# IMPROVING ROAD TRAFFIC INJURY STATISTICS IN LOW- AND MIDDLE-INCOME COUNTRIES

## Addressing Discrepancies between Official Statistics and Global Statistical Models

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# Acronyms

| | |
|---|---|
| **CI** | Confidence Interval |
| **DHS** | Demographic and Health Survey |
| **GBD** | Global Burden of Disease |
| **GHE** | Global Health Estimate |
| **GRSF** | Global Road Safety Facility |
| **GSRRS** | Global Status Reports on Road Safety |
| **IHME** | Institute for Health Metrics and Evaluation |
| **IHSN** | International Household Survey Network |
| **LMIC** | low- and middle-income country |
| **UN** | United Nations |
| **WHO** | World Health Organization |

# Executive Summary

Road traffic deaths are a global public health and economic crisis, with low- and middle-income countries (LMICs) bearing a disproportionately high burden compared with higher-income countries.

Accurate estimation of road traffic deaths and injuries is vital to acknowledging and understanding the true magnitude of the problem and developing effective interventions. But collecting accurate and comprehensive data on road traffic deaths is a significant challenge in LMICs. Limited resources, underdeveloped health information systems, and fragmented data collection processes contribute to incomplete and inconsistent data. The lack of standardized reporting and varying definitions of road traffic deaths further complicate the estimation process. These collection challenges, along with underdeveloped civil registration and vital statistics systems in LMICs, result in significant underreporting of fatalities and injuries that affects estimations considerably. Thus, estimations rely on the findings of three major global statistical models to fill the reporting gaps: the Institute for Health Metrics and Evaluation Global Burden of Disease (GBD) study, the World Health Organization (WHO) Global Status Reports on Road Safety (GSRRS), and WHO Global Health Estimates (GHE).

The GBD study collects data from countries, including vital registration data, hospital data, and data from traffic police for its estimates. However, limitations in data availability, quality, and coverage can affect the accuracy of estimates significantly. Similarly, the GSRRS collects data from member countries, but variations in data collection methods, definitions, and reporting systems contribute to inconsistencies in its estimates. GSRRS is not updated annually, leaving gaps of three to four years between updates. The GHE provides key insights on mortality and morbidity trends using the latest available data on death and disability globally, including from road traffic injuries and is updated annually. Discrepancies exist both among these three models and between these models and country statistics. Estimates of road traffic deaths and injuries from these models substantially exceed the official statistics reported by most LMICs. Thus, the use of these models in road safety advocacy and policy making is limited.

The World Bank Global Road Safety Facility undertook this study to understand how countries use road safety statistics in national road safety policy dialogue, the sources of discrepancies in statistical estimates, and how to strengthen modeling efforts to reduce those discrepancies.

This study undertook qualitative research to understand how stakeholders use statistical estimates of road traffic injuries in national policy dialogue. A systematic review was conducted of the availability of nationally representative epidemiological data sources on road traffic deaths and injuries in LMICs. Additionally, four case studies were conducted in Brazil, Cambodia, Ethiopia, and Tanzania to estimate the true incidence of road traffic injuries using local epidemiological data sources and the magnitude of underreporting in official statistics, and to assess the reasons for discrepancies in estimates with the global statistical models.

## Key Findings of This Study

- National decision-makers and road safety practitioners acknowledge the issue of underreporting in official statistics, but they often dismiss the much higher estimates made by the global statistical models because these are perceived to be estimates by foreign agencies. However, comparisons with local epidemiological data greatly increase the acceptability of statistical estimates and lead to greater acceptance of underreporting in official statistics.
- Countries mostly use the WHO GSRRS estimates. However, GBD reports national cause-of-death rankings that allow comparing the scale of the road traffic injury problem with other health issues confronting countries. GSRRS does not report such rankings. GHE estimates are not widely used.
- WHO GSRRS estimates do not align with the WHO GHE.
- National health surveys and censuses in LMICs often include questions that allow measuring the incidence of road traffic deaths and injuries, the prevalence of resulting disabilities, and household ownership of bicycles and motor vehicles. In many other surveys, minor modifications to existing survey instruments can greatly increase their use for such measurement.
- The country case studies show that data from national health surveys, mortality surveys, and censuses tend to provide estimates that are consistent with each other, and including these data in global statistical models can help resolve discrepancies and build confidence in estimates.

