Road Safety 2022 2

Saving lives through road safety risk factor interventions: global and national estimates

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Global road mortality is a leading cause of death in many low-income and middle-income countries. Data to support priority setting under current resource constraints are urgently needed to achieve Sustainable Development Goal (SDG) 3.6. This Series paper estimates the potential number of lives saved if each country implemented interventions to address risk factors for road injuries. We did a systematic review of all available evidence-based, preventive interventions for mortality reduction that targeted the four main risk factors for road injuries (ie, speeding, drink driving, helmet use, and use of seatbelt or child restraint). We used literature review variables and considered three key country-level variables (gross domestic product per capita, population density, and government effectiveness) to generate country-specific estimates on the potential annual attributable number of lives that would be saved by interventions focusing on these four risk factors in 185 countries. Our results suggest that the implementation of evidence-based road safety interventions that target the four main road safety risk factors could prevent between 25% and 40% of all fatal road injuries worldwide. Interventions addressing speed could save about 347 258 lives globally per year, and at least 16 304 lives would be saved through drink driving interventions. The implementation of seatbelt interventions could save about 121 083 lives, and 51 698 lives could be saved by helmet interventions. We identify country-specific estimates of the potential number of lives saved that would be attributable to these interventions. Our results show the potential effectiveness of the implementation and scaling of these interventions. This paper presents key evidence for priority setting on road safety interventions and shows a path for reaching SDG 3.6.

Lancet 2022; 400: 237–50

Published **Online** June 29, 2022 https://doi.org/10.1016/S0140-6736(22)00918-7

This is the second in a **Series** of three papers about road safety

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Introduction

Road traffic injuries (RTIs) are the eighth leading cause of death globally for all ages and the first cause in the 5–29 years age group.[1] Close to 1·4 million people die each year, and up to 50 million are injured by RTIs. More than half of these deaths are attributable to vulnerable road users (ie, pedestrians, cyclists, and motorcyclists).[1–3] Road traffic collisions reduce countries' annual gross domestic product by a range of 1–3%.[3,4]

Low-income and middle-income countries (LMICs) have the greatest burden of fatal and non-fatal road traffic injuries.[5] The risk of road traffic deaths is three times higher in low-income countries than in high-income countries (HICs).[1,6] For example, the road traffic mortality rate in Africa is 26·6 per 100 000 people, but it is only 9·3 per 100 000 in Europe. In fact, 93% of the world's fatalities on roads occur in LMICs.[1,2,6] The global community is still far from achieving the Sustainable Development Goal 3.6, which calls for a 50% reduction in road traffic injuries and deaths by 2030; reaching this goal will become harder now that the COVID-19 pandemic has changed priorities for governments and presented new competing challenges.[1,7]

Despite many factors leading to fatal and non-fatal road injuries, the evidence identifies that, in the context of a safe systems approach, four main risk factors consistently increase the risk for road injuries and deaths at a population level. These risk factors are speeding, drink driving, helmet use, and use of seatbelt or child restraint.[1,8,9] Although many other factors contribute to road injuries and deaths (eg, infrastructure), these four risk factors have a measurable effect on road mortality and morbidity. For

Key messages

- The burden of unintentional injuries is rising in low-income and middle-income countries, and the goal of halving global fatal road injuries by 2020 was not achieved; therefore, identifying the country-specific effectiveness of interventions that address the main risk factors for road injuries (ie, speeding, drink driving, helmet, and seatbelt use) is key to improving the priority-setting processes for effective decision making
- There are previous studies describing the effectiveness of specific interventions in specific countries; however, the data are sparse, and there are no consolidated sources available; such data are also often from high-income countries
- This paper compiles all available evidence on interventions that target risk factors for road injuries; we obtained country-specific variables on the potential effectiveness of the interventions addressing these risk factors in 185 countries
- All evidence-based interventions addressing risk factors will reduce mortality on the roads, and interventions addressing speeding are most likely to reduce mortality
- This paper provides policy makers with specific country-level data so that they can assess the value of road safety interventions to prevent mortality

this reason, WHO acknowledges these risk factors as part of a more comprehensive systems approach.[1,8,9] Previous reviews have found that most of the published, peer-reviewed evidence on risk factors for road injuries come from HICs despite these countries only accounting for 7% of global RTI-related mortalities.[10,11] Effectiveness estimates from LMICs are necessary to assess the effect of risk factor interventions for road injuries in these countries, which face 93% of road mortality, so that decision makers and funders can better focus their resources to where they will have the greatest effect.[12,13] However, current literature does not offer a clear direction, especially considering its focus on interventions in higher-income settings.[5,11,14–18]

In this paper, we build a library of effectiveness estimates for road safety interventions through a systematic review of the available peer-reviewed and grey literature; and produce estimates for the potential number of lives saved from interventions addressing the four main risk factors for road injuries in 185 countries. This paper provides decision makers and donors with evidence on the potential effect of addressing these risk factors for every given country. This has not been done before, either for RTIs or at a global scale.[5,19,20]

Review approach

Data collection

This review was done using the Cochrane guide for systematic review of intervention and following the Preferred Reporting Items for Systematic review and Meta-Analyses (known as PRISMA) guidelines.[21,22]

The primary inclusion criteria were a paper or report that evaluated interventions aimed at reducing RTI-related mortality through modifying any of the four main risk factors. These studies were searched for in both the health and non-health-related literature and their included interventions had to be preventive (eg, not trauma response). Mortality measurements had to be measured empirically (modelling studies were excluded) and independently of other metrics. It was also required that the study be published in English, Spanish, Portuguese or Arabic. For this systematic review, interventions were defined as any planned action, programme, or policy, that was designed and implemented with the aim of reducing RTI-related mortality. The review included peer-reviewed and grey literature reports for both HICs and LMICs published before August, 2018. The primary outcomes of interest were effectiveness estimates that directly measured mortality reduction by modifying the main four road safety risk factors.

See Online for appendix

Studies were excluded if they were abstracts, conference proceedings, book chapters, literature or systematic reviews, meta-analyses, modelling estimates, or commentaries or brief reports that did not describe their methods. We also excluded interventions targeting vehicle safety, device effectiveness, or post-crash interventions to manage injuries. Excluded studies also included those that did not assess road safety interventions (including studies assessing repeals of road safety interventions), those that did not assess one of the main four risk factors for road injuries (eg, studies assessing driver licence standards), or those that did not provide population-wide estimates but rather mortality effects in specific age groups (eg, graduated driver licensing and changes in minimum drinking age that only report mortality changes in populations of certain ages). The reason behind the last exclusion criterion was that the age distribution of drivers for all countries is not known and, therefore, the effect of specific age groups could not be assessed, unless the study reviewed provided population-level estimates.

PubMed, Embase, Cochrane Trials, Scopus, Global Health, and WHO Global Index Medicus (GIM) were searched on Aug 4, 2018, with the aid of an experienced public-health librarian. Public-health review databases and RTI registries were also searched including GIM regional databases, the Cochrane Injuries Group Specialized Register, the Transport Research Information Services, the International Road Research Documentation, and European Conference of Ministers of Transport databases. Additional sources included grey literature repositories such as Road Safety Research, Policing and Education Conference; International Co-operation on Theories and Concepts in Traffic Safety; Royal Society for the Prevention of Accidents; Travelsafe Committee; 6th World Conference Injury Prevention and Control; Road Traffic Injuries and Health Equity Conference 2002 Massachusetts; Road Safety on Three Continents Conference South Africa 2000; and the 17th Australian Research Board Conference. The appendix (p 2) displays our electronic search strategy.

Study selection and data collection

Two teams of two reviewers (MN and SE, and DNG-T and NP) each independently did title and abstract screening of all identified manuscripts following the inclusion and exclusion criteria. Duplicates and articles that did not meet inclusion or exclusion criteria were excluded. Full-text articles for all included manuscripts were obtained and independently assessed by four reviewers (MN, SE, DNG-T, NP); if reviewers decided an article was eligible, it was then included in the data extraction phase. Any disagreement about inclusion was resolved by a third reviewer (AIV-O).

