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Driving under the influence of alcohol and drugs in 39 countries: self-reported behaviour, attitudes and enforcement from the ESRA3 survey

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Driving under the influence of alcohol and drugs in 39 countries: self-reported behaviour, attitudes and enforcement from the ESRA3 survey

Abstract

Driving under the influence (DUI) of alcohol and drugs remains a major contributor to road deaths, yet comparable prevalence data are lacking in many countries. This study uses data from the third edition of the E-Survey of Road users' Attitudes (ESRA3), collected in 2023 among more than 37,000 adults in 39 countries. It compares self-reported DUI, related norms and attitudes, support for policy measures and experienced enforcement among car drivers in Europe, the Americas and Asia-Oceania. Self-reported driving above the legal alcohol limit in the past 30 days ranged from 1.2% (Kyrgyzstan) to 24.1% (Luxembourg), and driving after taking drugs from 1.3% (Serbia) to 37.0% (Thailand). Personal acceptability of DUI was low in all countries, but respondents consistently believed that others were more accepting of drink-driving than they were themselves. Support for measures against drink-driving was high, with at least 62% in favour of each measure in every region. Experienced alcohol checks in the past 12 months ranged from 0.8% (Japan) to 41.6% (Serbia), while drug tests were far less common. Regional logistic regression models, adjusted for country and social desirability, showed that male gender, personal acceptability of drink-driving, high perceived behaviour control, a weak intention to refrain and low support for policy measures were consistently associated with self-reported drink-driving. For self-reported drug-driving, male gender, personal acceptability of drug-driving and, counter-intuitively, having been tested for drugs were associated with the behaviour in all regions, probably reflecting selective enforcement. In seven European countries, self-reported drink-driving correlated strongly with prevalence observed in roadside surveys ($r = 0.933$). Between ESRA2 and ESRA3, self-reported driving after drinking decreased in most countries, and experienced drug testing increased. The findings support the

use of harmonised self-report surveys as a complement to roadside and crash data for monitoring DUI and for tailoring national countermeasures.

Keywords: Drink-driving; Drug-driving; Self-reported behaviour; Enforcement; Social norms; Roadside survey; Cross-national survey; Road safety culture; ESRA

1 Introduction

Driving under the influence (DUI) of alcohol and drugs is a major cause of road casualties. Impairing substances slow reaction times, reduce alertness, impair judgement and diminish vision. The World Health Organization (WHO) estimates that around 20% of drivers involved in fatal crashes in high-income countries have a blood alcohol concentration (BAC) above the legal limit, while in low- and middle-income countries alcohol has been found in 33% to 69% of fatally injured drivers [1]. At the same time, drink-driving data are incomplete in many countries, often rely on crash reports that under-represent the problem, and are recorded according to definitions that differ between countries [1–3]. For drugs, the WHO estimated that about 3% of road deaths worldwide in 2013 were linked to illicit drug use, compared with about 15% for alcohol [4]. In the European Union, around 25% of all road deaths are estimated to be alcohol-related, and crash risk rises steeply with BAC; for some drugs, and for combinations of drugs and alcohol, crash risk can be at least five times higher than for sober driving [5]. The updated European overview estimates that around 1.5% to 2% of the kilometres driven in the EU are driven by drivers above the legal alcohol limit, while pilot roadside surveys in several countries found drugs in 6% to 11% of drivers [6]. For cannabis, the substance most often involved in drug-driving, meta-analyses point to a modest but significant increase in crash risk, with considerable uncertainty due to methodological bias in the underlying studies [7]. Assessing the role of drugs is more complex than for alcohol, because many substances with

48 different effects can impair driving, new substances keep appearing, and detection is more
49 difficult.
50 Reliable and comparable data are essential to understand the size of the problem, to monitor
51 developments and to evaluate countermeasures. Roadside surveys provide the most direct
52 measure of prevalence, as in recent European projects (e.g., Trendline [8]; Baseline [9]), but
53 they are costly, available for only a limited number of countries and often based on different
54 methods. The European Trendline project, for instance, recommends random breath testing as
55 the reference method for the alcohol key performance indicator and accepts surveys as an
56 alternative where roadside testing is not possible. Its results also show how strongly the
57 different methods affect the estimate: 0.2% to 2.2% of randomly tested drivers were above the
58 legal limit, compared with 7% to 13% of drivers who reported having possibly driven above
59 the limit in the past 30 days, and 0.5% or less in trip-based surveys [8]. Together with other
60 studies based on observed or self-reported behaviour in other regions of the world [10–14],
61 they show that the prevalence of DUI varies widely between countries. Several explanations
62 have been suggested for these differences (e.g., [4, 15, 16]), including attitudes towards alcohol
63 and drug use in the general population, the acceptability and perceived social norms related to
64 DUI, differences in legal frameworks, and the intensity and perception of enforcement**.** Recent
65 population surveys in Germany confirm that drink-driving is reported more often by men and,
66 in one study, by younger drivers [17, 18], and a comparison of cities in six countries found that
67 self-reported drink-driving among drivers who drink ranged from 12% in China to 53% in
68 South Africa [19].
69 Socio-cognitive models help to understand these motivational factors. The theory of planned
70 behaviour (TPB) [20] explains behaviour through attitudes, subjective norms, perceived
71 behaviour control (PBC) and intention. It is widely used to study unsafe traffic behaviour (e.g.,
72 [21–24]) and is one of the key building blocks of traffic safety culture models (e.g., [25]). A

recent meta-analysis confirmed that attitudes, subjective norms and PBC explain drink-driving intentions well, whereas the role of perceived risk of apprehension was ambiguous [26]. Enforcement is expected to deter DUI by increasing the perceived likelihood of being caught. However, the relation between enforcement and self-reported DUI at the individual level is not straightforward, because police checks are often targeted at situations and road users with a higher risk of impairment (see e.g., [27]).

Online self-report surveys can collect such information in a harmonised way across many countries at relatively low cost, covering not only behaviour but also the norms, attitudes, policy support and enforcement experiences that underlie it. Their main weakness is that self-reports can be affected by social desirability and recall bias, and their correspondence with observed behaviour has rarely been tested across countries [28]. A systematic review of 41 survey studies using self-report measures of alcohol-impaired driving found that only 13 reported the reliability of these measures and none assessed their validity, for instance against measured BAC [29]. The E-Survey of Road users' Attitudes (ESRA) was set up to collect comparable data on road safety performance and road safety culture. Results on DUI from the first two ESRA editions were published in earlier reports [11, 30, 31], and the ESRA1 results were also summarised in a cross-national synthesis [32]. Analyses of the first wave of ESRA2 in 32 countries showed that drug-driving was reported less often in Europe than in other regions, and that personal and perceived social acceptance were the strongest predictors of drug-driving [33].

This paper builds on and extends the ESRA3 thematic report on DUI [34]. It uses ESRA3 data from 39 countries to address four questions: (1) how self-reported DUI of alcohol and drugs, and the related norms, attitudes, policy support and enforcement experiences, vary across countries, regions, gender and age groups; (2) which factors are associated with self-reported DUI of alcohol and of drugs when socio-demographic characteristics and social desirability are

controlled for; (3) whether national rates of self-reported drink-driving correlate with the prevalence observed in roadside surveys; and (4) how self-reported drink-driving and experienced enforcement changed between ESRA2 and ESRA3.

2 Methods

2.1 The ESRA3 survey

ESRA is a joint initiative of road safety institutes, research centres, public services and private sponsors. It is coordinated by [institute removed for anonymous review] together with a steering group of ten partners: BASt (Germany), DTU (Denmark), IATSS (Japan), ITS (Poland), KFV (Austria), NTUA (Greece), PRP (Portugal), SWOV (the Netherlands), TIRF (Canada) and University Gustave Eiffel (France). At the heart of ESRA is a jointly developed questionnaire, which in ESRA3 was translated into 49 national language versions. It covers self-reported behaviour, attitudes and opinions on unsafe traffic behaviour, enforcement experiences and support for policy measures for different road user groups [28, 34].

