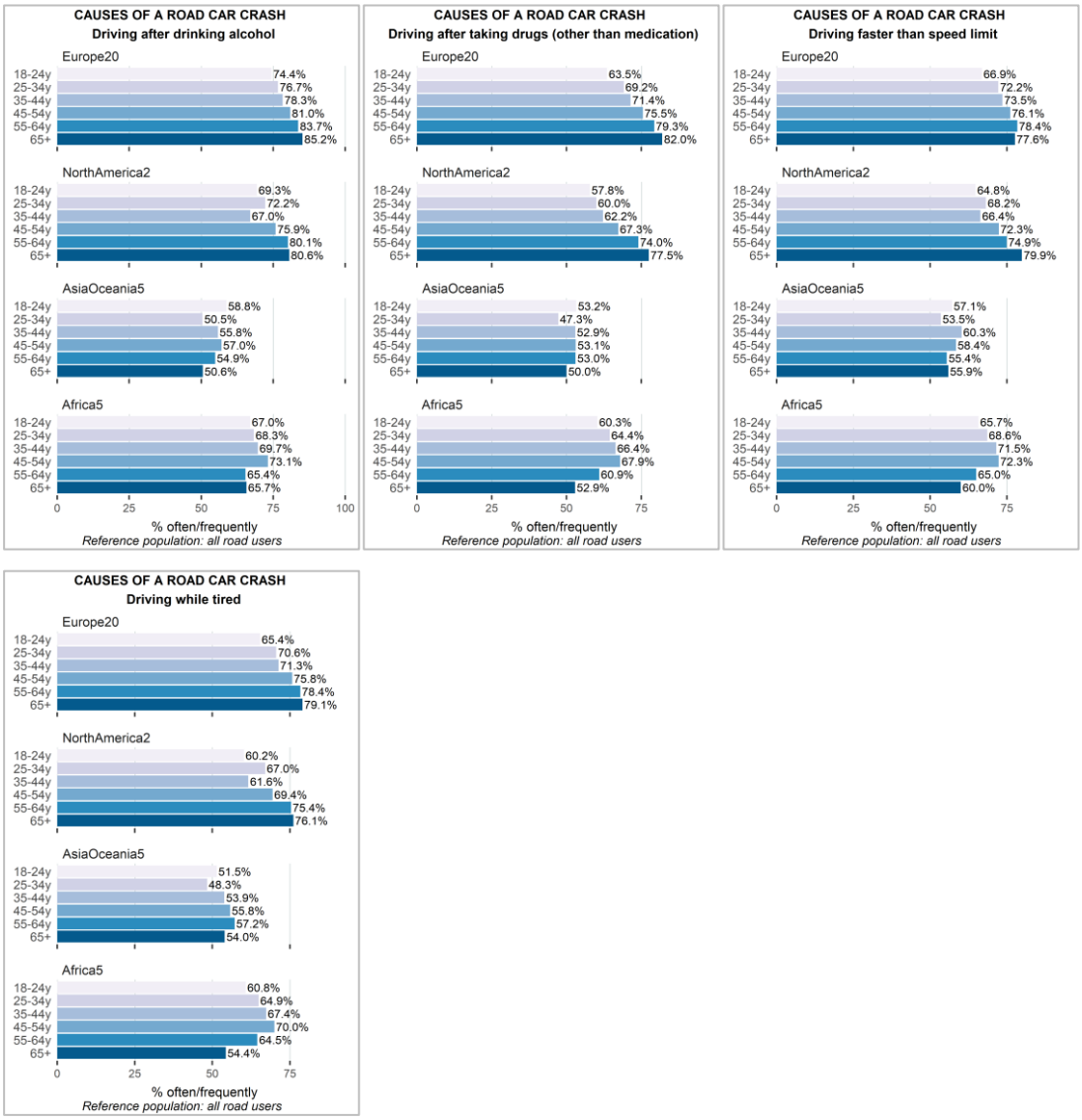


**Figure 6: Risk perception of driving, by region and age.**

### 3.1.5 Support for policy measures

The support for policy measures was assessed by asking '*Do you oppose or support a legal obligation to …?* Five items concerning impaired driving, or exceeding the speed limit were included:

- …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 for novice drivers (licence obtained less than 2 years);
- …have zero tolerance for alcohol 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).

All questions were answered on a Likert scale from 0 (oppose) to 5 (support) - the percentages of 'support' (answers 4 to 5) are presented in the results.

Results from Figure 7 show a high level of support for policy measures aimed at reducing alcohol related impaired driving. There is a general trend in Europe20, NorthAmerica2 and AsiaOceania5 in higher rates of support as drivers age, with elderly drivers being among the most if not the most supportive. In

Africa5 the responses from elderly drivers reveal a much lower level of support than the other age categories. Age was a significant factor (p-value <0.01, Cramer's V < 0.18) except for the support of alcohol interlock devices in AsiaOceania5.