Data from the included full-text studies were extracted using a standardised form that included country, type of intervention, risk factor addressed, type of occupant, study design, type of outcome measure (eg, odds ratios [OR], relative risk [RR], or percentage change), and the value of outcome measure and uncertainty measures. Many included manuscripts were from disciplines other than public health and epidemiology and, therefore, many usual checklist items were often not reported. This absence of items is an issue frequently observed in reviews involving non-medical literature,[23] making it difficult to assess manuscript quality comparatively. Despite this fact, we collected data to build a standard quality metric. The Mixed Methods Appraisal Tool (MMAT), a validated appraisal tool that is unique in considering all study designs and that fits the papers' variability in study designs, complied with the inclusion criteria.[23]

Estimation of lives saved

To estimate the number of lives saved, all effect sizes obtained from the systematic literature review were categorised into four groups, one for each of the four main risk factors. Similar to previous studies, if a given paper had several variables or specifications for the same intervention, we used the most conservative value.[11,24,25]

For all studies that data were extracted from, we obtained the absolute value of the percentage change in mortality that was attributable to the intervention. For papers presenting risk outcomes (including OR, RR, and IRR [incidence rate ratio]), we converted the outcomes to a percentage change with the equation: percentage change in mortality=1–RR=1–OR=1–IRR (defined as equation 1). Given that road mortality is a rare outcome and we are providing estimates in large populations, we believe we can safely use OR and RR interchangeably.[26] Importantly, we did not include mortality rates and percentage point changes in the calculations given, which are the additional assumptions that need to be made to transform them into percentage change values.

Selection of country-level data to construct country-specific predictors of effectiveness

There is no evidence that presents effect sizes for all countries and all road safety risk factor interventions. To produce country-specific estimates for the effectiveness of interventions that address the four main risk factors, we used key country-level predictors to assess the ability of a country to implement road safety interventions. By controlling for these factors, we could better observe what a contextualised full-implementation scenario would be for each country; full implementation might be different in each country as it depends on their baseline conditions.

In this study, we used three key country-level predictors. The first predictor was gross domestic product (GDP) per capita. GDP is a relevant variable because it captures the economic development level of where the intervention took place.[27] A wide body of literature has shown that GDP per capita is a predictor for road safety; mainly because resources are needed to build safer roads, install speed cameras, have well-trained police, or have safer vehicles. We obtained GDP per capita in international dollars for 2018 from the World Bank in purchasing power parity (PPP) values.[28] The second country-level predictor used was population density. Population density is a key variable that proxies factors affecting the severity and likelihood of a crash. Population density is inversely correlated to road injuries as it can be an indicator of more dense urban centres and metropolitan areas, and slower vehicle flows. Population density also indirectly indicates urban development and offers the opportunity to implement interventions that will affect more people in a given area.[29] Population density (defined as the number of people per km² of land area for 2018) was obtained from the World Bank database.[30] The third country-level predictor used was government effectiveness. This index was developed by the World Bank to measure the public perception of the quality of public services, public servants, and of policy formulation and implementation.[31] This variable is relevant as it defines the ability of a government to design, implement, and evaluate evidence-based road safety interventions. The government effectiveness index was obtained from the Worldwide Governance Indicators.[32,33]

Estimating variables to build country-specific estimates

Next, we linearly regressed the effectiveness of each intervention (measured as the percentage change in mortality) on the three key country-level predictors, the road-safety risk factor intervention, and a country dummy for the country where the intervention took place. The equation used was percentage change in $\text{mortality}_{ij} = \alpha + \beta_1$ type of $\text{intervention}_{ij} + \beta_2$ government $\text{effectiveness}_i + \beta_3$ population $\text{density}_i + \beta_4$ GDP per $\text{capita}_i + \beta_5$ country $\text{dummy}_i + \varepsilon_{ij}$ (defined as equation 2), in which the estimated percentage change in mortality is a function of the intervention addressing risk factor *j* in country *i*; three country-level variables in country *i* (government effectiveness, population density and GDP per capita); and a country dummy *i*. The coefficients and standard errors obtained from equation 2 were used as predictors of the country-specific estimates in the next step.

Building country-specific estimates for the impact of interventions addressing road injury risk factors

Using the coefficients and standard errors calculated using equation 2, we predicted country-specific estimates for the potential effect of interventions addressing the four main risk factors. These estimates were obtained by imputing the coefficients and standard errors in a Monte Carlo estimation with 10 000 iterations. The equation used (defined as equation 3) was: country-specific estimate of $\text{impact}_{ij} = \alpha + (\beta 1 \times \text{type of intervention}_{ij}) + (\beta 2 \times \text{government effectiveness}_i) + (\beta 3 \times \text{population density}_i) + (\beta 4 \times \text{GDP per capita (PPP)}_i)$ in which the country-specific estimate of impact for country *i*, and risk factor *j*, is simulated using Monte Carlo. The coefficients are assumed with a normal distribution, and with a standard deviation equal to the standard error obtained for that variable. These assumptions are necessary to provide an uncertainty estimate around the estimator.

Estimating the population-attributable fraction for interventions targeting road traffic risk factors

After calculating the country-specific impact for interventions addressing each of the four main risk factors, the next step was to obtain the baseline total number of deaths (ie, minimum, mean, and maximum) from the Global Burden of Diseases, Injuries, and Risk Factors (GBD) Study 2017.[34] We also obtained the percentage of alcohol-related deaths (used for drink driving interventions) from the Global Status Report on Road Safety 2018.[1] Mortality data by country and type of road user were matched to each country and risk factor predicted effectiveness variable (equation 3). Matching between type of road user and risk factor was done as follows: (1) all RTIs were matched with speeding interventions; (2) all RTIs multiplied by the percentage of alcohol-related road injuries (where available) were matched with drink driving interventions; (3) all motor vehicle injuries were matched with seatbelt interventions; and (4) all motorcyclist road injuries were matched with helmet interventions. However, drink driving estimates depend on the percentage of alcohol-related deaths reported, which in many cases is underestimated. We do not provide calculations for drink driving interventions for countries that do not report the percentage of alcohol-related deaths. Given the variability in these measures, there might be some countries for which these results are not stable (eg, negative values).

Following a comparative risk assessment approach,[11,24] we calculated the potential number of lives saved for each RTI intervention. To do this, we multiplied the country-specific estimate of impact_{ij} and the number of deaths attributable to road user type affected by that same risk factor j through the Monte Carlo simulation. The Monte Carlo simulation assumes mortality data with a triangular distribution (using the minimum, mean, and maximum values from the GBD 2017 mortality data). The estimation of the lives saved is determined by the equation (defined as equation 4): number of lives saved_{ij}=number of deaths_{ij}×country-specific estimate of impact_{ij}, in which lives saved in country i, for interventions addressing risk factor j, are equal to the estimated number of deaths in country i for type of road user j multiplied by the country-specific estimates of impact for interventions in that same country and that same risk factor. In the context of drink driving, we only use data on deaths that are identified as attributed to alcohol-related incidents, which is a conservative metric. This calculation relied on five assumptions (panel).

Panel: Assumptions for the lives saved estimation

Given the scarcity of data, some assumptions had to be made for the lives saved estimation.

National impact

We estimated the potential country-specific impact of interventions addressing a given road safety risk factor on the basis of key country-level variables; this assumption implies that interventions for that risk factor are implemented at a national level.

Distributions

We assumed a normal distribution for the effect sizes of the interventions and the country-level variables; we assumed a triangular distribution of mortality based on the Global Burden of Diseases, Injuries, and Risk Factors study 2017.

Time-invariant determinants

We assumed determinants were time-invariant given that the years in which the variables were obtained did not necessarily match with the country-level predictors; however, we do not consider this assumption to be a major issue because most institutional and macroeconomic variables do not change rapidly over time, especially when compared at scale with other countries.