## Key Recommendations

- Incorporating epidemiological data sources identified in this report into the global statistical models (GBD, GHE, and GSRRS) can help resolve discrepancies in the models and build confidence in their estimates. Additionally, updating the GBD's covariate models that estimate national vehicle ownership with data from household surveys on bicycle and motor vehicle ownership can improve the accuracy of its estimates.
- Agencies supporting the implementation of national health surveys can facilitate epidemiological measurements of road traffic injuries by including relevant questions in upcoming national data collections. The United States Agency for International Development's Demographic and Health Surveys and the World Bank's Living Standards Measurement Study especially offer valuable opportunities to expand such epidemiological measurements.
- Involving local capacity, context, and data in producing country estimates can help draw on all available data sources and produce better estimates. The case studies in this report are a valuable starting point and template for such efforts.
- Improving coordination and collaboration between the Institute for Health Metrics and Evaluation and the World Health Organization can harness each institution's strengths to improve estimates of road traffic injuries and reduce inconsistencies.

National governments worldwide will need to direct substantial resources to road safety if they are to achieve the goal of the Second United Nations Decade of Action for Road Safety: to reduce by 50 percent the number of road traffic fatalities and injuries by 2030. Accurate annual reporting and statistical estimates of road traffic deaths and injuries are required to accomplish this goal.

# 1. Background and Motivation

National governments worldwide will need to direct substantial resources to road safety if they are to achieve the goals of the United Nations (UN) Second Decade of Action of Road Safety of reducing road traffic deaths and serious injuries by half by 2030. Road traffic injuries have emerged as a leading threat to population health in low- and middle-income countries (LMICs), which suffer more than 90 percent of the global road crash deaths.[1, 2] In 2019, traffic crashes killed an estimated 1.2 million people globally and were the seventh leading cause of population health loss.[3] The global traffic death toll has remained stable at a high level since the year 2000 and now exceeds deaths from HIV/AIDS, tuberculosis, and malaria, all of which saw large declines during this period (50 percent, 38 percent, and 34 percent, respectively).[4]

In contrast to the situation in LMICs, traffic deaths in high-income countries have been declining since the 1960s after they implemented regulatory reform that established national road safety agencies with a mandate and the resources necessary to undertake large-scale road safety action.[5] These agencies undertook interventions that focused on vehicles, road infrastructure, road user behavior, and post-crash care, using what is now called the Safe System approach.[6, 7]

However, most LMICs have failed to similarly prioritize road safety in the national policy agenda despite substantial global advocacy. The 2004 *World Report on Road Traffic Injury Prevention*, issued jointly by the World Bank and the World Health Organization (WHO),[8] was followed by a series of eight resolutions by the UN General Assembly and the World Health Assembly and three global ministerial conferences calling on LMICs to increase investments in safety interventions.[9] The 2012 UN resolution proclaimed 2011–20 to be the global Decade of Action for Road Safety. Nevertheless, despite these global efforts, progress has been slow toward making the investments and regulatory changes necessary for running effective national road safety programs in LMICs, and few countries have made adequate progress during this period.[10] A new UN resolution in 2020 has renewed global commitments and declared 2021–30 the Second Decade of Action for Road Safety.[11] However, persuading LMICs to make road safety investments commensurate with the scale of the problem is still a primary concern of international efforts.

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1 WHO (World Health Organization). 2018. *Global Status Report on Road Safety 2018*. Geneva: WHO.

2 Vos, T., S. S. Lim, C. Abbafati, K. M. Abbas, M. Abbasi, M. Abbasifard, M. Abbasi-Kangevari et al. 2020. "Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019." *The Lancet* 396 (10258): 1204–22. doi:10.1080/17457300.2019.1704789.