For policy measures aimed at speeding, age was a significant factor in all regions except NorthAmerica2 (p-value<0.01, Cramer's V<0.19). In Europe20 and AsiaOceania5, elderly drivers are among the most supportive, while in Africa5, elderly drivers are the least supportive.

Interestingly, support is higher for intelligent speed assistance in AsiaOceania5 and Africa5 (78.7% and 77.2% respectively) than in Europe20 (60.8%) and NorthAmerica2 (44.4%) (p-value<0.01, Cramer's V 0.20). This is also true for support of dynamic speed signs in AsiaOceania5 and Africa5 (80.7% and 83.8% respectively) compared to Europe20 (67.6%) and NorthAmerica2 (56.7%) (p-value<0.01, Cramer's V 0.17).

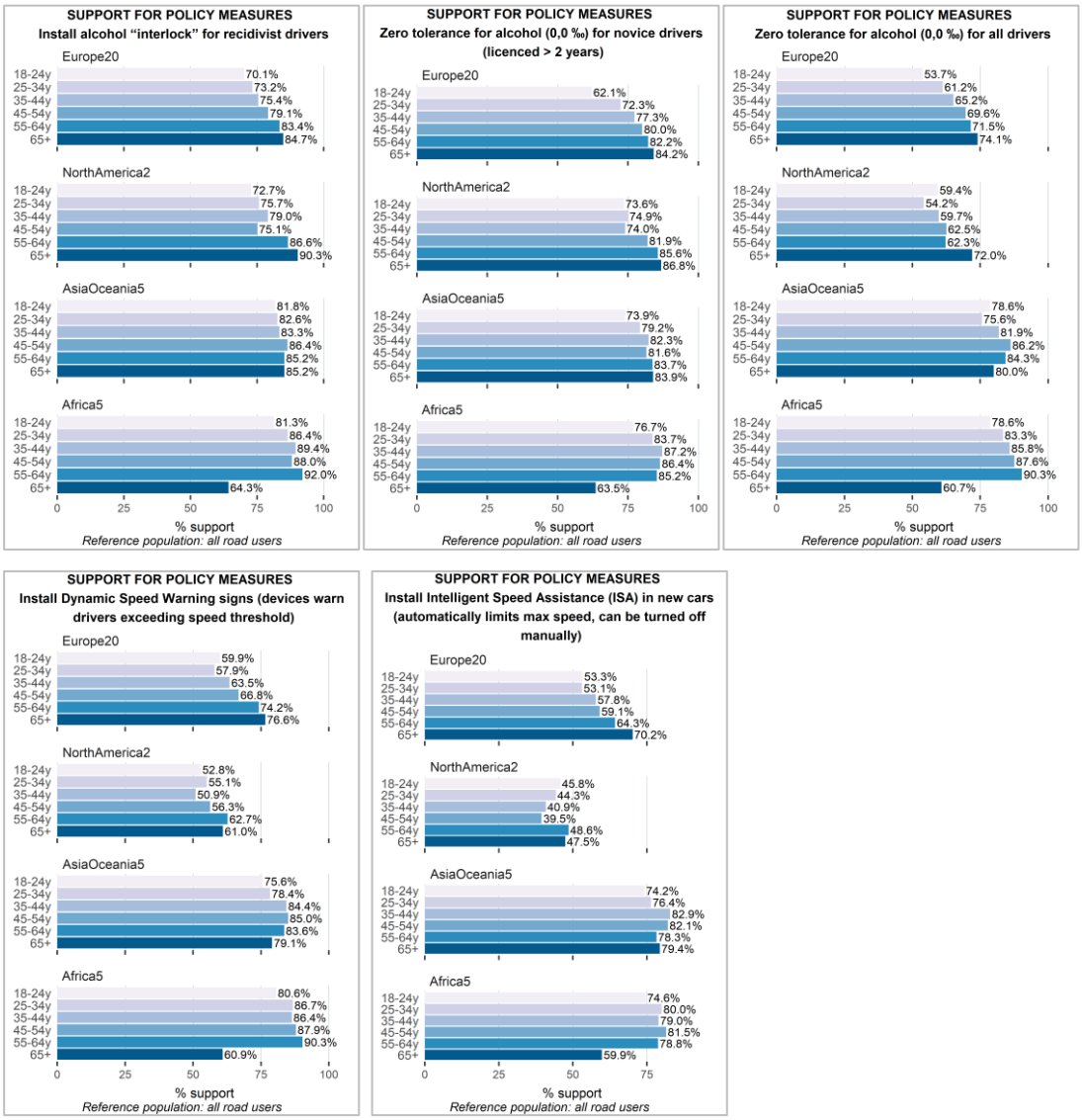


**Figure 7: Support for policy measures, by region and age.**

### 3.1.6 Traffic rules and penalties

Opinions on rules and penalties concerning driving under the influence of alcohol or driving faster than the speed limit were assessed by asking if they agree/disagree with three statements: '*traffic rule/penalties should be stricter*', '*traffic rules/penalties are too severe*', and '*traffic rules are not being checked sufficiently*'.