ESRA3 data were collected in 2023 through online panel surveys, aiming at 1,000 respondents per country. The national samples were representative of the adult population aged 18–74 years in terms of gender and age, based on interlaced quotas for gender and six age groups (18–24, 25–34, 35–44, 45–54, 55–64 and 65–74 years) [35]. In four countries (Armenia, Kyrgyzstan, Luxembourg and Uzbekistan), the target was reduced to 500 respondents because larger samples were not feasible. In Armenia, Kyrgyzstan and Uzbekistan, no suitable online panels were available, and respondents were interviewed face-to-face using computer-assisted personal interviewing (CAPI). In total, more than 37,000 road users from 39 countries took part. The participating countries were grouped into three regions. Europe comprised Austria, Belgium, Bosnia and Herzegovina, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Poland, Portugal, Serbia,

Slovenia, Spain, Sweden, Switzerland and the United Kingdom. The Americas comprised Brazil, Canada, Chile, Colombia, Mexico, Panama, Peru and the United States. Asia-Oceania comprised Armenia, Australia, Israel, Japan, Kazakhstan, Kyrgyzstan, Thailand, Türkiye and Uzbekistan. The data collection, sampling, questionnaire and data cleaning are described in detail in the ESRA3 methodology report [36], and further results on DUI are presented in the ESRA3 thematic report on driving under the influence [34].

2.2 Measures

The analyses focus on car drivers. Self-reported DUI was measured by asking how often, over the last 30 days, respondents had driven (a) after drinking alcohol, (b) when they may have been over the legal limit for drinking and driving, and (c) within 1 hour after taking drugs other than prescribed or over-the-counter medication. Answers on a 5-point scale from 1 (never) to 5 ((almost) always) were dichotomised into never versus at least once. Personal acceptability and perceived social acceptability (whether most other people where the respondent lives would find the behaviour acceptable) were measured on a 5-point scale and dichotomised into acceptable (4–5) versus unacceptable or neutral (1–3). One attitude item ("For short trips, one can risk driving under the influence of alcohol"), one intention item ("I intend not to drive after drinking alcohol in the next 30 days") and three PBC items on the ability to drive after drinking a small amount of alcohol, when a little drunk after a party, or after drinking a large amount of alcohol were rated from 1 (disagree) to 5 (agree) and dichotomised into agree (4–5) versus disagree or neutral (1–3).

Support for three legal measures against drink-driving (zero tolerance for all drivers of motorised vehicles, zero tolerance for novice drivers, and an alcohol interlock for drivers caught drink-driving more than once) and for zero tolerance for cyclists was rated from 1 (oppose) to 5 (support), with 4–5 coded as support. The perceived likelihood of being checked by the police for alcohol or drugs on a typical journey was rated on a 7-point scale, with 5–7

147 coded as likely. Experienced enforcement was measured as the number of police checks for
148 alcohol and for drugs in the last 12 months, dichotomised into never versus at least once. Social
149 desirability was measured with the six-item Social Desirability–Gamma Short Scale (KSE-G),
150 which covers exaggerating positive qualities and minimising negative qualities [37]. The
151 dichotomised variables were used for the descriptive analyses. In the regression models,
152 perceived behaviour control and support for policy measures were entered as composite scores,
153 calculated as the mean of the three PBC items and the mean of support for the three legal
154 measures for drivers (zero tolerance for all drivers, zero tolerance for novice drivers and the
155 alcohol interlock), respectively (range 1–5; higher scores indicating more perceived control
156 and stronger support). The two KSE-G sub-scales were likewise entered as mean scores (range
157 1–5).

158 ***2.3 Analysis***

159 Data were weighted to correct for small deviations from national population distributions by
160 gender and six age groups (18–24, 25–34, 35–44, 45–54, 55–64 and 65–74 years) [35].
161 Regional means additionally took the population size of each country into account. Three
162 regional means were used: Europe22 (22 countries), America8 (eight countries) and
163 AsiaOceania6 (six countries). Armenia, Kyrgyzstan and Uzbekistan were excluded from the
164 AsiaOceania6 mean because of the different data collection method, but their national results
165 are reported.

166 Differences between regions, genders and age groups were tested with chi-square tests for
167 independence and pairwise comparisons, and effect sizes were expressed as Cramér's V [38].
168 Because of the large sample, only differences with $p < 0.01$ were considered statistically
169 significant in the descriptive analyses. Associations at country level were assessed with Pearson
170 correlation coefficients (r). These correlations between ESRA3 indicators were based on the
171 36 countries with online data collection; Armenia, Kyrgyzstan and Uzbekistan were excluded

because of the different data collection method. Because country-level correlations are based on a small number of units, $p < 0.05$ was used as the significance threshold for these analyses. Binary logistic regression models were estimated separately for each region to identify factors associated with self-reported DUI of alcohol above the legal limit and with self-reported DUI of drugs in the past 30 days. The models included car drivers who had driven at least a few days a month in the past 12 months. Variables were entered in two blocks. Block 1 contained gender, age group, educational level, household income, level of urbanisation and driving frequency. Block 2 contained, for alcohol, personal and perceived social acceptability, attitude, a PBC composite score, intention, a policy-support composite score, perceived likelihood of enforcement and experienced enforcement; for drugs, it contained personal acceptability, perceived likelihood of enforcement and experienced enforcement. All models were adjusted for country and for the two KSE-G sub-scores. Odds ratios (OR) are reported with 99% confidence intervals (CI), and model fit with Nagelkerke R^2. As in the descriptive analyses, only associations with $p < 0.01$ (i.e., 99% CIs not including 1) were considered statistically significant; associations with p between 0.01 and 0.05 are marked in the tables for information only.

To assess the correspondence between self-reported and observed behaviour, national ESRA3 results were correlated with the key performance indicator on drink-driving from the Baseline project, which reports the percentage of car drivers driving within the legal BAC limit in EU Member States [9]. For the analysis, its complement was used, i.e., the percentage of car drivers above the legal BAC limit. To ensure comparability, only countries with data collected through random roadside breath tests by the police were included. Seven countries met this criterion: Belgium, Greece, Latvia, Luxembourg, Poland, Portugal and Spain.

For the comparison over time, ESRA2 results were recalculated to match the ESRA3 population (adults aged 18–74 years), data cleaning rules and reference populations [36, 39]. Only items with the same wording and answer scale were compared, and only at country level, because the composition of the regions differed between editions. Changes were assessed using 95% confidence intervals. Analyses were carried out in SPSS 29.0 [40] and R 4.3.1 [41].

During the preparation of this paper, the authors used a large language model (Claude Opus 5.5, Anthropic) to condense the underlying ESRA3 thematic report into a shorter manuscript, to assist with drafting, and for language editing (grammar, clarity, consistency and concision). After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication. The data collection, all statistical analyses, the original figures and the underlying ESRA3 thematic report were produced by the authors themselves; the tool was also used for the technical preparation of the figure files (cropping of titles and notes).

3 Results

3.1 Self-reported DUI of alcohol and drugs

Driving when possibly over the legal alcohol limit in the past 30 days was reported by 14.0% of car drivers in America8, which was significantly more than in Europe22 (11.6%) and AsiaOceania6 (10.0%; $p < 0.001$, Cramér's $V = 0.039$). Driving after drinking any alcohol was reported by 15.4% in Europe22, 17.4% in America8 and 11.3% in AsiaOceania6. Driving within 1 hour after taking drugs was reported significantly less often in Europe22 (7.2%) than in America8 (13.3%) and AsiaOceania6 (11.8%; $p < 0.001$, Cramér's $V = 0.093$). In all regions, drink-driving was reported mostly during weekend nights, and cannabis was the substance most often mentioned by drug-drivers (for details, see [28]).