3 Vos et al., "Global Burden of 369 Diseases and Injuries."

4 WHO, *Global Status Report on Road Safety 2018*.

5 Bhalla, K., D. Mohan, and B. O'Neill. 2020. "What Can We Learn from the Historic Road Safety Performance of High-Income Countries?" *International Journal of Injury Control and Safety Promotion* 27 (1): 27–34. doi:10.1080/17457300.2019.1704789.

6 Peden, M., R. Scurfield, D. Sleet, D. Mohan, A. A. Hyder, E. Jarawan, and C. Mathers, eds. 2004. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization.

7 Bliss, T., and J. Breen. 2009. *Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies, and Safe System Projects.* Washington, DC: The World Bank Global Road Safety Facility.

8 M. Peden et al. *World Report on Road Traffic Injury Prevention.*

9 WHO. n.d. "Resolutions and UN Secretary-General's Reports." Accessed February 21, 2023.

10 Third Global Ministerial Conference on Road Safety. 2020. "Stockholm Declaration: Achieving Global Goals 2030." Accessed March 20, 2021.

11 UN (United Nations). 2020. "Resolution Adopted by the General Assembly on 31 August 2020: Improving Global Road Safety." A/RES/74/299, UN, New York.

Road safety is still low on many LMICs' policy agendas, at least partly because countries underestimate the magnitude of their traffic injury problem compared with other pressing social concerns. For example, WHO's Global Status Reports on Road Safety (GSRRS) include modeled estimates of road traffic deaths in all countries. A comparison of GSRRS estimates with officially reported data shows that in many countries that have the weakest road safety policies, estimates of road traffic deaths are more than five times higher than the official statistic (figure 1.1). The magnitude of these discrepancies is meaningful from the perspective of national priorities. Typically, the estimates from the global health statistical projects show that road traffic deaths are among the top 10 causes of death in these countries, often with death counts comparable to diseases such as malaria or HIV/AIDS that are considered important on the national policy agenda. By contrast, the official statistics usually place road traffic deaths much lower, often not even in the top 20 causes of death.

However, estimates from the Institute for Health Metrics and Evaluation's Global Burden of Disease (GBD) study often vary from those reported by GSRRS (box 1.1), especially in information-poor settings (figure 1.2). Both GBD and GSRRS estimates of road traffic deaths use statistical models that rely on a variety of cause-of-death data sources (especially vital registers and verbal autopsies) and covariates (for example, development indicators and vehicle fleet). GBD and GSRRS estimates of road traffic deaths are reasonably consistent with each other and with official statistics in regions with high-quality vital registration data, which includes most countries in the Americas, Australasia, and Europe. However, in countries without low-quality vital registers (which includes most countries in Sub-Saharan Africa, Middle East and North Africa, South Asia, and Southeast Asia), the differences in GBD and GSRRS methods lead to large discrepancies in estimates. For instance, GSRRS estimates of road traffic deaths in the western Sub-Saharan Africa region are more than twice the GBD estimates.

**Box 1.1.** Global Health Statistical Models

Three major projects develop national-level estimates of road traffic injuries.