Results from Figure 8 show that with respect to driving under the influence of alcohol, the majority of respondents in all regions agree that traffic rules should be stricter, and that they are not being checked sufficiently. Elderly drivers are more likely to be in agreement (p-value<0.01, Cramer's V<0.13), with the exception of AsiaOceania5 and the question pertaining to rules should be stricter, where the age differences were not statistically significant, and Africa5 and the question pertaining to the traffic rules being checked sufficiently. Rates of agreement for elderly drivers ranged from 56.7% to 96.2% with the lowest rates of agreement from Africa5.

On the other hand, a minority agreed that traffic penalties related to alcohol are too severe. Respondents from Europe20 and NorthAmerica2 are less likely to agree with this statement (p-value<0.01, Cramer's V 0.20). Age was a significant factor in all regions except Africa5 and elderly drivers had the lowest rate of agreement in Europe20 (14.8%), NorthAmerica2 (11.3%) and AsiaOceania5 (23.9%).

For speeding, a very high majority of respondents in AsiaOceania5 (90.6% overall) reported that traffic rules and penalties for speeding should be stricter. A majority in Europe20 (57.4%) agreed while less than half agreed in NorthAmerica2 (47.6%) and Africa5 (47%). In Europe20 and Africa5 age was a significant factor and elderly drivers reported the highest level of agreement (62.3% and 54.7% respectively) (p-value<0.01, Cramer's V<0.08). A majority of drivers in all regions reported that the rules are not being checked sufficiently. Age was a significant factor in Europe20, AsiaOceania5 and NorthAmerica2 and elderly drivers again reported the highest levels of agreement in these regions ranging from 71.4% to 79.1%. In Africa5, the rate of agreement for elderly drivers was the lowest for elderly drivers at 56.8%.

On the other hand, a minority in all regions agreed that traffic penalties related to speeding are too severe. Age was a significant factor in all regions and elderly drivers reported the lowest or near lowest levels of agreement, except in Africa5 where elderly drivers had the highest rate of agreement (50.3%).