National rates varied strongly (Fig. 1). In Europe22, self-reported drink-driving above the legal limit ranged from 4.2% in Poland to 24.1% in Luxembourg, and drug-driving from 1.3% in Serbia to 10.1% in the United Kingdom. In America8, the corresponding ranges were 10.5% (Canada) to 20.5% (Mexico) and 6.0% (Panama) to 17.3% (United States). In Asia-Oceania, Thailand was a clear outlier, with 23.2% reporting drink-driving above the limit and 37.0% reporting drug-driving; in the other countries of this region, including the three countries with face-to-face data collection, rates ranged from 1.2% (Kyrgyzstan) to 15.8% (Uzbekistan) for alcohol and from 1.6% (Armenia) to 13.6% (Uzbekistan) for drugs.

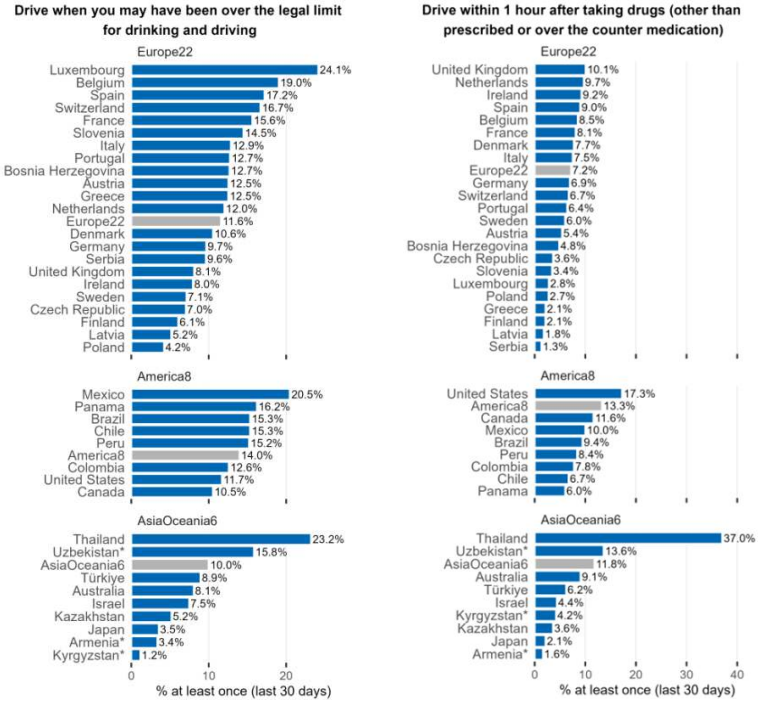


Fig. 1 Self-reported drink-driving and drug-driving as a car driver, by country

Left: driving when possibly over the legal alcohol limit; right: driving within 1 hour after taking drugs (other than prescribed or over-the-counter medication); % at least once in the last 30 days. Reference population: car drivers at least a few days a month. Grey bars show regional means; countries marked with an asterisk are not included in the regional mean (different data collection method).

Men reported DUI more often than women in all regions. The differences were largest in America8, where 19.6% of male and 7.9% of female drivers reported drink-driving above the legal limit ($p < 0.001$, Cramér's $V = 0.169$), and 17.1% versus 9.2% reported drug-driving (p

235 < 0.001, Cramér's V = 0.116). In AsiaOceania6, the gender difference was not significant for
236 drug-driving. In Europe22, self-reported DUI generally decreased with age, whereas age
237 patterns were less clear in the other regions.

238 ***3.2 Acceptability, attitude, intention and perceived behaviour control***

239 The large majority of road users considered DUI unacceptable: across countries, personal
240 acceptability of drink-driving above the legal limit ranged from 0.6% (Armenia) to 5.6%
241 (Thailand), and that of drug-driving from 0.2% (Armenia) to 8.8% (Thailand). Acceptability
242 was significantly higher in America8 than in Europe22, both for alcohol above the legal limit
243 (3.7% vs. 2.7%; $p < 0.01$, Cramér's V = 0.026) and for drugs (4.0% vs. 2.6%; $p < 0.001$,
244 Cramér's V = 0.036). Countries with high acceptability of one form of DUI tended to show
245 high acceptability of the others; in Europe22 the highest rates were found in Austria and in
246 America8 in the United States. Acceptability was often more than twice as high among men as
247 among women in Europe22 and America8, while no significant gender differences were found
248 in AsiaOceania6.
249 Perceived social acceptability of drink-driving above the legal limit ranged from 1.9% (Czech
250 Republic, Armenia) to 9.6% (Luxembourg). In every country except Israel, respondents
251 thought that others were more accepting of drink-driving than they were themselves. At country
252 level, perceived social acceptability and personal acceptability were strongly correlated ($r =$
253 0.778, $p < 0.001$; Fig. 2).



Fig. 2 Perceived social versus personal acceptability of drink-driving above the legal limit, by country

% of road users who consider driving when possibly over the legal alcohol limit acceptable, at country level. Reference population: all road users. Armenia, Kyrgyzstan and Uzbekistan not included (different data collection method). r: Pearson correlation coefficient.

Few car drivers agreed that "for short trips, one can risk driving under the influence of alcohol", but agreement was significantly lower in Europe22 (2.8%) than in America8 (5.9%) and AsiaOceania6 (7.8%; $p < 0.001$, Cramér's $V = 0.096$). National values ranged from 0.8% (Poland) to 7.3% (Mexico), with Thailand as an outlier at 24.8%. The intention not to drink and drive in the next 30 days was highest in Europe22 (73.3%), followed by America8 (69.7%) and AsiaOceania6 (64.6%; $p < 0.001$, Cramér's $V = 0.069$), with national values ranging from 29.4% (Uzbekistan) to 84.7% (Czech Republic).

Perceived ability to drive after drinking depended clearly on the amount of alcohol (Fig. 3). Between 10.6% (AsiaOceania6) and 19.0% (Europe22) of car drivers trusted themselves to drive after drinking a small amount of alcohol, whereas only 2.9% to 4.4% considered themselves able to drive after drinking a large amount. Trust in driving after a small amount of

alcohol varied widely between countries, from 2.2% in Japan to 36.9% in Greece. In all regions, men reported higher PBC than women.

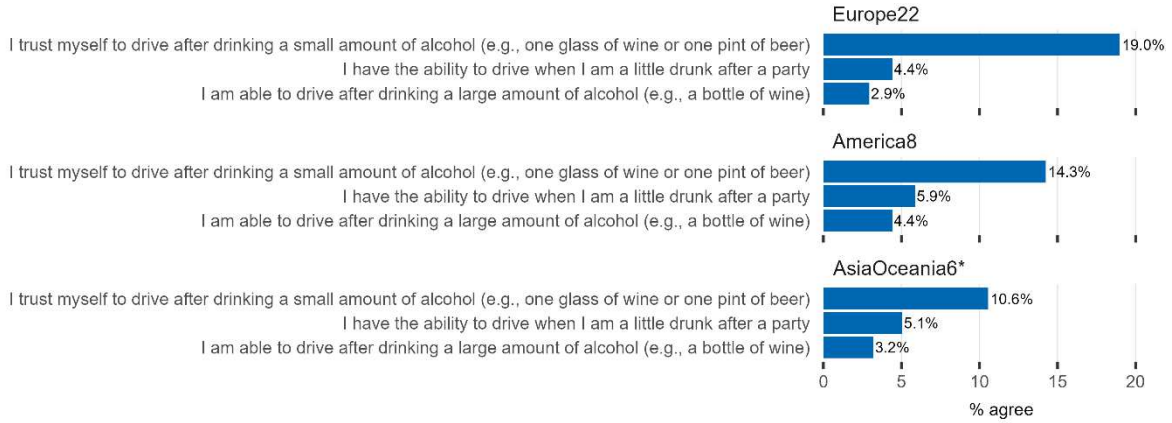


Fig. 3 Perceived behaviour control related to drink-driving, by region (% agree)

Reference population: car drivers at least a few days a year. AsiaOceania6 does not include Armenia, Kyrgyzstan and Uzbekistan (different data collection method).