Independence

The effect estimated from addressing one risk factor was independent from the effect estimated by addressing other risk factors; the effects are assumed to be non-additive.

Current levels of implementation of the interventions studied

Currently, there are no standards to systematically measure the degree of in-country implementation and its variability for interventions addressing the four risk factors studied. For this reason, we assumed that all countries might have a similar marginal change in road traffic deaths by implementing these interventions. Naturally, differences might arise from heterogeneous baseline levels over the different regions of a country.

Literature review

The systematic review across all datasets initially produced 8375 studies (appendix p 4). Of these, 753 (9%) papers were reviewed in depth, with 7622 (91%) excluded. Of all papers undergoing in-depth review, 74 (10%) studies were included and a total of 159 parameters were extracted for the analyses (appendix p 5).

Most of the 159 parameters were from HICs and were predominantly from the USA (79 [50%]). Brazil (12 [8%]) had the highest number of studies for an LMIC. Most studies described national-level programmes and interventions, and made use of either pre–post design, interrupted time series, or time series analysis. Most parameters (122 [77%)] assessed combined legislative and enforcement interventions. The great majority of the parameters assessed drink driving (100 [63%]) followed by speeding (30 [19%]). 23 (15%) parameters assessed seatbelt and child restraint use, whereas only six eligible (4%) parameters were found on helmet use (appendix p 22).

Due to the diversity of the literature and the search across multiple fields, we used MMAT to assess the quality of the studies included. Many of the studies included had moderate to low quality (appendix p 24).

Estimation of lives saved

We first regressed the country-level predictors on the calculated effect sizes (appendix p 25). Next, we did the estimates for the number of lives saved, obtaining the mean of lives saved by addressing each risk factor in each country. For drink driving, we could only produce results for the countries that provided estimated percentages of alcohol-related deaths of all fatalities.

Our effectiveness estimates account for 36% of the variability in the mortality effects and identified speed as the most impactful risk factor (appendix p 26). Detailed expected estimates by country and risk factor are displayed in the table. Our estimates found that if interventions addressing road safety risk factors were implemented in 2018, they might have reduced road deaths by 25–40% (25% assuming full overlap between interventions; 40% assuming zero overlap of road deaths), per year. Interventions addressing speed would have saved about 347 258 lives annually. Drink driving interventions would have saved 16 304 lives. About 121 083 lives would have been saved through seatbelt interventions, and a further 51 698 lives by helmet interventions.

Conclusions

As the second Decade of Action for Global Road Safety was launched in February, 2021 with ambitious targets for 2030, there is an urgent need for the effective implementation of a safe systems approach with evidence-based interventions to reduce road traffic injuries.[1,2,5,11,35] This paper shows evidence that addressing the four main road safety risk factors could make it possible to avert between 25% and 40% of the annual 1·4 million deaths that occur globally. This paper addresses, within the context of a safe systems approach, the four main road injury risk factors in 185 countries by making initial data available to policy makers, which can be used in their own cost-effectiveness, return on investment analysis, feasibility, and priority-setting studies. To our knowledge, this is the first study that gives country-specific estimates of the effect of addressing the four main road safety risk factors through interventions for 185 countries.

In a previous paper with a more limited literature review we found that the data on the effectiveness of interventions for road safety risk factors are sparse.[11] In this paper, we did a much more ambitious literature review using a wider search strategy. We found more studies by including papers from grey literature and from disciplines other than public health. However, two findings from the previous research remained true. First, the overall quality assessment, done indirectly in this case, showed that many studies have moderate to low quality, particularly when it comes to study design and addressing bias. This fact has been discussed in the literature, particularly in the context of multisectoral issues.[36] Second, this study confirmed that most of the