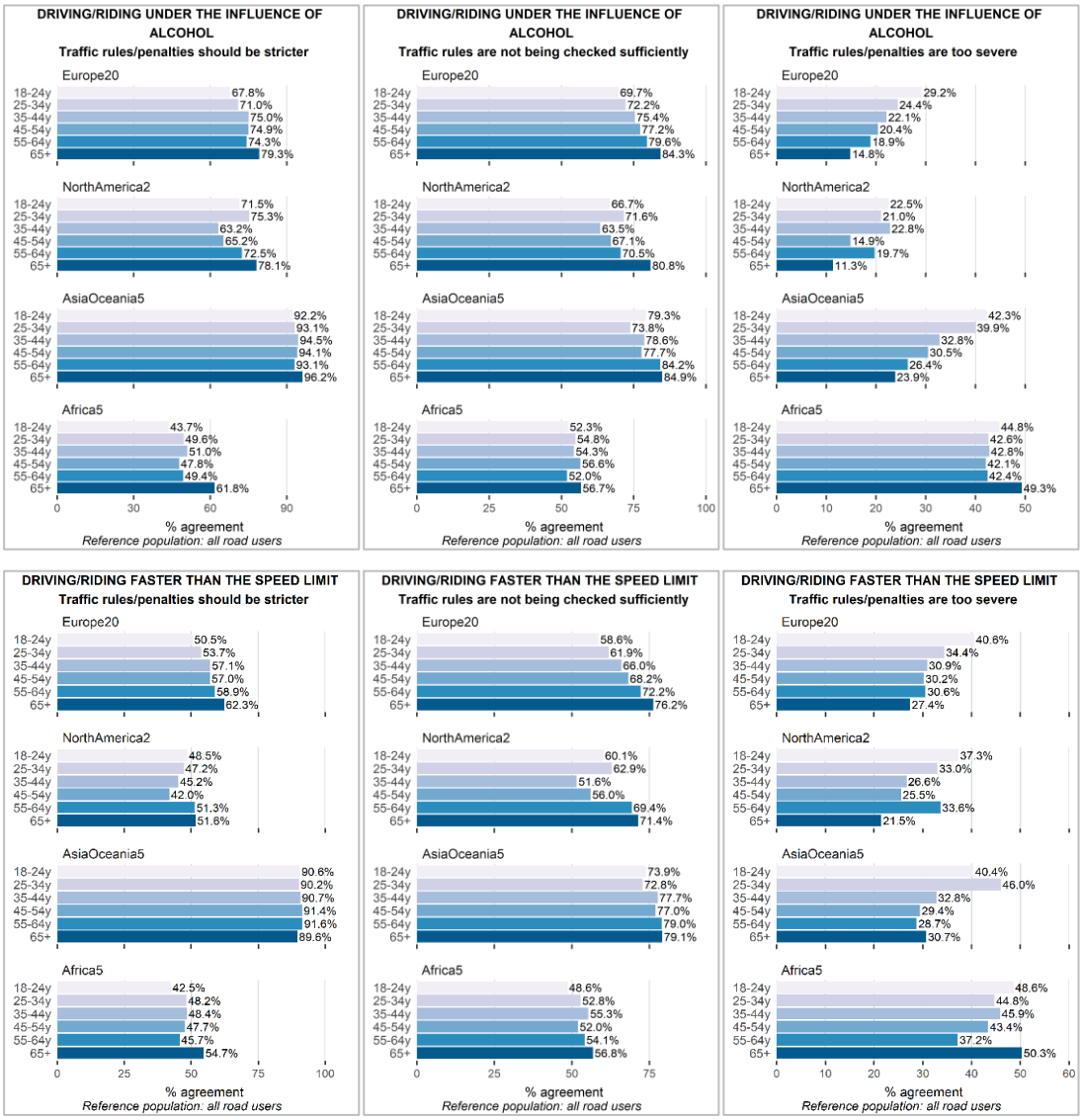


**Figure 8: Opinions on traffic rules and penalties, by region and age.**

## 3.2 In-depth analyses

To further investigate the crash risk of elderly drivers, binary logistic regression models were developed to study the factors that influence reported crash involvement. The criteria for a survey respondent to be included in the analysis were:

1. Aged 65+
2. Holding a valid driving licence or learner's permit
3. Reported operating a car, moped, motorbike, bus or truck at least once within the past 12 months.

The respondents were considered positive for crash involvement if they reported involvement in one or more crashes that resulted in somebody being taken to the hospital, a minor injury or only material damage, and in which they were driving a car, moped, motorcycle, bus or truck within the past 12 months.

Models were estimated using Stata's svy: logistic commands applying the ESRA2 individual country weights. A significance level of 95% confidence was selected for variable selection.

Models were developed using all data combined because the sample of 65+ drivers was small for most regions and the number of drivers reporting a crash involvement in the past 12 months was also small.

The sample used included 3,543 drivers from Europe20, 589 from AsiaOceania5, 320 from NorthAmerica2 and only 87 from Africa5. Of these, 394 reported involvement in a crash in the previous 12 months. Because of the low sample size in Africa5, models were also run excluding the African countries to assess impacts on the results.

In each model, the outcome is a binary variable indicating no crash involvements (0=never) or one or more crash involvements (1=at least once) in the past 12 months. Independent variables were entered in the model in two phases. In the first phase, sociodemographic characteristics and driving exposure variables were included (gender, age, region, driving exposure and urbanisation). An area was defined as an urban area if the distance to the nearest bus stop, light rail stop, or metro/underground station was within 1 kilometre and the frequency of transit service was at least 3 times per hour. Other areas were considered semi-urban or rural. In the second phase, a second set of models were developed that explored the inclusion of responses to survey questions regarding the acceptability of unsafe traffic behaviours, attitudes, risk perception, enforcement perception, support for policy measures and responses on the social desirability scale. For both phases, models were run including and excluding the data from Africa5.

Odds ratios (and the respective 95% Confidence Intervals) are used to measure the strength of association between the predictor variables and crash involvement.

Table 2 shows the results of the four logistic regression models estimated.

The odds of being involved in a crash for elderly females, in comparison with males, decrease by 23% to 30% between the four models. All these results are statistically significant (p-value <0.05). An interaction of age (within the 65+ age category) and gender was explored but a statistically significant relationship was not found.

For both models including Africa5, the odds of being involved in a crash increased for drivers aged 75+, by 66% for the simpler model and 56% for the extended model, with both results being significant (p-value <0.05). When the data from Africa5 is not included, an increase in the odds of crash involvement is still seen but is of smaller magnitude (20% and 23%) and is not statistically significant at the 95$^{th}$ percentile level.

The impact of region indicates that the odds of crash involvement for elderly drivers is higher in AsiaOceania5 and Africa5 compared to Europe20 and that the odds in NorthAmerica2 are lower than in Europe20. The results for NorthAmerica2 are however not statistically significant.