3.3 Support for policy measures

Support for legal measures against drink-driving was high in all regions, with at least 62% in favour of each measure (Fig. 4). In America8 and AsiaOceania6, the most strongly supported measure was an alcohol interlock for drivers caught drink-driving more than once (82.4% and 80.0%); in Europe22, zero tolerance for novice drivers received the highest support (78.3%), closely followed by the interlock (76.4%). Zero tolerance for all drivers was the least supported measure for drivers (Europe22: 65.8%; America8: 73.6%; AsiaOceania6: 71.2%), and zero tolerance for cyclists received even less support (Europe22: 62.5%; America8: 71.1%; AsiaOceania6: 68.0%). Variation between countries was largest in Europe22, where support for zero tolerance for all drivers ranged from 42.8% in Luxembourg to 74.7% in Serbia. Women supported the measures more than men, and in Europe22 support increased with age.

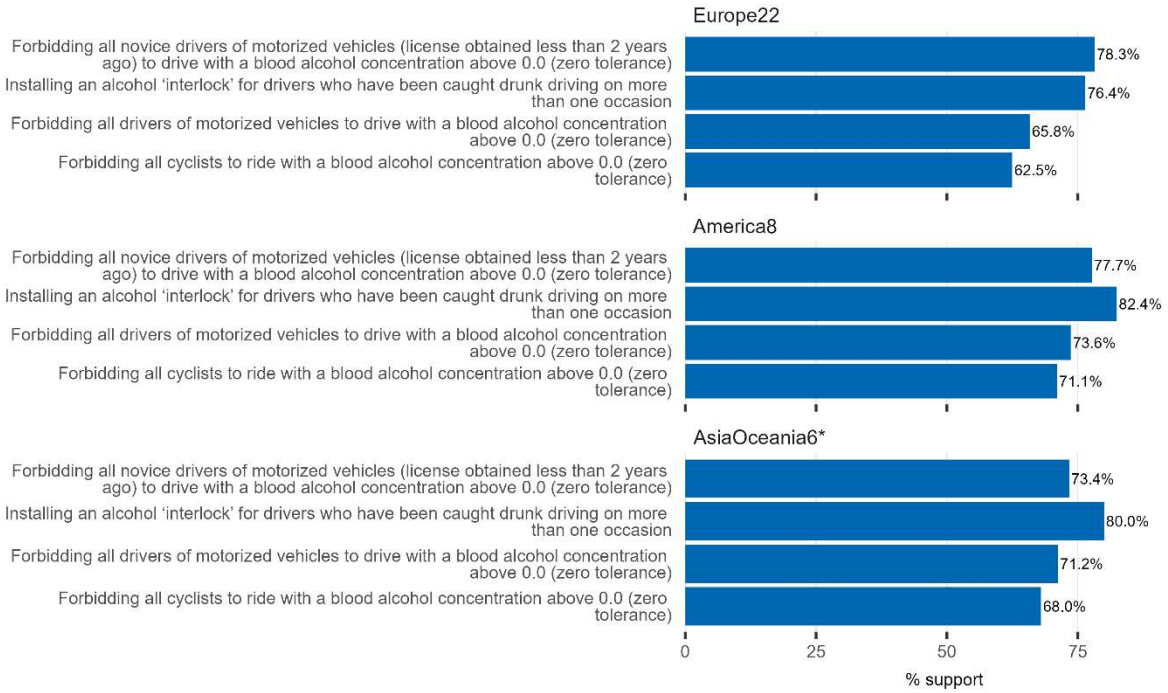


Fig. 4 Support for policy measures against drink-driving, by region (% support)

Reference population: all road users. AsiaOceania6 does not include Armenia, Kyrgyzstan and Uzbekistan (different data collection method).

3.4 Perceived and experienced enforcement

In all countries, car drivers considered a police check for alcohol more likely than one for drugs. The perceived likelihood of an alcohol check on a typical journey was significantly higher in AsiaOceania6 (30.1%) than in America8 (25.6%) and Europe22 (17.1%; $p < 0.001$, Cramér's $V = 0.127$), and the same pattern applied to drug checks (20.3%, 12.4% and 10.9%; $p < 0.001$, Cramér's $V = 0.098$).

Experienced enforcement showed a different pattern (Fig. 5). The share of car drivers checked for alcohol at least once in the past 12 months did not differ significantly between regions (Europe22: 18.8%; America8: 20.7%; AsiaOceania6: 17.5%), but varied strongly between countries, from 0.8% in Japan to 41.6% in Serbia. Drug tests were reported by far fewer drivers in every country, ranging from 0.5% in Japan to 12.6% in Peru, and were significantly more common in America8 (8.2%) than in Europe22 (5.5%) and AsiaOceania6 (5.8%; $p < 0.001$, Cramér's $V = 0.046$). In eight countries, the difference between alcohol and drug checks

exceeded 30 percentage points. Male drivers reported more checks in all regions, and younger drivers in most.

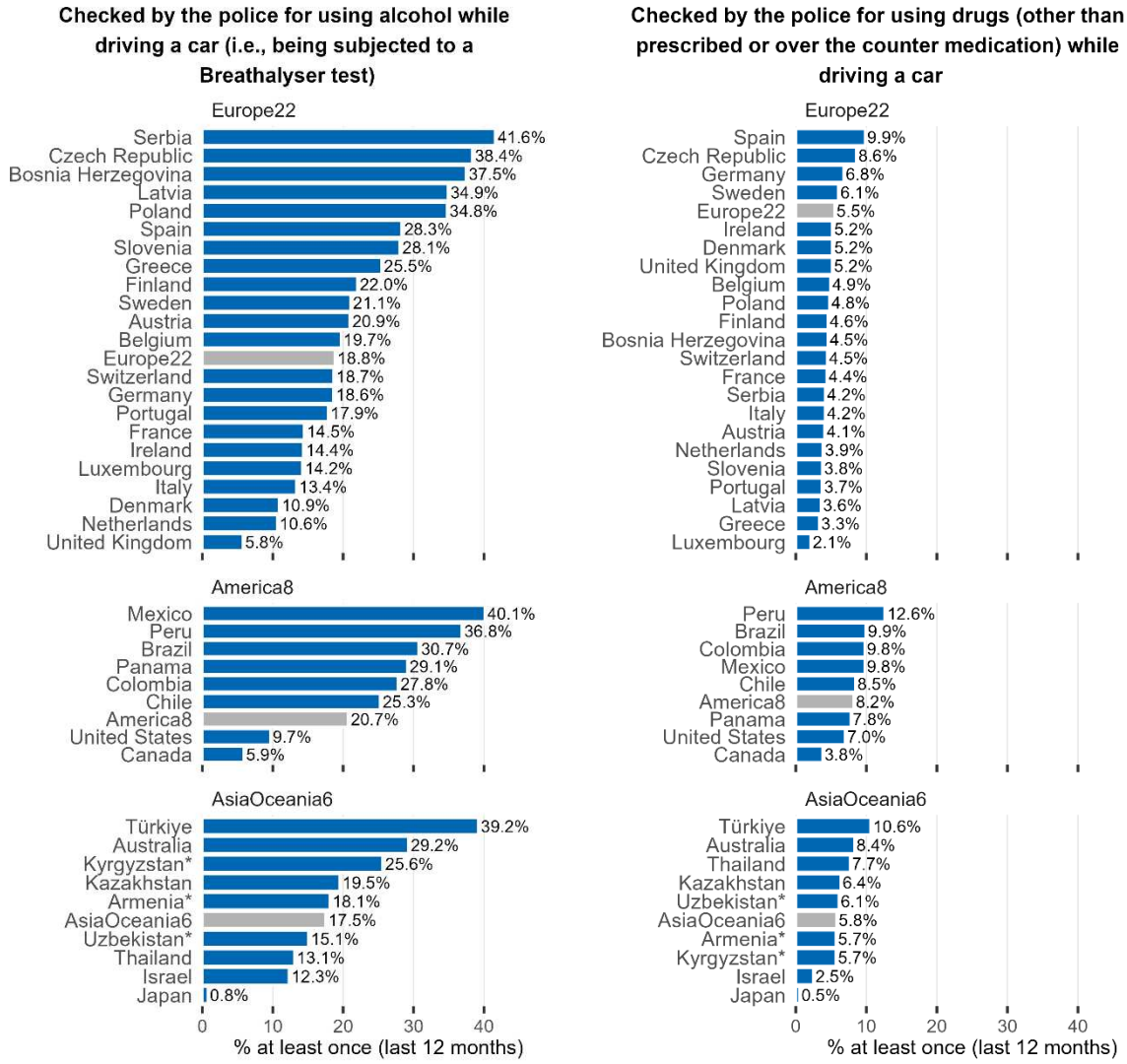


Fig. 5 Experienced alcohol checks and drug tests by the police as a car driver, by country