	ISO code	Risk factor	Mean (SD)
Afghanistan	AFG	Drink driving	··
Afghanistan	AFG	Helmet	307 (433)
Afghanistan	AFG	Seatbelt	1246 (1918)
Afghanistan	AFG	Speed	2675 (3613)
Albania	ALB	Drink driving	3 (80)
Albania	ALB	Helmet	9 (9)
Albania	ALB	Seatbelt	29 (30)
Albania	ALB	Speed	87 (80)
Algeria	DZA	Drink driving	··
Algeria	DZA	Helmet	261 (233)
Algeria	DZA	Seatbelt	1707 (1614)
Algeria	DZA	Speed	2708 (2318)
Andorra	AND	Drink driving	··
Andorra	AND	Helmet	0 (0)
Andorra	AND	Seatbelt	1 (1)
Andorra	AND	Speed	1 (1)
Angola	AGO	Drink driving	··
Angola	AGO	Helmet	104 (114)
Angola	AGO	Seatbelt	1132 (1319)
Angola	AGO	Speed	2394 (2494)
Antigua and Barbuda	ATG	Drink driving	0 (3)
Antigua and Barbuda	ATG	Helmet	0 (1)
Antigua and Barbuda	ATG	Seatbelt	1 (1)
Antigua and Barbuda	ATG	Speed	2 (3)
Argentina	ARG	Drink driving	348 (2184)
Argentina	ARG	Helmet	470 (401)
Argentina	ARG	Seatbelt	1301 (1167)
Argentina	ARG	Speed	2697 (2204)
Armenia	ARM	Drink driving	1 (76)
Armenia	ARM	Helmet	10 (9)
Armenia	ARM	Seatbelt	35 (36)
Armenia	ARM	Speed	83 (77)
Australia	AUS	Drink driving	119 (973)
Australia	AUS	Helmet	112 (130)
Australia	AUS	Seatbelt	512 (623)
Australia	AUS	Speed	865 (976)
Austria	AUT	Drink driving	8 (285)
Austria	AUT	Helmet	33 (46)
Austria	AUT	Seatbelt	86 (126)
Austria	AUT	Speed	212 (285)
Azerbaijan	AZE	Drink driving	22 (216)
Azerbaijan	AZE	Helmet	47 (49)
Azerbaijan	AZE	Seatbelt	78 (89)
Azerbaijan	AZE	Speed	215 (218)
The Bahamas	BHS	Drink driving	··
The Bahamas	BHS	Helmet	4 (3)
The Bahamas	BHS	Seatbelt	13 (11)
The Bahamas	BHS	Speed	24 (20)
Barbados	BRB	Drink driving	··
Barbados	BRB	Helmet	0 (2)
Barbados	BRB	Seatbelt	–2 (8)
Barbados	BRB	Speed	–2 (14)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Belarus	BLR	Drink driving	40 (337)
Belarus	BLR	Helmet	20 (18)
Belarus	BLR	Seatbelt	179 (179)
Belarus	BLR	Speed	377 (340)
Belgium	BEL	Drink driving	··
Belgium	BEL	Helmet	27 (72)
Belgium	BEL	Seatbelt	96 (289)
Belgium	BEL	Speed	234 (586)
Belize	BLZ	Drink driving	··
Belize	BLZ	Helmet	5 (5)
Belize	BLZ	Seatbelt	13 (13)
Belize	BLZ	Speed	28 (24)
Benin	BEN	Drink driving	··
Benin	BEN	Helmet	57 (62)
Benin	BEN	Seatbelt	326 (384)
Benin	BEN	Speed	969 (1007)
Bhutan	BTN	Drink driving	··
Bhutan	BTN	Helmet	8 (7)
Bhutan	BTN	Seatbelt	8 (7)
Bhutan	BTN	Speed	30 (23)
Bolivia	BOL	Drink driving	40 (663)
Bolivia	BOL	Helmet	67 (56)
Bolivia	BOL	Seatbelt	432 (379)
Bolivia	BOL	Speed	843 (670)
Bosnia and Herzegovina	BIH	Drink driving	14 (92)
Bosnia and Herzegovina	BIH	Helmet	12 (12)
Bosnia and Herzegovina	BIH	Seatbelt	43 (48)
Bosnia and Herzegovina	BIH	Speed	94 (92)
Botswana	BWA	Drink driving	4 (101)
Botswana	BWA	Helmet	4 (4)
Botswana	BWA	Seatbelt	75 (64)
Botswana	BWA	Speed	131 (102)
Brazil	BRA	Drink driving	··
Brazil	BRA	Helmet	5802 (5289)
Brazil	BRA	Seatbelt	5557 (5364)
Brazil	BRA	Speed	17 898 (15 618)
Brunei	BRN	Drink driving	··
Brunei	BRN	Helmet	8 (12)
Brunei	BRN	Seatbelt	12 (20)
Brunei	BRN	Speed	32 (49)
Bulgaria	BGR	Drink driving	2 (251)
Bulgaria	BGR	Helmet	24 (23)
Bulgaria	BGR	Seatbelt	147 (145)
Bulgaria	BGR	Speed	283 (253)
Burkina Faso	BFA	Drink driving	··
Burkina Faso	BFA	Helmet	82 (83)
Burkina Faso	BFA	Seatbelt	543 (593)
Burkina Faso	BFA	Speed	1169 (1134)
Burundi	BDI	Drink driving	··
Burundi	BDI	Helmet	3 (67)
Burundi	BDI	Seatbelt	–9 (465)
Burundi	BDI	Speed	67 (1044)
Cambodia	KHM	Drink driving	115 (1286)
Cambodia	KHM	Helmet	244 (260)
Cambodia	KHM	Seatbelt	334 (382)
Cambodia	KHM	Speed	1283 (1299)
Cameroon	CMR	Drink driving	··
Cameroon	CMR	Helmet	264 (277)
Cameroon	CMR	Seatbelt	819 (923)
Cameroon	CMR	Speed	1398 (1403)
Canada	CAN	Drink driving	342 (1598)
Canada	CAN	Helmet	104 (120)
Canada	CAN	Seatbelt	822 (992)
Canada	CAN	Speed	1432 (1603)
Cape Verde	CPV	Drink driving	··
Cape Verde	CPV	Helmet	1 (1)
Cape Verde	CPV	Seatbelt	5 (5)
Cape Verde	CPV	Speed	14 (14)
Central African Republic	CAF	Drink driving	··
Central African Republic	CAF	Helmet	37 (53)
Central African Republic	CAF	Seatbelt	394 (605)
Central African Republic	CAF	Speed	1161 (1578)
Chad	TCD	Drink driving	··
Chad	TCD	Helmet	71 (93)
Chad	TCD	Seatbelt	358 (507)
Chad	TCD	Speed	879 (1105)
Chile	CHL	Drink driving	107 (956)
Chile	CHL	Helmet	63 (60)
Chile	CHL	Seatbelt	339 (338)
Chile	CHL	Speed	1050 (961)
China	CHN	Drink driving	248 (92 284)
China	CHN	Helmet	13 703 (15 122)
China	CHN	Seatbelt	13 228 (15 672)
China	CHN	Speed	88 374 (93 066)
Colombia	COL	Drink driving	··
Colombia	COL	Helmet	1054 (927)
Colombia	COL	Seatbelt	413 (384)
Colombia	COL	Speed	2877 (2418)
Comoros	COM	Drink driving	··
Comoros	COM	Helmet	0 (4)
Comoros	COM	Seatbelt	–2 (39)
Comoros	COM	Speed	1 (55)
Congo	COG	Drink driving	··
Congo	COG	Helmet	19 (21)
Congo	COG	Seatbelt	224 (275)
Congo	COG	Speed	432 (475)
Costa Rica	CRI	Drink driving	66 (267)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Costa Rica	CRI	Helmet	33 (32)
Costa Rica	CRI	Seatbelt	60 (62)
Costa Rica	CRI	Speed	289 (270)
Cote d'Ivoire	CIV	Drink driving	..
Cote d'Ivoire	CIV	Helmet	103 (106)
Cote d'Ivoire	CIV	Seatbelt	560 (618)
Cote d'Ivoire	CIV	Speed	1205 (1181)
Croatia	HRV	Drink driving	27 (144)
Croatia	HRV	Helmet	21 (21)
Croatia	HRV	Seatbelt	65 (68)
Croatia	HRV	Speed	152 (145)
Cuba	CUB	Drink driving	82 (344)
Cuba	CUB	Helmet	44 (45)
Cuba	CUB	Seatbelt	98 (107)
Cuba	CUB	Speed	359 (348)
Cyprus	CYP	Drink driving	7 (55)
Cyprus	CYP	Helmet	11 (12)
Cyprus	CYP	Seatbelt	25 (29)
Cyprus	CYP	Speed	54 (55)
Czech Republic	CZE	Drink driving	23 (398)
Czech Republic	CZE	Helmet	30 (38)
Czech Republic	CZE	Seatbelt	145 (197)
Czech Republic	CZE	Speed	327 (400)
Democratic Republic of the Congo	COD	Drink driving	..
Democratic Republic of the Congo	COD	Helmet	351 (293)
Democratic Republic of the Congo	COD	Seatbelt	3829 (3360)
Democratic Republic of the Congo	COD	Speed	7880 (6253)
Denmark	DNK	Drink driving	..
Denmark	DNK	Helmet	18 (27)
Denmark	DNK	Seatbelt	58 (94)
Denmark	DNK	Speed	123 (180)
Djibouti	DJI	Drink driving	..
Djibouti	DJI	Helmet	4 (4)
Djibouti	DJI	Seatbelt	23 (27)
Djibouti	DJI	Speed	60 (61)
Dominica	DMA	Drink driving	..
Dominica	DMA	Helmet	1 (1)
Dominica	DMA	Seatbelt	2 (2)
Dominica	DMA	Speed	4 (4)
Dominican Republic	DOM	Drink driving	..
Dominican Republic	DOM	Helmet	93 (142)
Dominican Republic	DOM	Seatbelt	497 (843)
Dominican Republic	DOM	Speed	777 (1117)
Ecuador	ECU	Drink driving	78 (1419)
Ecuador	ECU	Helmet	230 (216)
Ecuador	ECU	Seatbelt	499 (498)
Ecuador	ECU	Speed	1602 (1434)
Egypt	EGY	Drink driving	..
Egypt	EGY	Helmet	841 (924)
Egypt	EGY	Seatbelt	4792 (5670)
Egypt	EGY	Speed	8718 (9125)
El Salvador	SLV	Drink driving	..
El Salvador	SLV	Helmet	8 (19)
El Salvador	SLV	Seatbelt	53 (142)
El Salvador	SLV	Speed	218 (451)
Equatorial Guinea	GNQ	Drink driving	..
Equatorial Guinea	GNQ	Helmet	4 (5)
Equatorial Guinea	GNQ	Seatbelt	39 (56)
Equatorial Guinea	GNQ	Speed	77 (97)
Eritrea	ERI	Drink driving	..
Eritrea	ERI	Helmet	31 (43)
Eritrea	ERI	Seatbelt	166 (252)
Eritrea	ERI	Speed	433 (583)
Estonia	EST	Drink driving	3 (42)
Estonia	EST	Helmet	2 (2)
Estonia	EST	Seatbelt	20 (21)
Estonia	EST	Speed	42 (42)
Ethiopia	ETH	Drink driving	86 (3169)
Ethiopia	ETH	Helmet	222 (251)
Ethiopia	ETH	Seatbelt	1221 (1493)
Ethiopia	ETH	Speed	2979 (3201)
Fiji	FJI	Drink driving	1 (27)
Fiji	FJI	Helmet	4 (3)
Fiji	FJI	Seatbelt	19 (17)
Fiji	FJI	Speed	33 (27)
Finland	FIN	Drink driving	29 (178)
Finland	FIN	Helmet	16 (19)
Finland	FIN	Seatbelt	79 (101)
Finland	FIN	Speed	151 (178)
France	FRA	Drink driving	378 (2211)
France	FRA	Helmet	283 (379)
France	FRA	Seatbelt	723 (1028)
France	FRA	Speed	1713 (2219)
Gabon	GAB	Drink driving	..
Gabon	GAB	Helmet	8 (8)
Gabon	GAB	Seatbelt	82 (86)
Gabon	GAB	Speed	167 (159)
The Gambia	GMB	Drink driving	1 (97)
The Gambia	GMB	Helmet	5 (8)
The Gambia	GMB	Seatbelt	26 (50)
The Gambia	GMB	Speed	63 (98)
Georgia	GEO	Drink driving	19 (246)
Georgia	GEO	Helmet	22 (20)
Georgia	GEO	Seatbelt	153 (146)
Georgia	GEO	Speed	289 (248)
Germany	DEU	Drink driving	83 (2866)
Germany	DEU	Helmet	263 (473)
Germany	DEU	Seatbelt	703 (1369)
Germany	DEU	Speed	1655 (2874)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Ghana	GHA	Drink driving	..
Ghana	GHA	Helmet	94 (101)
Ghana	GHA	Seatbelt	700 (807)
Ghana	GHA	Speed	1665 (1689)
Greece	GRC	Drink driving	89 (467)
Greece	GRC	Helmet	65 (67)
Greece	GRC	Seatbelt	230 (252)
Greece	GRC	Speed	475 (470)
Grenada	GRD	Drink driving	..
Grenada	GRD	Helmet	0 (1)
Grenada	GRD	Seatbelt	1 (2)
Grenada	GRD	Speed	2 (4)
Guatemala	GTM	Drink driving	..
Guatemala	GTM	Helmet	123 (165)
Guatemala	GTM	Seatbelt	230 (340)
Guatemala	GTM	Speed	727 (925)
Guinea	GIN	Drink driving	..
Guinea	GIN	Helmet	55 (61)
Guinea	GIN	Seatbelt	292 (351)
Guinea	GIN	Speed	661 (706)
Guinea-Bissau	GNB	Drink driving	..
Guinea-Bissau	GNB	Helmet	11 (15)