As expected, less frequent driving exposure is related to lower odds of crash involvement. The results for the level of development indicated that semi-urban and rural areas are related to lower odds of crash involvement compared to urban areas with a range in reduced odds from 15% to 22% between the four models. These results were however not quite significant at the 95$^{th}$ percentile limit. This finding might confirm the literature that indicates a higher crash risk in more complicated urban driving environments. It is important to note that these results are for a crash of any severity and the odds for rural areas could possibly increase if the focus was on high severity crashes due to the increased speeds and crash types (e.g. run-off-road) typical in rural environments.

Concerning the other factors, results show that a higher rate of reported driving when sleepy is associated with a higher likelihood of crash involvement, 32% when including Africa5 and 28% when excluding Africa5 (p-value <0.05). The higher the acceptance of driving after drinking for short trips, the higher the odds of crash involvement (30% to 32%, p-value <0.01). Elderly drivers who report always being confident of how to react in traffic situations have lower odds of crash involvement although this result was only statistically significant when Africa5 is included. Using all regions, the odds are 15% lower (p-value <0.05) and excluding Africa5 8% lower and not statistically significant at the 95$^{th}$ percentile level.

**Table 2: Factors that influence the likelihood of an elderly driver being involved in a crash as a driver.**

| **Independent variables** (reference categories) | Dependent variable: **involvement as a driver in a crash (past 12 months) (**0=never; 1=at least once) | | | |
|---|---|---|---|---|
| | **Simple Model** | | **Extended Model** | |
| | **Incl. Africa5** | **Excl. Africa5** | **Incl. Africa5** | **Excl. Africa5** |
| | Odds Ratio (CI99%) | Odds Ratio (CI99%) | Odds Ratio (CI99%) | Odds Ratio (CI99%) |
| **BLOCK 1 – Sociodemographic** | | | | |
| **Gender** (Ref. male) | | | | |
| female | **0.77*** (0.60-0.99) | **0.70**** (0.55-0.88) | **0.77*** (0.60-1.00) | **0.71**** (0.56-0.92) |
| **Age group** (Ref. 65-74y) | | | | |
| 75+y | **1.66**** (1.17-2.36) | **1.20** (0.86-1.69) | **1.56*** (1.11-2.21) | **1.23** (0.87-1.75) |
| **Region** (Ref. Europe20) | | | | |
| AsiaOceania5 | **2.10**** (1.56-2.81) | **2.09**** (1.56-2.80) | **1.65**** (1.23-2.21) | **1.69**** (1.27-2.24) |
| NorthAmerica2 | **0.67** (0.42-1.19) | **0.70** (0.42-1.17) | **0.71*** (0.42-1.19) | **0.73** (0.43-1.22) |
| Africa5 | **5.45**** (3.00-9.91) | - | **4.73**** (2.64-8.47) | **-** |
| **Driving Exposure** (Ref. at least 4 days a week) | | | | |
| Less than 4 days a week | **0.62**** (0.48-0.81) | **0.64**** (0.50-0.83) | **0.61**** (0.47-0.80) | **0.62**** (0.48-0.81) |
| **Urbanisation** (Ref. urban) | | | | |
| Semi-urban and rural | **0.82** (0.64-1.05) | **0.78** (0.61-1.00) | **0.85** (0.66-1.10) | **0.79** (0.61-1.01) |
| **Self-Declared Behaviour** | | | | |
| Drive when you were so sleepy that you had trouble keeping your eyes open. | | | **1.32*** (1.07-1.64) | **1.28*** (1.02-1.61) |
| **Attitudes Towards Safe And Unsafe Behaviour In Traffic** | | | | |
| For short trips, one can risk driving under the influence of alcohol. | | | **1.32**** (1.15-1.52) | **1.30**** (1.13-1.49) |
| **Self Efficacy** | | | | |
| I am always confident of how to react in traffic situations. | | | **0.85*** (0.74-0.99) | **0.92** (0.79-1.06) |

*Notes: (1)* p-value<0.05, **p-value<0.01.*

The results indicate that amongst elderly drivers, the cohort aged 75+ is more likely to be involved in a crash while driving when controlling for other factors, although statistical significance is lost when Africa5 is not included. The direction of effect is however consistent. Interaction terms in the models for age were pursued but no statistically significant interactions were found. That is to say, there was no evidence seen that the relationship between age and crash likelihood differs by gender, region or other variables.

Although the results are not the focus of the analysis and are not reported in full, it is noted that models similar to those in Table 2 were estimated using drivers of all ages and it was seen that elderly drivers aged 65+ had the lowest odds of being involved in a crash, almost identical to the age group 55-64, compared to younger age categories.

## 3.3 Contextual data and comparison with other findings

This section includes the analysis of external data and its association with some results of the ESRA2_2018 survey.