Left: alcohol checks; right: drug tests; % at least once in the last 12 months. Reference population: car drivers at least a few days a year. Grey bars show regional means; countries marked with an asterisk are not included in the regional mean (different data collection method).

At country level, the percentage of drivers who had been checked was moderately correlated with the perceived likelihood of being checked, both for alcohol ($r = 0.348$, $p = 0.037$) and for drugs ($r = 0.353$, $p = 0.035$). Kyrgyzstan, which was not included in the correlation because of its different data collection method, shows that the two do not necessarily go together: drivers

315 there perceived the highest likelihood of alcohol checks (57.8%) but reported checks at a level
316 close to the median (25.6%).

317 ***3.5 Factors associated with self-reported DUI***

318 Table 1 presents the regional models for self-reported drink-driving above the legal limit.
319 Nagelkerke R^2 ranged from 0.38 to 0.41 (0.411 in Europe22, 0.384 in America8 and 0.400 in
320 AsiaOceania6). In all regions, the odds of drink-driving were higher for men (OR = 1.60 to
321 2.29) and for drivers who found drink-driving personally acceptable (OR = 2.89 to 7.10).
322 Drivers who believed that others found drink-driving acceptable also had higher odds in
323 Europe22 (OR = 2.04) and America8 (OR = 2.43); in AsiaOceania6 the estimate pointed in the
324 same direction but was not significant (OR = 1.96). PBC showed a strong and consistent
325 association: each point on the 1–5 composite score was associated with odds of drink-driving
326 that were 2.62 to 2.81 times higher. A stronger intention not to drink and drive (OR = 0.45 to
327 0.76) and stronger support for policy measures (OR = 0.70 to 0.78) were associated with lower
328 odds. In Europe22, older drivers, drivers living in urban areas and those with a risky attitude
329 towards short trips also showed significant associations, as did drivers who drive frequently.
330 Drivers who had been checked for alcohol in the past 12 months were more likely to report
331 drink-driving in Europe22 (OR = 1.59); in America8 the estimate pointed in the same direction
332 but was not significant (OR = 1.25). Higher social desirability scores were associated with
333 lower odds of self-reported drink-driving: minimising negative qualities in all regions (OR =
334 0.70 to 0.71) and exaggerating positive qualities in Europe22 and America8 (OR = 0.80 and
335 0.77).

336 [Table 1 about here]

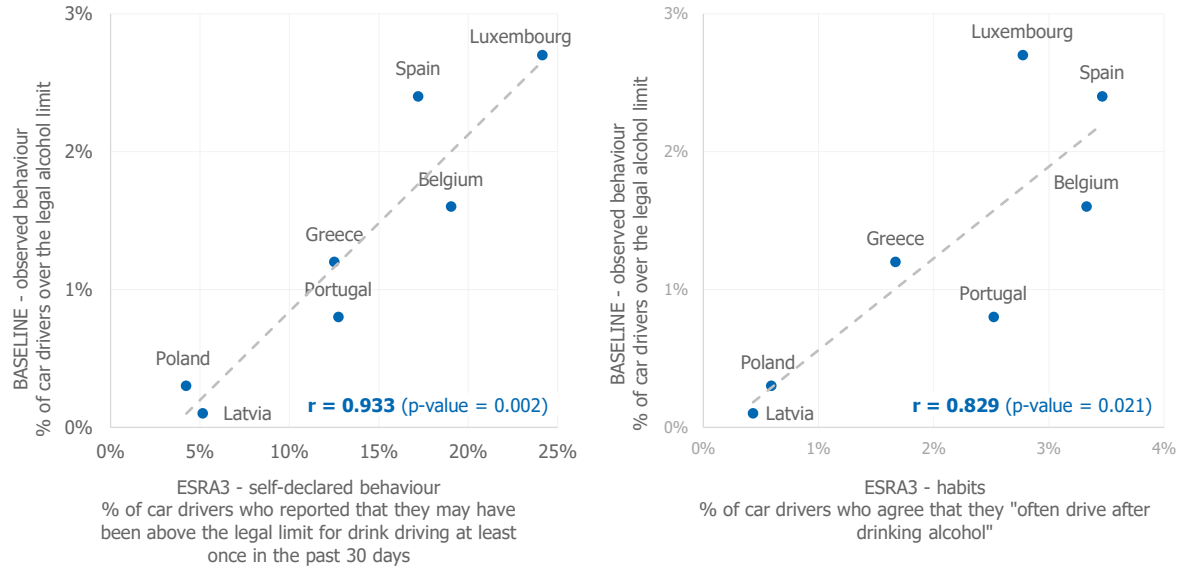
337 For the models for self-reported drug-driving (Table 2), Nagelkerke R^2 ranged from 0.27 to
338 0.37 (0.314 in Europe22, 0.274 in America8 and 0.367 in AsiaOceania6). Men were more

likely to report drug-driving in all regions (OR = 1.38 to 1.58). In Europe22, the odds decreased clearly with age (OR = 0.39 for drivers aged 65–74 compared with those aged 18–24), whereas in America8 drivers aged 25–44 had higher odds than the youngest group. Personal acceptability of drug-driving was by far the strongest correlate (OR = 10.44 to 16.22). Drivers who had been tested for drugs in the past 12 months were much more likely to report drug-driving in all regions (OR = 2.34 to 4.89), and a higher perceived likelihood of drug checks was associated with higher odds in Europe22 and America8 (OR = 1.75). As for alcohol, higher social desirability scores were associated with lower odds of reporting the behaviour (OR = 0.52 to 0.76).

[Table 2 about here]

3.6 Self-reported versus observed drink-driving

In the seven countries with comparable Baseline data, the prevalence of drivers above the legal BAC limit observed in roadside surveys was strongly and positively correlated with self-reported drink-driving above the legal limit in ESRA3 ($r = 0.933$, $p = 0.002$) and with the self-reported habit of driving after drinking alcohol ($r = 0.829$, $p = 0.021$; Fig. 6). Countries with a high observed prevalence thus also had a high self-reported prevalence, and vice versa.



355 **Fig. 6** Observed versus self-reported drink-driving above the legal alcohol limit, at country
356 level

357 Observed: share of drivers above the legal BAC limit in Baseline roadside surveys. Self-reported (ESRA3): drink-driving
358 above the legal limit in the past 30 days (left) and habit of driving after drinking alcohol (right). r: Pearson correlation
359 coefficient. Notes from the Baseline report: minimum sample not achieved for all strata in Greece; minimum number of
360 locations per stratum not achieved in Latvia and Luxembourg; no weighting used in Luxembourg; motorways not included in
361 Latvia and Poland.

362 ***3.7 Changes between ESRA2 and ESRA3***

363 Of the 26 countries that took part in both editions, all were included in the comparison of
364 enforcement experiences, while Colombia and Thailand were excluded from the comparison
365 of drink-driving because the wording differed in ESRA2.