Guinea-Bissau	GNB	Seatbelt	51 (82)
Guinea-Bissau	GNB	Speed	116 (163)
Guyana	GUY	Drink driving	6 (37)
Guyana	GUY	Helmet	8 (7)
Guyana	GUY	Seatbelt	22 (19)
Guyana	GUY	Speed	47 (37)
Haiti	HTI	Drink driving	..
Haiti	HTI	Helmet	15 (341)
Haiti	HTI	Seatbelt	–10 (886)
Haiti	HTI	Speed	146 (2312)
Honduras	HND	Drink driving	20 (423)
Honduras	HND	Helmet	37 (40)
Honduras	HND	Seatbelt	118 (135)
Honduras	HND	Speed	421 (427)
Hungary	HUN	Drink driving	16 (312)
Hungary	HUN	Helmet	30 (33)
Hungary	HUN	Seatbelt	123 (143)
Hungary	HUN	Speed	299 (314)
Iceland	ISL	Drink driving	1 (9)
Iceland	ISL	Helmet	1 (1)
Iceland	ISL	Seatbelt	5 (6)
Iceland	ISL	Speed	7 (9)
India	IND	Drink driving	..
India	IND	Helmet	5683 (26 087)
India	IND	Seatbelt	3204 (21 929)
India	IND	Speed	20 554 (83 318)
Indonesia	IDN	Drink driving	..
Indonesia	IDN	Helmet	2311 (2498)
Indonesia	IDN	Seatbelt	3513 (4085)
Indonesia	IDN	Speed	11 426 (11 742)
Iran	IRN	Drink driving	91 (6575)
Iran	IRN	Helmet	868 (806)
Iran	IRN	Seatbelt	3457 (3416)
Iran	IRN	Speed	7507 (6646)
Iraq	IRQ	Drink driving	..
Iraq	IRQ	Helmet	66 (95)
Iraq	IRQ	Seatbelt	624 (984)
Iraq	IRQ	Speed	1146 (1583)
Ireland	IRL	Drink driving	28 (140)
Ireland	IRL	Helmet	7 (11)
Ireland	IRL	Seatbelt	51 (85)
Ireland	IRL	Speed	92 (140)
Israel	ISR	Drink driving	2 (332)
Israel	ISR	Helmet	12 (33)
Israel	ISR	Seatbelt	49 (167)
Israel	ISR	Speed	122 (333)
Italy	ITA	Drink driving	241 (2571)
Italy	ITA	Helmet	242 (366)
Italy	ITA	Seatbelt	784 (1293)
Italy	ITA	Speed	1783 (2585)
Jamaica	JAM	Drink driving	..
Jamaica	JAM	Helmet	11 (17)
Jamaica	JAM	Seatbelt	29 (50)
Jamaica	JAM	Speed	67 (98)
Japan	JPN	Drink driving	70 (4436)
Japan	JPN	Helmet	270 (622)
Japan	JPN	Seatbelt	591 (1521)
Japan	JPN	Speed	2023 (4450)
Jordan	JOR	Drink driving	..
Jordan	JOR	Helmet	29 (28)
Jordan	JOR	Seatbelt	192 (201)
Jordan	JOR	Speed	378 (353)
Kazakhstan	KAZ	Drink driving	3 (1012)
Kazakhstan	KAZ	Helmet	65 (58)
Kazakhstan	KAZ	Seatbelt	676 (634)
Kazakhstan	KAZ	Speed	1191 (1020)
Kenya	KEN	Drink driving	..
Kenya	KEN	Helmet	125 (126)
Kenya	KEN	Seatbelt	781 (845)
Kenya	KEN	Speed	1814 (1742)
Kiribati	KIR	Drink driving	..
Kiribati	KIR	Helmet	1 (1)
Kiribati	KIR	Seatbelt	2 (2)
Kiribati	KIR	Speed	4 (4)
Kuwait	KWT	Drink driving	..
Kuwait	KWT	Helmet	6 (14)
Kuwait	KWT	Seatbelt	89 (217)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Kuwait	KWT	Speed	158 (336)
Kyrgyzstan	KGZ	Drink driving	··
Kyrgyzstan	KGZ	Helmet	29 (27)
Kyrgyzstan	KGZ	Seatbelt	153 (152)
Kyrgyzstan	KGZ	Speed	322 (289)
Laos	LAO	Drink driving	··
Laos	LAO	Helmet	125 (119)
Laos	LAO	Seatbelt	166 (168)
Laos	LAO	Speed	618 (565)
Latvia	LVA	Drink driving	8 (92)
Latvia	LVA	Helmet	6 (6)
Latvia	LVA	Seatbelt	41 (43)
Latvia	LVA	Speed	97 (93)
Lebanon	LBN	Drink driving	··
Lebanon	LBN	Helmet	–8 (35)
Lebanon	LBN	Seatbelt	–55 (182)
Lebanon	LBN	Speed	–56 (260)
Lesotho	LSO	Drink driving	108 (276)
Lesotho	LSO	Helmet	13 (14)
Lesotho	LSO	Seatbelt	137 (165)
Lesotho	LSO	Speed	261 (279)
Liberia	LBR	Drink driving	··
Liberia	LBR	Helmet	14 (19)
Liberia	LBR	Seatbelt	78 (111)
Liberia	LBR	Speed	158 (199)
Libya	LBY	Drink driving	5 (841)
Libya	LBY	Helmet	67 (100)
Libya	LBY	Seatbelt	359 (578)
Libya	LBY	Speed	589 (844)
Lithuania	LTU	Drink driving	11 (148)
Lithuania	LTU	Helmet	8 (8)
Lithuania	LTU	Seatbelt	59 (65)
Lithuania	LTU	Speed	148 (149)
Luxembourg	LUX	Drink driving	2 (36)
Luxembourg	LUX	Helmet	2 (4)
Luxembourg	LUX	Seatbelt	7 (19)
Luxembourg	LUX	Speed	15 (36)
Madagascar	MDG	Drink driving	··
Madagascar	MDG	Helmet	80 (95)
Madagascar	MDG	Seatbelt	471 (606)
Madagascar	MDG	Speed	1145 (1308)
Malawi	MWI	Drink driving	··
Malawi	MWI	Helmet	37 (57)
Malawi	MWI	Seatbelt	215 (370)
Malawi	MWI	Speed	532 (768)
Malaysia	MYS	Drink driving	2 (3086)
Malaysia	MYS	Helmet	551 (617)
Malaysia	MYS	Seatbelt	1306 (1553)
Malaysia	MYS	Speed	2872 (3103)
Maldives	MDV	Drink driving	··
Maldives	MDV	Helmet	–9 (9)
Maldives	MDV	Seatbelt	–9 (9)
Maldives	MDV	Speed	–29 (29)
Mali	MLI	Drink driving	3 (1108)
Mali	MLI	Helmet	94 (98)
Mali	MLI	Seatbelt	487 (545)
Mali	MLI	Speed	1114 (1117)
Malta	MLT	Drink driving	··
Malta	MLT	Helmet	–2 (3)
Malta	MLT	Seatbelt	–5 (6)
Malta	MLT	Speed	–11 (15)
Marshall Islands	MHL	Drink driving	··
Marshall Islands	MHL	Helmet	0 (1)
Marshall Islands	MHL	Seatbelt	1 (3)
Marshall Islands	MHL	Speed	1 (5)
Mauritania	MRT	Drink driving	··
Mauritania	MRT	Helmet	24 (22)
Mauritania	MRT	Seatbelt	140 (137)
Mauritania	MRT	Speed	256 (226)
Mauritius	MUS	Drink driving	–4 (81)
Mauritius	MUS	Helmet	0 (20)
Mauritius	MUS	Seatbelt	–2 (35)
Mauritius	MUS	Speed	1 (81)
Mexico	MEX	Drink driving	1072 (6808)
Mexico	MEX	Helmet	911 (869)
Mexico	MEX	Seatbelt	2395 (2427)
Mexico	MEX	Speed	7532 (6869)
Micronesia	FSM	Drink driving	3 (5)
Micronesia	FSM	Helmet	1 (1)
Micronesia	FSM	Seatbelt	3 (4)
Micronesia	FSM	Speed	5 (5)
Moldova	MDA	Drink driving	9 (142)
Moldova	MDA	Helmet	11 (12)
Moldova	MDA	Seatbelt	61 (74)
Moldova	MDA	Speed	135 (144)
Mongolia	MNG	Drink driving	42 (175)
Mongolia	MNG	Helmet	41 (34)
Mongolia	MNG	Seatbelt	104 (90)
Mongolia	MNG	Speed	225 (177)
Montenegro	MNE	Drink driving	··
Montenegro	MNE	Helmet	2 (2)
Montenegro	MNE	Seatbelt	8 (8)
Montenegro	MNE	Speed	23 (20)
Morocco	MAR	Drink driving	67 (2264)
Morocco	MAR	Helmet	258 (244)
Morocco	MAR	Seatbelt	1470 (1482)
Morocco	MAR	Speed	2540 (2288)
Mozambique	MOZ	Drink driving	··
Mozambique	MOZ	Helmet	135 (141)
Mozambique	MOZ	Seatbelt	482 (540)
Mozambique	MOZ	Speed	1762 (1759)
Myanmar	MMR	Drink driving	489 (4037)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Myanmar	MMR	Helmet	675 (848)
Myanmar	MMR	Seatbelt	916 (1250)
Myanmar	MMR	Speed	3391 (4068)
Namibia	NAM	Drink driving	6 (142)
Namibia	NAM	Helmet	9 (7)
Namibia	NAM	Seatbelt	104 (85)
Namibia	NAM	Speed	191 (143)
Nepal	NPL	Drink driving	··
Nepal	NPL	Helmet	289 (480)
Nepal	NPL	Seatbelt	258 (484)
Nepal	NPL	Speed	1563 (2449)
Netherlands	NLD	Drink driving	6 (582)
Netherlands	NLD	Helmet	16 (72)
Netherlands	NLD	Seatbelt	49 (272)
Netherlands	NLD	Speed	138 (583)
New Zealand	NZL	Drink driving	39 (198)
New Zealand	NZL	Helmet	18 (21)
New Zealand	NZL	Seatbelt	120 (141)
New Zealand	NZL	Speed	182 (199)
Nicaragua	NIC	Drink driving	··
Nicaragua	NIC	Helmet	36 (38)
Nicaragua	NIC	Seatbelt	61 (69)
Nicaragua	NIC	Speed	223 (224)
Niger	NER	Drink driving	··
Niger	NER	Helmet	107 (103)
Niger	NER	Seatbelt	469 (482)
Niger	NER	Speed	929 (857)
Nigeria	NGA	Drink driving	11 (7413)
Nigeria	NGA	Helmet	317 (595)
Nigeria	NGA	Seatbelt	1852 (3975)
Nigeria	NGA	Speed	4229 (7468)
North Korea	PRK	Drink driving	··
North Korea	PRK	Helmet	179 (450)
North Korea	PRK	Seatbelt	262 (775)
North Korea	PRK	Speed	1073 (2531)
North Macedonia	MKD	Drink driving	1 (53)
North Macedonia	MKD	Helmet	5 (4)
North Macedonia	MKD	Seatbelt	32 (32)
North Macedonia	MKD	Speed	59 (53)
Norway	NOR	Drink driving	12 (148)
Norway	NOR	Helmet	14 (19)
Norway	NOR	Seatbelt	67 (92)
Norway	NOR	Speed	116 (148)
Oman	OMN	Drink driving	5 (844)
Oman	OMN	Helmet	36 (36)
Oman	OMN	Seatbelt	564 (606)
Oman	OMN	Speed	863 (849)
Pakistan	PAK	Drink driving	··
Pakistan	PAK	Helmet	1937 (3947)
Pakistan	PAK	Seatbelt	1760 (4201)
Pakistan	PAK	Speed	9830 (18 674)
Palestine	PSE	Drink driving	··
Palestine	PSE	Helmet	–3 (8)
Palestine	PSE	Seatbelt	–41 (105)
Palestine	PSE	Speed	–51 (167)
Panama	PAN	Drink driving	··
Panama	PAN	Helmet	9 (9)
Panama	PAN	Seatbelt	77 (79)
Panama	PAN	Speed	200 (184)
Papua New Guinea	PNG	Drink driving	429 (929)
Papua New Guinea	PNG	Helmet	199 (185)
Papua New Guinea	PNG	Seatbelt	451 (447)
Papua New Guinea	PNG	Speed	1051 (938)
Paraguay	PRY	Drink driving	··
Paraguay	PRY	Helmet	259 (234)
Paraguay	PRY	Seatbelt	85 (81)
Paraguay	PRY	Speed	577 (499)
Peru	PER	Drink driving	125 (1476)
Peru	PER	Helmet	115 (100)
Peru	PER	Seatbelt	665 (607)
Peru	PER	Speed	1803 (1491)
Philippines	PHL	Drink driving	··
Philippines	PHL	Helmet	346 (845)
Philippines	PHL	Seatbelt	603 (1795)
Philippines	PHL	Speed	1715 (3867)
Poland	POL	Drink driving	137 (1617)
Poland	POL	Helmet	122 (140)
Poland	POL	Seatbelt	634 (775)
Poland	POL	Speed	1480 (1627)
Portugal	PRT	Drink driving	86 (446)
Portugal	PRT	Helmet	40 (47)
Portugal	PRT	Seatbelt	155 (195)
Portugal	PRT	Speed	392 (448)
Qatar	QAT	Drink driving	3 (573)
Qatar	QAT	Helmet	9 (24)
Qatar	QAT	Seatbelt	133 (403)
Qatar	QAT	Speed	211 (574)
Romania	ROU	Drink driving	33 (806)
Romania	ROU	Helmet	61 (63)
Romania	ROU	Seatbelt	345 (383)
Romania	ROU	Speed	813 (812)
Russia	RUS	Drink driving	1809 (8846)
Russia	RUS	Helmet	671 (600)
Russia	RUS	Seatbelt	5446 (5137)
Russia	RUS	Speed	10 360 (8915)
Rwanda	RWA	Drink driving	··
Rwanda	RWA	Helmet	23 (206)
Rwanda	RWA	Seatbelt	9 (230)
Rwanda	RWA	Speed	144 (1028)
Saint Lucia	LCA	Drink driving	··
		(Table continues in next column)	