Figure 9 shows the percentage, for the ESRA2 countries in which these data were available, of the population killed in road crashes that are 65+ and the percentage of the population that is 65+. In all countries where data were available, road users aged 65+ are overrepresented in the population being killed in a road crash. Note that these data do not distinguish between killed as vehicle driver, vehicle passenger or killed while outside of a vehicle. Despite the findings from the ESRA2 survey that elderly drivers in general report lower rates of risk-taking behaviours and attitudes, they are still overrepresented in traffic fatalities in these countries, probably because of their greater fragility and reduced tolerance to injury.

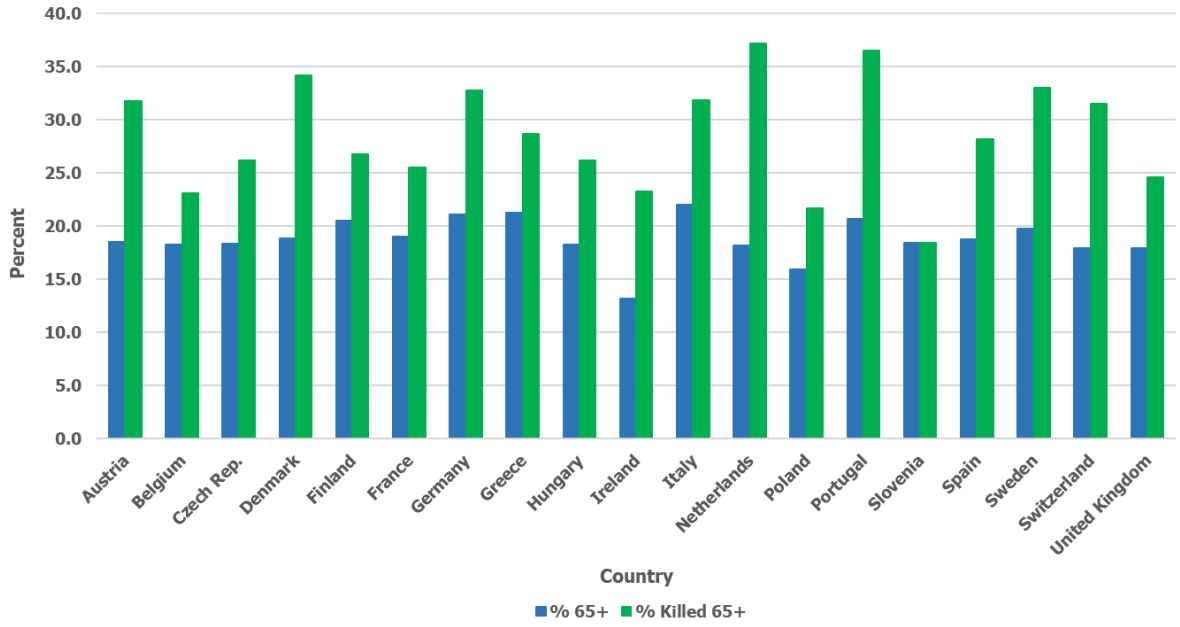


**Figure 9: Percentage of population killed in road crashes aged 65+ (2016) vs percentage of population aged 65+.**

Figures 10 and 11 plot the percentage of the population aged 65+ that was killed in road crashes in 2016 versus the percentage of the population aged 65+ in a given country that rated the safety of travel as a pedestrian and car driver respectively 5 or less on a 10 point scale. The required fatality and popluation data was only available for 24 of the ESRA2 countries. One may expect that as the percentage of respondents indicating a mode of travel is not safe increases, so would the percentage of the population being killed in road crashes. However, the data do not show any strong trends. This indicates that the reported perceptions of safety by travel mode are not necessarily based on factual evidence of road safety risks in general. The data however does not separate out those killed by travel mode so cannot be considered conclusive.