366 In the 24 countries with comparable data, the share of car drivers reporting drink-driving above
367 the legal limit increased in 13 countries and decreased in 11, but the change was statistically
368 significant only in the Netherlands (from 7.3% to 12.0%). Driving after drinking any alcohol,
369 by contrast, decreased in 21 of the 24 countries, significantly so in 12 (Fig. 7). Large decreases
370 were observed in Australia (22.4% to 12.7%), Greece (29.8% to 17.3%), Switzerland (33.5%
371 to 22.6%) and the United States (21.2% to 14.1%).

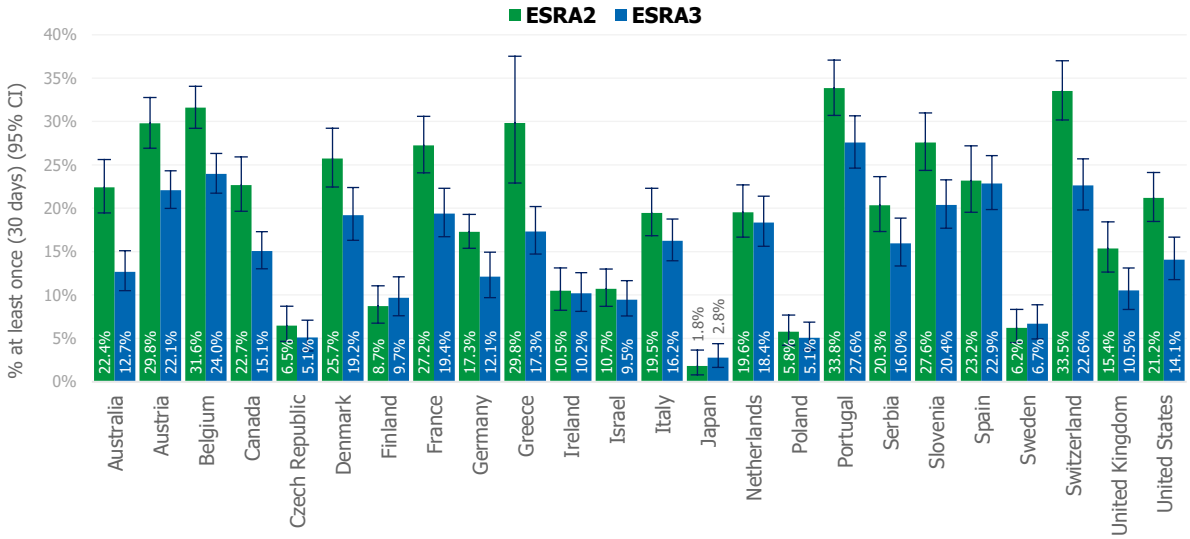


Fig. 7 Self-reported driving after drinking alcohol as a car driver in ESRA2 and ESRA3, by country

% at least once in the past 30 days, ± 95% confidence intervals. ESRA2 results recalculated for comparability with ESRA3.

Experienced alcohol checks increased significantly in four of 26 countries (Germany, Italy, Switzerland and the United States), decreased significantly in six (Australia, Finland, Ireland, Japan, Poland and Thailand) and did not change significantly in 16. Experienced drug tests increased in 24 of the 26 countries, significantly in eight: Belgium, Denmark, France, Germany, Israel, Sweden, the United Kingdom and the United States (Fig. 8). In Germany, for example, the share of drivers tested for drugs rose from 1.9% to 6.8%, and in the United States from 1.8% to 7.0%.

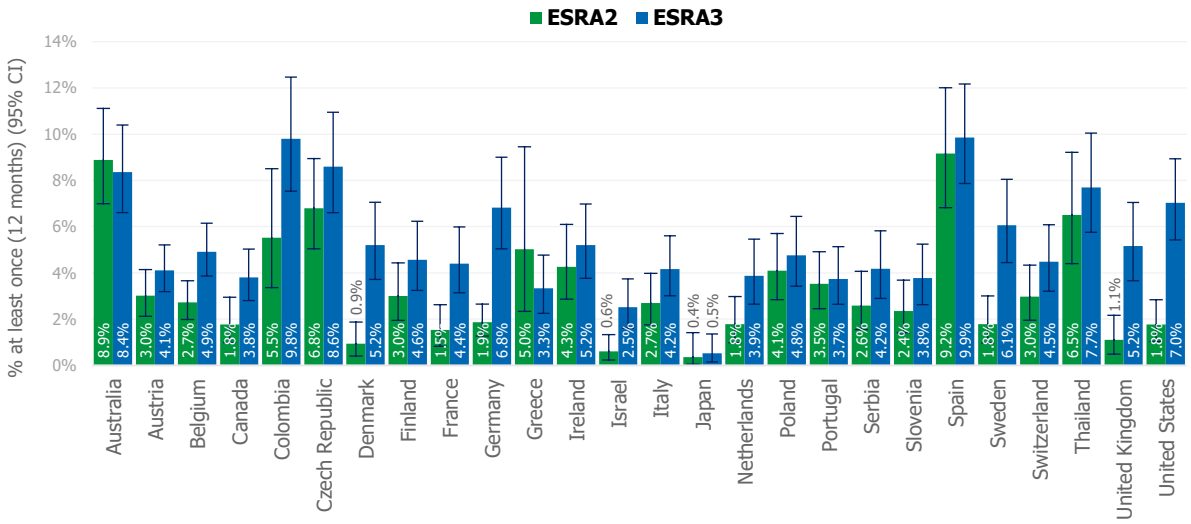


Fig. 8 Experienced police drug tests as a car driver in ESRA2 and ESRA3, by country

% at least once in the past 12 months, ± 95% confidence intervals. ESRA2 results recalculated for comparability with ESRA3. In ESRA2, respondents could also choose not to answer (0.2% of the sample), and the question referred to drugs "other than medication" instead of "other than prescribed or over-the-counter medication".

4 Discussion

4.1 Cross-national variation in DUI

The ESRA3 results confirm that DUI of alcohol and drugs remains common and varies strongly between countries. Between one in ten and one in seven car drivers per region reported having driven when possibly over the legal alcohol limit in the past month, with national rates ranging from about 1% to 24%. The very high rates in Thailand, for both alcohol and drugs, and the high drink-driving rate in Luxembourg stand out and deserve further investigation at national level. Differences in legal BAC limits, drinking cultures, enforcement practices and survey methods may all contribute to these differences. Drug-driving was reported less often than drink-driving above the legal limit in Europe22, but about as often in America8 and AsiaOceania6, which suggests that drug-driving deserves more attention in policy and monitoring than it currently receives in many countries. This regional pattern is consistent with

ESRA2 results [33]. Since cannabis was the substance most often mentioned by drug-drivers in ESRA3, it is also relevant that driving after cannabis use is generally viewed more favourably and as less dangerous than drink-driving, and that the perceived risk of apprehension for it is low to moderate and lower than for drink-driving [42].

4.2 Norms, attitudes and perceived behaviour control

Personal acceptability of DUI was low everywhere, yet in almost all countries respondents overestimated how acceptable others found drink-driving. Such a gap between personal and perceived social norms is relevant for prevention, because perceived norms were independently associated with self-reported drink-driving in Europe22 and America8, with a similar tendency in AsiaOceania6. Communication that corrects the misperception that drink-driving is widely accepted could therefore complement deterrence-based campaigns. Research among young drivers, based on Social Norm Theory [43], points partly in the same direction: drivers' own approval of next-day drink-driving and the belief that friends also engage in it were associated with their own next-day drink-driving, whereas perceived approval by friends and family was not [44]. PBC was one of the strongest correlates of self-reported drink-driving: many drivers, especially in Europe22 (19.0%) and most of all in Greece (36.9%), trusted themselves to drive after drinking a small amount of alcohol. This finding is in line with TPB-based research on DUI (e.g., [21–24]) and with a recent meta-analysis showing that PBC is a key determinant of drink-driving intentions [26] and suggests that campaigns should address drivers' overconfidence in their ability to drive after moderate drinking, not only heavy drinking. The very strong association between personal acceptability and self-reported drug-driving points in the same direction. It also mirrors the ESRA2 finding that acceptance was the strongest predictor of drug-driving [33], and the systematic review by Boicu et al. [42], which found that favourable attitudes towards driving after cannabis use were associated with past and intended behaviour.