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Saint Lucia	LCA	Helmet	1 (2)
Saint Lucia	LCA	Seatbelt	3 (5)
Saint Lucia	LCA	Speed	5 (9)
Saint Vincent and the Grenadines	VCT	Drink driving	··
Saint Vincent and the Grenadines	VCT	Helmet	0 (1)
Saint Vincent and the Grenadines	VCT	Seatbelt	1 (2)
Saint Vincent and the Grenadines	VCT	Speed	3 (4)
Samoa	WSM	Drink driving	··
Samoa	WSM	Helmet	1 (1)
Samoa	WSM	Seatbelt	3 (3)
Samoa	WSM	Speed	7 (6)
São Tomé and Príncipe	STP	Drink driving	··
São Tomé and Príncipe	STP	Helmet	0 (1)
São Tomé and Príncipe	STP	Seatbelt	2 (4)
São Tomé and Príncipe	STP	Speed	5 (8)
Saudi Arabia	SAU	Drink driving	··
Saudi Arabia	SAU	Helmet	205 (236)
Saudi Arabia	SAU	Seatbelt	4009 (4894)
Saudi Arabia	SAU	Speed	5536 (6200)
Senegal	SEN	Drink driving	··
Senegal	SEN	Helmet	55 (52)
Senegal	SEN	Seatbelt	313 (319)
Senegal	SEN	Speed	615 (560)
Serbia	SRB	Drink driving	36 (258)
Serbia	SRB	Helmet	29 (27)
Serbia	SRB	Seatbelt	124 (124)
Serbia	SRB	Speed	290 (261)
Seychelles	SYC	Drink driving	··
Seychelles	SYC	Helmet	1 (1)
Seychelles	SYC	Seatbelt	2 (3)
Seychelles	SYC	Speed	4 (6)
Sierra Leone	SLE	Drink driving	··
Sierra Leone	SLE	Helmet	65 (91)
Sierra Leone	SLE	Seatbelt	195 (297)
Sierra Leone	SLE	Speed	355 (470)
Singapore	SGP	Drink driving	–68 (757)
Singapore	SGP	Helmet	–351 (256)
Singapore	SGP	Seatbelt	–336 (243)
Singapore	SGP	Speed	–1037 (757)
Slovakia	SVK	Drink driving	8 (187)
Slovakia	SVK	Helmet	13 (15)
Slovakia	SVK	Seatbelt	78 (95)
Slovakia	SVK	Speed	171 (188)
Slovenia	SVN	Drink driving	14 (68)
Slovenia	SVN	Helmet	10 (12)
Slovenia	SVN	Seatbelt	29 (36)
Slovenia	SVN	Speed	59 (68)
Solomon Islands	SLB	Drink driving	··
Solomon Islands	SLB	Helmet	6 (6)
Solomon Islands	SLB	Seatbelt	14 (16)
Solomon Islands	SLB	Speed	41 (43)
Somalia	SOM	Drink driving	··
Somalia	SOM	Helmet	79 (144)
Somalia	SOM	Seatbelt	415 (833)
Somalia	SOM	Speed	1542 (2702)
South Africa	ZAF	Drink driving	2684 (5079)
South Africa	ZAF	Helmet	176 (151)
South Africa	ZAF	Seatbelt	3718 (3370)
South Africa	ZAF	Speed	6233 (5128)
South Korea	KOR	Drink driving	3 (3627)
South Korea	KOR	Helmet	98 (569)
South Korea	KOR	Seatbelt	140 (1150)
South Korea	KOR	Speed	697 (3641)
Spain	ESP	Drink driving	52 (1157)
Spain	ESP	Helmet	139 (163)
Spain	ESP	Seatbelt	490 (610)
Spain	ESP	Speed	1027 (1162)
Sri Lanka	LKA	Drink driving	··
Sri Lanka	LKA	Helmet	86 (214)
Sri Lanka	LKA	Seatbelt	123 (371)
Sri Lanka	LKA	Speed	439 (1007)
Sudan	SDN	Drink driving	8 (4664)
Sudan	SDN	Helmet	751 (992)
Sudan	SDN	Seatbelt	1881 (2682)
Sudan	SDN	Speed	3692 (4689)
Suriname	SUR	Drink driving	··
Suriname	SUR	Helmet	8 (7)
Suriname	SUR	Seatbelt	19 (19)
Suriname	SUR	Speed	39 (34)
Swaziland	SWZ	Drink driving	··
Swaziland	SWZ	Helmet	6 (7)
Swaziland	SWZ	Seatbelt	70 (78)
Swaziland	SWZ	Speed	127 (126)
Sweden	SWE	Drink driving	39 (241)
Sweden	SWE	Helmet	26 (32)
Sweden	SWE	Seatbelt	105 (136)
Sweden	SWE	Speed	201 (242)
Switzerland	CHE	Drink driving	13 (242)
Switzerland	CHE	Helmet	23 (43)
Switzerland	CHE	Seatbelt	49 (100)
Switzerland	CHE	Speed	133 (243)
Syria	SYR	Drink driving	··
Syria	SYR	Helmet	30 (52)
Syria	SYR	Seatbelt	229 (438)
Syria	SYR	Speed	474 (779)
Taiwan	TWN	Drink driving	··
Taiwan	TWN	Helmet	540 (492)
Taiwan	TWN	Seatbelt	401 (383)
Taiwan	TWN	Speed	1870 (1646)