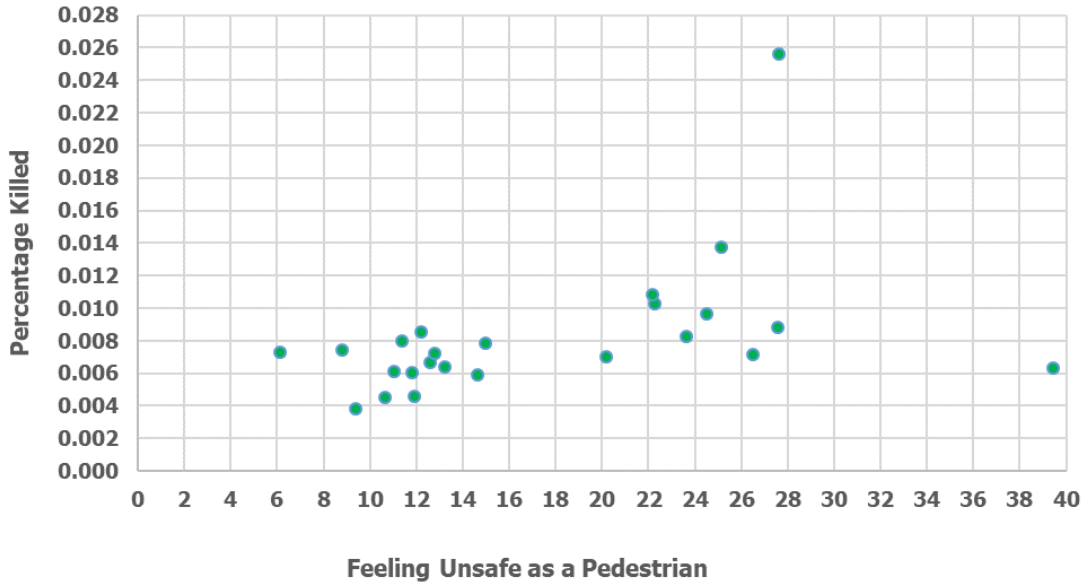


**Figure 10: Percentage of population aged 65+ killed in road crashes (2016) vs percentage of population aged 65+ rating 5 or less the safety of travel as a pedestrian**

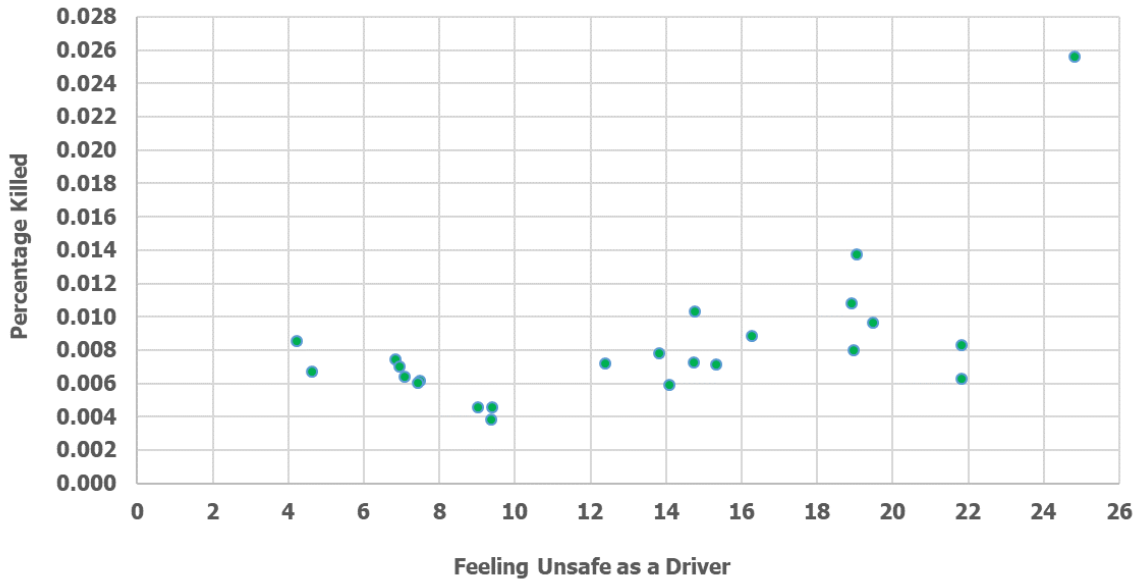


**Figure 11: Percentage of population aged 65+ killed in road crashes (2016) vs percentage of population aged 65+ rating 5 or less the safety of travel as a driver**

## 3.4 Limitations of the data

In general, self-reported data are vulnerable to a number of biases, like (Choi & Pak, 2005; Krosnick and Presser, 2010): 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.

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 ESRA2 countries

where the percentage of 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 quite low, so that the answers of this particular age group in African countries cannot be considered to be representative.

# 4. Discussion/Conclusions

This thematic ESRA report on elderly road users focuses on two road safety issues, 1) driver impairment due to alcohol, drugs, prescription medication or driving while drowsy, and 2) driving over the speed limit. In the descriptive analyses, the focus is on differences between elderly drivers (65+) and other age groups. An analysis was also conducted on the factors that increase the likelihood of a crash involvement for an elderly driver.

The results show that elderly drivers typically report lower or similar rates of risky behaviours compared to other age groups, with the exception of Africa5, where elderly drivers consistently report higher rates of risky behaviour. However, within the African countries, the numbers of 65+ respondents who answered the ESRA2 survey were quite low, 118 in total, so that the answers of this particular age group in African countries cannot be considered to be representative. Statements made throughout the report concerning Africa5 should therefore not be considered definitive but are nevertheless included to describe the trends observed with the data collected. It is recommended that in future surveys a larger sample for elderly drivers is collected in Africa5.