4.3 Enforcement

Alcohol checks were experienced far more often than drug tests in every country, although drug tests became more common between ESRA2 and ESRA3. The positive association between having been checked and self-reported DUI, particularly for drugs, should not be read as a counterproductive effect of enforcement. It is more likely to reflect the selectivity of police checks, which are often targeted at drivers, times and places with a higher risk of impairment (see e.g., [27]). The cross-sectional design does not allow conclusions on causality. The mismatch between perceived and experienced enforcement, especially in AsiaOceania6 and in Kyrgyzstan, shows that perceived likelihood of being checked is shaped not only by actual checks but also by their visibility and by the general perception of police presence. In an Australian study, exposure to random breath testing was not significantly related to the perceived certainty of being caught, although more exposure predicted a stronger intention not to drink and drive [45]. More generally, a recent meta-analysis found that the relation between perceived risk of apprehension and drink-driving intentions was ambiguous and notably under-researched. Previous offending and experiences of punishment avoidance were useful predictors of drink-driving intentions, whereas personal experience of punishment appeared to have a negligible impact [26]. Since deterrence depends on the perceived likelihood of being caught, highly visible random breath testing and drug testing remain important.

4.4 Validity of self-reported data

A key concern with self-report surveys is whether they reflect actual behaviour. The strong correlation between self-reported and observed drink-driving in seven European countries supports the use of ESRA data as an indicator of the relative level of drink-driving in a country, even though the analysis is exploratory and based on a small number of countries. This is relevant because evidence on the validity of self-report measures of alcohol-impaired driving is scarce [29]. The two measures are conceptually different: roadside surveys measure point

prevalence at one moment in time, whereas ESRA measures period prevalence over 30 days, so the absolute levels cannot be compared directly. The Trendline project similarly found much higher levels in 30-day self-report surveys than in random breath tests [8]. Trip-based self-report measures, which ask about randomly selected recent trips, may offer a way to obtain survey estimates that are closer to the point prevalence measured at the roadside [18]. The negative association between social desirability and self-reported DUI in all models indicates that self-reports probably underestimate the true prevalence and shows the value of including a social desirability scale in such surveys. Taken together, these results suggest that harmonised self-report surveys can complement roadside surveys, which are available for only a few countries, and crash data, which often under-record DUI.

4.5 Changes over time and implications

The decrease in self-reported driving after drinking in most countries between ESRA2 and ESRA3, and the increase in experienced drug testing, are encouraging. However, these changes should be interpreted with caution, because they may be influenced by remaining methodological differences between the editions and by the COVID-19 pandemic, which affected mobility and risky driving [46]. Future ESRA editions and national monitoring data are needed to confirm these trends.

The results support a comprehensive approach against DUI that combines legislation, enforcement, education, rehabilitation and research, and is tailored to the needs of each country [5]. The updated European Road Safety Observatory report highlights a broad set of countermeasures: policies to reduce the consumption of alcohol and drugs and their use before driving, strict legislation backed by police enforcement, the provision of alternative means of transport, awareness campaigns, rehabilitation courses, a safety culture in companies, alcohol interlocks, and in-vehicle technology that warns or intervenes when impairment leads to critical events. The report also stresses that measures work better in combination. For example, lower

BAC limits are effective mainly when combined with highly visible and frequent enforcement, preferably random breath testing, and alcohol interlock programmes are associated with a reduction in reoffending of about 75% while the device is installed [6]. The high public support for alcohol interlocks for repeat offenders and for zero tolerance for novice drivers found in ESRA3 indicates that there is room for stricter legislation in many countries. In line with this combined approach, further priorities include nationwide random breath and drug testing, testing all drivers involved in fatal crashes for alcohol and drugs, continuous awareness campaigns that target high-risk groups such as young men, and better cross-border data collection to improve benchmarking and trend monitoring.

4.6 Limitations

Several limitations should be noted (see also [36]). First, cultural differences may influence how respondents in different countries interpret and answer the questions [47]. Second, self-reported data are subject to social desirability, misunderstanding of questions and recall errors [48, 49]; social desirability was controlled for in the regression models but not in the descriptive results. Third, online panels can lead to selection and coverage bias. They may under-represent people without internet access or those less willing to take part in online surveys, such as older adults, and those who choose to participate may differ from non-respondents (non-response bias). In addition, people aged 75 years and older were not included in the survey population. Fourth, in Armenia, Kyrgyzstan and Uzbekistan, where no suitable online panels were available, data were collected face-to-face with smaller samples. These data are therefore not fully comparable with the online data and were not included in the regional means. Fifth, because of the large sample, small differences can reach statistical significance; most effect sizes were small. Finally, the data are cross-sectional, so the associations identified in the regression models do not imply causality.

5 Conclusions

Based on data from more than 37,000 road users in 39 countries, this study shows that DUI of alcohol and drugs remains widespread and varies strongly between countries, even though most people consider it unacceptable and strongly support measures against it. Male gender, personal acceptability of DUI, overconfidence in one's ability to drive after drinking and low support for policy measures were consistently associated with self-reported drink-driving across regions. National self-reported drink-driving rates were strongly correlated with roadside observations in the countries where both were available. Harmonised international surveys such as ESRA can therefore provide valuable benchmarks for monitoring DUI, complement roadside and crash data, and support the development of targeted, evidence-based countermeasures. Future ESRA editions will allow these findings to be monitored over time and the observed trends to be confirmed.

Abbreviations

BAC: blood alcohol concentration; CAPI: computer-assisted personal interviewing; CI: confidence interval; DUI: driving under the influence; ESRA: E-Survey of Road users' Attitudes; KSE-G: Social Desirability–Gamma Short Scale; OR: odds ratio; PBC: perceived behaviour control; TPB: theory of planned behaviour.

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Table 1 Factors associated with self-reported drink-driving above the legal limit as a car driver