(Table continues in next column)

	ISO code	Risk factor	Mean (SD)
(Continued from previous column)			
Tajikistan	TJK	Drink driving	6 (238)
Tajikistan	TJK	Helmet	18 (22)
Tajikistan	TJK	Seatbelt	125 (165)
Tajikistan	TJK	Speed	205 (240)
Tanzania	TZA	Drink driving	13 (1863)
Tanzania	TZA	Helmet	118 (126)
Tanzania	TZA	Seatbelt	737 (839)
Tanzania	TZA	Speed	1857 (1880)
Thailand	THA	Drink driving	652 (6659)
Thailand	THA	Helmet	3057 (3281)
Thailand	THA	Seatbelt	1872 (2153)
Thailand	THA	Speed	6557 (6716)
Timor-Leste	TLS	Drink driving	..
Timor-Leste	TLS	Helmet	11 (10)
Timor-Leste	TLS	Seatbelt	16 (15)
Timor-Leste	TLS	Speed	42 (37)
Togo	TGO	Drink driving	..
Togo	TGO	Helmet	22 (33)
Togo	TGO	Seatbelt	120 (201)
Togo	TGO	Speed	295 (422)
Tonga	TON	Drink driving	2 (4)
Tonga	TON	Helmet	0 (0)
Tonga	TON	Seatbelt	1 (2)
Tonga	TON	Speed	4 (4)
Trinidad and Tobago	TTO	Drink driving	..
Trinidad and Tobago	TTO	Helmet	3 (6)
Trinidad and Tobago	TTO	Seatbelt	28 (55)
Trinidad and Tobago	TTO	Speed	52 (86)
Tunisia	TUN	Drink driving	15 (1164)
Tunisia	TUN	Helmet	192 (179)
Tunisia	TUN	Seatbelt	619 (611)
Tunisia	TUN	Speed	1328 (1176)
Turkey	TUR	Drink driving	72 (3174)
Turkey	TUR	Helmet	202 (220)
Turkey	TUR	Seatbelt	1691 (1973)
Turkey	TUR	Speed	3064 (3198)
Turkmenistan	TKM	Drink driving	..
Turkmenistan	TKM	Helmet	12 (13)
Turkmenistan	TKM	Seatbelt	57 (66)
Turkmenistan	TKM	Speed	121 (126)
Uganda	UGA	Drink driving	6 (1958)
Uganda	UGA	Helmet	94 (148)
Uganda	UGA	Seatbelt	548 (971)
Uganda	UGA	Speed	1336 (1977)
Ukraine	UKR	Drink driving	109 (2136)
Ukraine	UKR	Helmet	151 (149)
Ukraine	UKR	Seatbelt	1047 (1102)
Ukraine	UKR	Speed	2297 (2158)
United Arab Emirates	ARE	Drink driving	22 (2547)
United Arab Emirates	ARE	Helmet	167 (275)
United Arab Emirates	ARE	Seatbelt	1036 (1822)
United Arab Emirates	ARE	Speed	1590 (2552)
UK	GBR	Drink driving	71 (1456)
UK	GBR	Helmet	125 (234)
UK	GBR	Seatbelt	373 (765)
UK	GBR	Speed	815 (1461)
Uruguay	URY	Drink driving	..
Uruguay	URY	Helmet	42 (36)
Uruguay	URY	Seatbelt	96 (89)
Uruguay	URY	Speed	268 (226)
USA	USA	Drink driving	5188 (28 296)
USA	USA	Helmet	2409 (3136)
USA	USA	Seatbelt	14 121 (19 382)
USA	USA	Speed	22 353 (28 367)
Uzbekistan	UZB	Drink driving	34 (1291)
Uzbekistan	UZB	Helmet	63 (64)
Uzbekistan	UZB	Seatbelt	651 (712)
Uzbekistan	UZB	Speed	1341 (1304)
Vanuatu	VUT	Drink driving	10 (16)
Vanuatu	VUT	Helmet	3 (2)
Vanuatu	VUT	Seatbelt	7 (7)
Vanuatu	VUT	Speed	19 (17)
Venezuela	VEN	Drink driving	..
Venezuela	VEN	Helmet	310 (436)
Venezuela	VEN	Seatbelt	632 (970)
Venezuela	VEN	Speed	2228 (3015)
Vietnam	VNM	Drink driving	..
Vietnam	VNM	Helmet	783 (1508)
Vietnam	VNM	Seatbelt	1095 (2453)
Vietnam	VNM	Speed	4070 (7303)
Yemen	YEM	Drink driving	..
Yemen	YEM	Helmet	269 (540)
Yemen	YEM	Seatbelt	1358 (3029)
Yemen	YEM	Speed	2647 (5096)
Zambia	ZMB	Drink driving	..
Zambia	ZMB	Helmet	36 (32)
Zambia	ZMB	Seatbelt	272 (262)
Zambia	ZMB	Speed	783 (678)
Zimbabwe	ZWE	Drink driving	..
Zimbabwe	ZWE	Helmet	70 (84)
Zimbabwe	ZWE	Seatbelt	451 (581)
Zimbabwe	ZWE	Speed	913 (1044)