Lower rates of risky behaviours amongst elderly drivers correspond with how elderly drivers view driving circumstances compared to when driving as a younger driver. A questionnaire study in Sweden (Henricksson et al., 2014) asked elderly drivers (aged 70+) to express whether a driving circumstance was more difficult today and whether they took steps to avoid it compared to when they were 40 years of age. Over half of respondents indicated that driving in adverse weather, driving in an unfamiliar town, driving in darkness and driving against the light were more difficult as an elderly driver and 30% or more took steps to avoid these situations. Only 10% agreed that their driving behaviour was unsafe.

Personal acceptability rates are very low concerning driving while impaired by alcohol, drugs or prescription medication, or driving while drowsy, while for speeding, the rate of acceptance is higher, but a majority of respondents still indicate speeding is unacceptable. The general trend is that elderly drivers report the lowest or near-lowest level of acceptance towards these behaviours. The level of personal acceptability is lowest for speeding in built-up areas, with greater acceptance for speeding in non built-up areas and on motorways/freeways. Percentages of personal acceptability are much lower than the percentages of the corresponding self-declared behaviours, showing that a significant number of drivers engage in risky behaviours such as driving while potentially impaired or drowsy or speeding even if they consider the behaviour unacceptable. The level of personal acceptability is roughly the same for alcohol, drugs and prescription medication indicating that drivers understand that impairment from any of these causes constitutes a risk factor.

Risk perception is higher for alcohol causing a crash than for drugs. This may be because some respondents believe that the rate of use is higher for alcohol than for drugs rather than that the relative risk of driving under the influence of alcohol is higher. Elderly drivers in North America and Europe were most likely to agree alcohol and drugs are causes of crashes while in Asia and Africa elderly drivers are among the least likely to agree.

In order to investigate the crash risk of elderly drivers, binary logistic regression models were developed to study the factors that influence reported crash involvement within the past 12 months. Using data from all regions, the odds of being involved in a crash for elderly females were found to be lower than for males in the order of magnitude of 23% to 30%. The odds of being involved in a crash increased for drivers aged 75+ compared to drivers aged 65-74 between 56% and 66%. Elderly drivers who report always being confident of how to react in traffic situations have a lower odds of crash involvement. There was no evidence seen that the relationship between age and crash likelihood differs by gender, region or other variables.

These findings are generally supported by an analysis of crash data in Europe (Polders et al., 2015) that found a small to medium increase in road fatalities in the 65-74 age group but a doubling for those aged 75+. Other findings included that the fatality rate for elderly men was over twice that of elderly women and that fatal crash rates in urban areas were higher for the elderly compared to those middle-aged. These data include all road fatalities and not just those in which the elderly person was a driver. A study in the Netherlands (DaCoTA, 2012) of drivers also found that the fatality rate, measured as

traffic fatalities per billion kilometres travelled, of drivers aged 75+ was over four and a half times that of drivers aged 65-74.

Despite the findings from the ESRA2 survey that elderly drivers in general report lower rates of risk taking behaviours and less risky attitudes, an analysis of the percentage of the population killed in road crashes that are 65+ versus the percentage of the population being 65+ found they are still overrepresented in traffic fatalities in these countries. This finding is consistent with the literature as discussed in the Introduction.

A comparison of reported feelings of safety when travelling by car or as a pedestrian and rates of road crash fatalities indicated that the reported perceptions of safety by travel mode are not necessarily based on factual evidence of road safety risks in general. The data however does not separate out those killed by travel mode so cannot be considered conclusive.

**Recommendations**

Policy recommendations at national and regional level

- Continue to study the impact of age on crash risk and aim programs at those most at risk. In this study drivers aged 75+ were more at risk than those aged 65-74.
- Begin conversations with drivers early in life and focus on fitness to drive as opposed to a focus strictly on aging. Outreach and communication are essential, as is the provision of information about alternative transportation options and community resources for those who are required to submit to medical review or those who decide not to pursue licence renewal.
- Modify the licensing process for drivers to identify the most at-risk drivers due to physical or mental limitations with respect to the driving task and develop tests for assessing their fitness to drive.
- Ensure the existence and availability of alternative transportation options for those for whom a cessation of driving is necessary.

Specific recommendations to particular stakeholders

- *[To Non-Governmental Organizations (NGOs)]* Contribute to education and awareness raising campaigns and events against impaired driving, driving while drowsy and speeding.
- *[To vehicle manufacturers, other companies and research organisations]* Continue to develop and promote low cost solutions that can be incorporated in vehicles and can assist drivers.

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. The ESRA has become a global initiative which already conducted surveys in 46 countries across 6 continents. The outputs of the ESRA project have become building blocks of a global road safety monitoring system that goes beyond monitoring road traffic casualties and also includes indicators for possible underlying causal factors.

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. This will become a solid foundation for a joint global monitoring system on road safety attitudes and behaviour.

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# 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. |