Independent variables (reference categories)	Dependent variable: self-declared behaviour (past 30 days) - **drive when you may have been over the legal limit for drinking and driving** (0=never; 1=at least once)		
	Europe22	**America8**	**AsiaOceania6**
	Odds Ratio (CI99%)	Odds Ratio (CI99%)	Odds Ratio (CI99%)
BLOCK 1 – Sociodemographic			
Gender (Ref. female)			
Male	**2.29** (1.99-2.64)***	**2.23** (1.77-2.82)***	**1.60** (1.17-2.20)***
Age group (Ref. 18-24y)			
25-34y	**0.99** (0.78-1.25)	**1.42** (0.98-2.07)*	**0.89** (0.54-1.47)
35-44y	**0.94** (0.74-1.19)	**1.51** (1.02-2.22)**	**0.82** (0.49-1.36)
45-54y	**0.75** (0.59-0.96)**	**1.23** (0.82-1.85)	**0.75** (0.44-1.28)
55-64y	**0.70** (0.54-0.90)***	**0.99** (0.63-1.55)	**0.46** (0.24-0.89)**
65-74y	**0.68** (0.51-0.91)***	**0.72** (0.41-1.25)	**0.59** (0.29-1.22)
Educational level (Ref. secondary education or lower)			
Bachelor's degree or similar	**1.17** (1.00-1.37)*	**1.14** (0.85-1.52)	**0.95** (0.66-1.37)
Master's degree or higher	**1.21** (1.01-1.46)**	**1.30** (0.92-1.84)	**1.02** (0.59-1.75)
Household's income (Ref. living comfortably on present income)			
Coping on present income	**1.09** (0.93-1.29)	**1.07** (0.82-1.39)	**0.91** (0.62-1.32)
Finding it difficult on present income	**1.18** (0.97-1.44)*	**0.96** (0.68-1.36)	**1.02** (0.65-1.60)
Finding it very difficult on present income	**0.94** (0.67-1.30)	**0.75** (0.42-1.34)	**0.92** (0.48-1.76)
Level of urbanisation (Ref. rural)			
Urban/ semi-urban	**0.82** (0.71-0.96)***	**0.83** (0.57-1.21)	**0.94** (0.58-1.51)
Frequency of driving a car (Ref. a few days a month)			
1 to 3 days a week	**1.54** (1.21-1.95)***	**1.25** (0.91-1.72)	**1.27** (0.78-2.09)
at least 4 days a week	**1.32** (1.02-1.71)**	**1.31** (0.93-1.85)*	**1.36** (0.80-2.31)
BLOCK 2			
Acceptability (Ref. unacceptable/neutral)			
Perceived social acceptability of drink-driving above the legal limit (acceptable)	**2.04** (1.51-2.76)***	**2.43** (1.37-4.31)***	**1.96** (0.93-4.12)*
Personal acceptability of drink-driving above the legal limit (acceptable)	**2.89** (1.96-4.27)***	**7.10** (3.21-15.73)***	**3.34** (1.41-7.91)***
Attitude (Ref. disagree/neutral)			
For short trips, one can risk DUI of alcohol (agree)	**1.78** (1.25-2.53)***	**1.36** (0.84-2.22)	**1.29** (0.74-2.24)
Perceived behaviour control			
Composite score (1-5)[(1)]	**2.73** (2.50-2.97)***	**2.62** (2.27-3.03)***	**2.81** (2.32-3.39)***
Intention (Ref. disagree/neutral)			
I intend not to drive after drinking alcohol in the next 30 days (agree)	**0.45** (0.39-0.53)***	**0.76** (0.59-0.98)**	**0.62** (0.43-0.90)***
Support for policy measures			
Composite score (1-5)[(2)]	**0.75** (0.70-0.81)***	**0.78** (0.69-0.89)***	**0.70** (0.60-0.83)***
Enforcement perception (Ref. unlikely/neutral)			
Checked by the police for alcohol, in other words, being subjected to a Breathalyser test (likely)	**1.21** (0.99-1.47)*	**1.13** (0.85-1.51)	**1.20** (0.81-1.77)
Enforcement experience (Ref. never)			
Checked by the police for using alcohol while driving a car (i.e., being subjected to a Breathalyser test) (at least once in last 12 months)	**1.59** (1.33-1.89)***	**1.25** (0.94-1.67)*	**1.12** (0.72-1.73)
Social Desirability Scale[(3)]			
Exaggerating positive qualities (composite score 1-5)	**0.80** (0.73-0.88)***	**0.77** (0.67-0.90)***	**0.85** (0.69-1.04)*
Minimizing negative qualities (composite score 1-5)	**0.71** (0.65-0.78)***	**0.70** (0.61-0.81)***	**0.70** (0.59-0.84)***
Sample size	16575	5454	3694
Nagelkerke R^2	0.411	0.384	0.400

Binary logistic regression models by region. Reference population: car drivers at least a few days a month. Models adjusted for country and for the Social Desirability Scale. * $p < 0.05$ (shown for information only; not considered significant, see Methods), ** $p < 0.01$, *** $p < 0.001$. (1) Perceived behaviour control: mean of three items on the ability to drive after drinking a small amount, when a little drunk after a party and after a large amount of alcohol (1–5; higher = more perceived control). (2) Support for policy measures: mean of support for zero tolerance for all drivers, zero tolerance for novice drivers and an alcohol interlock for repeat offenders (1–5; higher = stronger support). (3) Social Desirability–Gamma Short Scale (KSE-G), composite scores 1–5.

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694 **Table 2** Factors associated with self-reported drug-driving as a car driver

Independent variables (reference categories)	Dependent variable: self-declared behaviour (past 30 days) - **drive within 1 hour after taking drugs (other than prescribed or over the counter medication)** (0=never; 1=at least once)		
	Europe22	**America8**	**AsiaOceania6**
	Odds Ratio (CI99%)	Odds Ratio (CI99%)	Odds Ratio (CI99%)
BLOCK 1 – Sociodemographic			
Gender (Ref. female)			
Male	**1.58** (1.31-1.91)***	**1.56** (1.20-2.02)***	**1.38** (1.01-1.89)**
Age group (Ref. 18-24y)			
25-34y	**0.90** (0.68-1.20)	**1.69** (1.10-2.61)**	**1.10** (0.64-1.88)
35-44y	**0.78** (0.58-1.05)*	**1.78** (1.14-2.77)***	**1.06** (0.62-1.83)
45-54y	**0.45** (0.32-0.62)***	**1.22** (0.76-1.96)	**1.06** (0.61-1.87)
55-64y	**0.51** (0.36-0.72)***	**1.25** (0.76-2.05)	**0.80** (0.42-1.52)
65-74y	**0.39** (0.26-0.59)***	**0.91** (0.51-1.65)	**0.50** (0.22-1.16)*
Educational level (Ref. secondary education or lower)			
Bachelor's degree or similar	**1.19** (0.96-1.48)*	**0.79** (0.58-1.07)*	**1.00** (0.69-1.47)
Master's degree or higher	**1.15** (0.89-1.48)	**0.77** (0.52-1.13)	**1.15** (0.67-1.98)
Household's income (Ref. Living comfortably on present income)			
Coping on present income	**0.98** (0.79-1.23)	**1.09** (0.80-1.49)	**0.76** (0.52-1.11)
Finding it difficult on present income	**1.06** (0.81-1.39)	**1.43** (0.98-2.08)*	**0.70** (0.44-1.12)
Finding it very difficult on present income	**1.17** (0.77-1.79)	**1.26** (0.71-2.24)	**0.76** (0.39-1.47)
Level of urbanisation (Ref. rural)			
Urban/ semi-urban	**0.87** (0.71-1.08)	**0.71** (0.48-1.05)*	**0.91** (0.56-1.46)
Frequency of driving a car (Ref. a few days a month)			
1 to 3 days a week	**0.71** (0.54-0.94)**	**0.98** (0.69-1.40)	**1.02** (0.64-1.64)
at least 4 days a week	**0.92** (0.69-1.24)	**1.19** (0.82-1.73)	**1.06** (0.64-1.76)
BLOCK 2			
Acceptability (Ref. unacceptable/neutral)			
Personal acceptability of driving within 1 hour after taking drugs (other than prescribed or over the counter medication) (acceptable)	**16.22** (11.40-23.08)***	**10.44** (6.23-17.50)***	**14.89** (8.09-27.41)***
Enforcement perception (Ref. unlikely/neutral)			
Checked by the police for the use of illegal drugs (likely)	**1.75** (1.34-2.28)***	**1.75** (1.25-2.46)***	**1.32** (0.84-2.06)
Enforcement experience (Ref. never)			
Checked by the police for using drugs (other than prescribed or over the counter medication) while driving a car (at least once in last 12 months)	**4.89** (3.68-6.50)***	**3.95** (2.73-5.70)***	**2.34** (1.36-4.03)***
Social Desirability Scale(1)			
Exaggerating positive qualities (composite score 1-5)	**0.72** (0.64-0.81)***	**0.76** (0.66-0.88)***	**0.70** (0.58-0.84)***
Minimizing negative qualities (composite score 1-5)	**0.52** (0.47-0.58)***	**0.55** (0.48-0.63)***	**0.64** (0.55-0.75)***
Sample size	16575	5454	3694
Nagelkerke R^2	0.314	0.274	0.367

695 Binary logistic regression models by region. Reference population: car drivers at least a few days a month. Models adjusted
696 for country and for the Social Desirability Scale. * $p < 0.05$ (shown for information only; not considered significant, see
697 Methods), ** $p < 0.01$, *** $p < 0.001$. (1) Social Desirability–Gamma Short Scale (KSE-G), composite scores 1–5.