Table: Potential number of lives saved by country and risk factor
ISO=International Organization for Standardization. SD=standard deviation.

literature on effective interventions is from HICs. The high proportion of HIC-based studies suggests that, despite many efforts, the first Decade of Action did not necessarily result in more high-quality evaluations of interventions in LMICs, despite being called for as early as 2004 in the first World Report on Road Traffic Injury Prevention.[37] It is important for the global community to recognise and respond to this continued shortcoming as we enter the new Decade of Action.

This paper contributes to the development of priority-setting exercises that are country specific by proposing a strategy to estimate the potential effect of injury interventions based on key country-level determinants. We believe these data are crucial to stimulate the next major effort in improving global road safety by focusing on implementing successful interventions. The identification and promotion of interventions worth investing in is not enough. Instead, evidence and tools to foster successful implementation should be provided. We hope that the results from this analysis can be used by country-based experts to perform their own analyses, and refine them to inform local decision making to reduce road fatalities.

Our analysis made use of a practical approach to the estimation of global and national estimates of potential lives saved by addressing road safety risk factors. First, we used a number of assumptions described in detail in the methods section. These assumptions were necessary to obtain country-specific estimates of interventions addressing the four main road safety risk factors. Our estimates are also the lower bound for the potential lives saved given that we use the most conservative variables we found during the literature review for any single study included. We also assumed that the intervention effects were independent and in the case of drink driving, the target population mortality is known to be related to alcohol consumption.

Second, we could not make causal claims with the existing data as most studies do not present causal estimates.[24]

Third, this paper also made use of mortality data from GBD 2017, which were, at the time of analysis, the best available estimates for mortality, yet we acknowledge that these estimates are modelled and our results rely on the precision of those estimates. These estimates are also used by global agencies and previous papers in *The Lancet*.[38,39]

Fourth, we only presented fatal outcomes because systematic measurement error for non-fatal injuries is common, which implies that our findings constitute a lower bound for health gains of addressing road injury risk factors and the potential gains can be greater if the scope of any study also encompasses non-fatal outcomes.

Fifth, the literature review excluded studies that focused on interventions that estimated mortality on specific age ranges (such as Graduated Driving Licensing) due to the difficulty of observing drivers' age distribution and the effect of interventions addressing different risk factors across all countries. Naturally, results from age-specific studies would be included if the interventions resulted in population-level effects.

Sixth, we also did not consider the current degree of implementation of the interventions studied. Currently, there are no standardised methods to systematically measure the degree and variability of in-country implementation for interventions addressing the four risk factors studied. For this reason, we assumed that all countries might have a similar marginal change in road traffic deaths by implementing these interventions.

Finally, some variables such as the proportion of deaths by road user type, road network size, and motor vehicles per 1000 people would have added power to our estimates. However, since these data are difficult to find systematically and reliably for all countries studied, we relied on a broader variable (GDP per capita) that indirectly captures this information. Although other risk factors might be the root causes for road crash mortality, the four risk factors for road injuries selected for this study are relevant because they (1) have the strongest evidence on identifying mortality; and (2) constitute a proximal factor for mortality. For example, distraction while driving is certainly an important cause for road crashes in some contexts, but might become lethal when speed is involved. Similarly, safe infrastructure is very important for the prevention of road crashes, and the main way in which it does so is through reducing speed. For these reasons, WHO has classified the risk factors of the four studies as the main risk factors for road injuries.[9]

In this paper, our aim was to describe how effective it is to address key risk factors for RTIs but we did not provide guidance on how to address them. For example, speed is an important issue and could be addressed through different overlapping approaches including infrastructure improvement, increased enforcement, and road user education, all of which are part of a safe systems approach. Since this paper is the first effort of this dimension on this topic, we did not have external data to validate our results. We hope that future research can identify other strategies to calculate intervention effectiveness, so that these results can be validated.

Given the existing challenges in the field of road safety and the impact of the COVID-19 pandemic, achieving the ambitious goal of the second Decade of Action for Global Road Safety will be a challenge and will require the global road safety community to act on the implementation of evidence-based actions in different countries. By providing country-specific estimates on the potential lives saved by road traffic interventions, this study highlights the urgency of implementing of a safe systems approach in which specific interventions can effectively address road injury deaths by 2030. This paper also calls for better-designed empirical studies on road safety interventions to improve future estimates, with a focus on LMICs where most road injuries take place. We hope that these estimates stimulate a change of focus for the global road safety community from highlighting the effects of road injuries to effective implementation of evidence-based interventions at scale, especially in LMICs.

Contributors

AIV-O led the systematic review, did the analyses, and led the drafting of the manuscript. MN and SE contributed to the initial conceptualisation

and the development of the systematic review and drafted the document. DNG-T and NP contributed to the systematic review and drafted the document. AAH developed the original approach, conceptualised the analytical process, and contributed to drafting the document. All authors read and approved the final paper.

Declaration of interests

We declare no competing interests.

Acknowledgments

We thank Peggy Gross (Johns Hopkins Welch Medical Library, John Hopkins University, Baltimore, MA, USA), the anonymous reviewers of this work, and Stephanie Puerto (Institute of Public Health. Pontificia Universidad Javeriana, Bogota, Colombia).

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