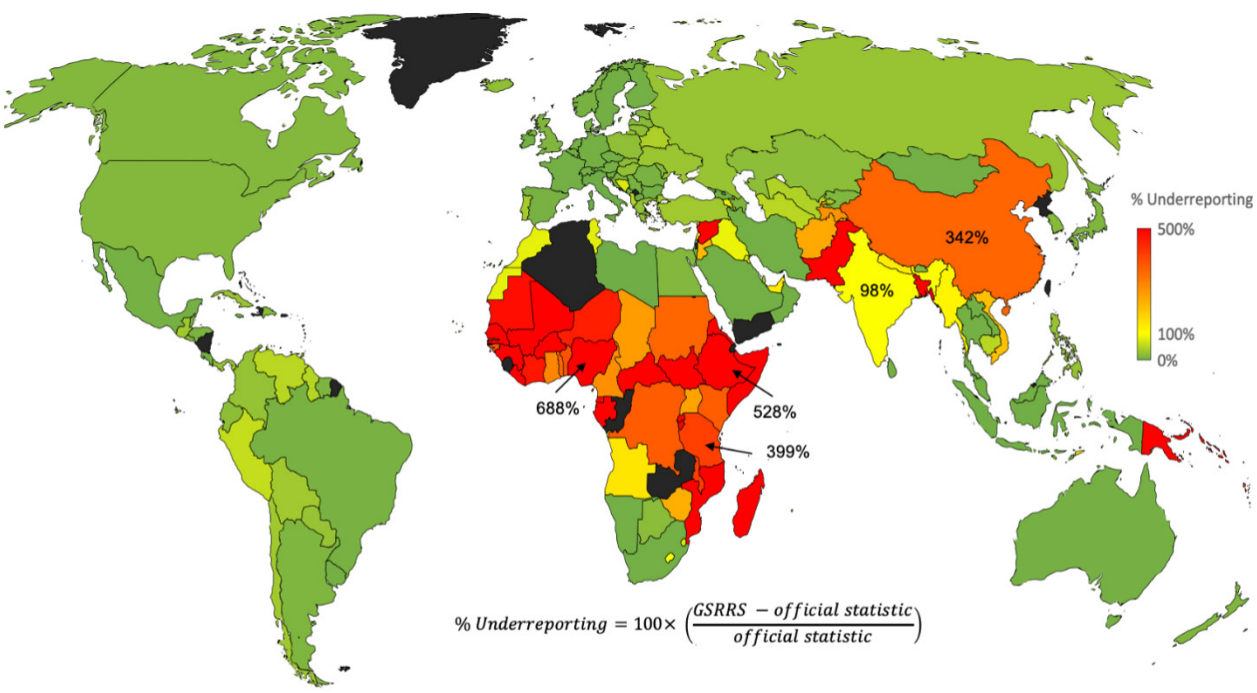
1. **Global Burden of Disease (GBD) Project:** Led by the Institute for Health Metrics and Evaluation at the University of Washington, GBD is a collaborative research study that assesses population health loss from major diseases, injuries, and risk factors in all countries globally. This includes estimates of deaths and nonfatal road traffic injuries, including separate estimates for pedestrians, bicyclists, motorcyclists, and vehicle occupants. The project aims to use all available data sources after correcting for source-specific biases. Results from GBD are published in leading academic journals and disseminated through online data visualization and download tools.
2. **Global Status Reports on Road Safety (GSRRS):** Led by the World Health Organization (WHO), GSRRS is a series of reports published approximately every two years since 2009. The reports are developed through an iterative and consultative process with country governments coordinated through national data coordinators appointed by WHO. In addition to country-reported statistics, GSRRS includes statistical estimates of national road traffic deaths developed by WHO.
3. **Global Health Estimates (GHE):** Led by WHO, GHE provide the latest available data on death and disability globally, by region and country, and by age, sex and cause. The latest updates include global, regional and country trends from 2000 to 2019 inclusive

*Source:* Global Road Safety Facility; World Bank.

The World Bank engages with LMICs to support evidence-based and result-oriented strategies to reduce road traffic injuries that countries primarily rely on their official road safety statistics. However, comparisons with global statistical models show that in many LMICs, official statistics severely underreport traffic injuries. Nevertheless, discrepancies between estimates from the two major global statistical models are a critical barrier to convincing client countries that the true road traffic injury toll is much higher than officially reported numbers. Therefore, understanding how country stakeholders use statistics from various sources in road safety policy dialogue, the sources of discrepancies in statistical estimates, and how modeling efforts can be strengthened to reduce these discrepancies is vital to the World Bank's and other international agencies' engagement with the countries for the global road safety efforts during the Second Decade of Action for Road Safety. With this background, the Global Road Safety Facility undertook a study with the following components:

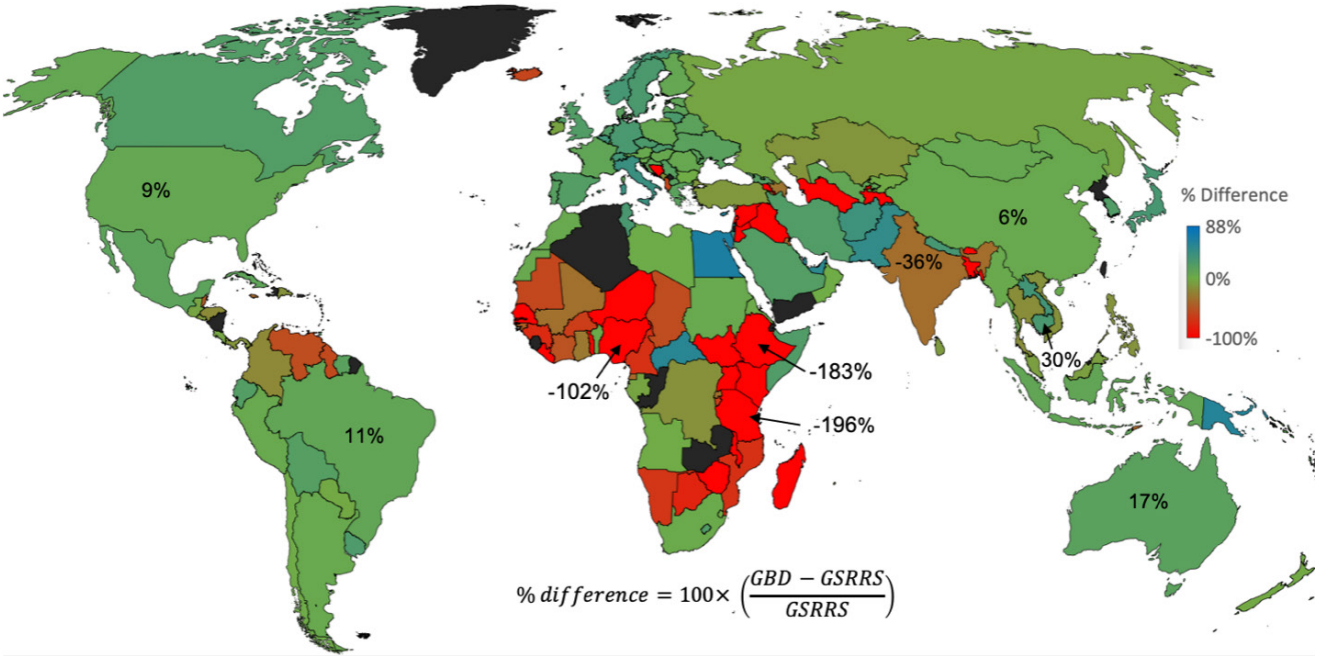
1. Stakeholder interviews: qualitative research to understand how researchers and decision-makers use road traffic injury statistics, including official statistics and global statistical models, in national policy dialogue
2. Review of data sources: systematic review of the availability of nationally representative epidemiological data sources for estimating road traffic deaths and injuries in all LMICs
3. Country case studies: detailed analyses for selected countries (Brazil, Cambodia, Ethiopia, and Tanzania) to estimate the true incidence of road traffic deaths and injuries and to assess the reasons for discrepancies between these estimates and official statistics, and estimates from global statistical models
4. Recommendations: for improving country-reported numbers and reducing discrepancies in global statistical models

**Figure 1.1.** Underreporting of Road Traffic Deaths in Official Statistics in LMICs, Based on Comparisons with GSRRS 2018 Estimates




*Source:* Global Road Safety Facility; World Bank.
*Note:* Black denotes no data. GSRRS = Global Status Reports on Road Safety; LMIC = low- and middle-income country.

**Figure 1.2.** Discrepancies between Estimates of Road Traffic Deaths from the GBD 2019 and GSRRS 2018 Global Health Statistical Models




*Source:* Global Road Safety Facility; World Bank.
*Note:* Black denotes no data. GBD = Global Burden of Disease; GSRRS = Global Status Reports on Road Safety.

# 2. Use of Road Traffic Injury Statistics in National Policy Dialogue

Comparisons with estimates from global statistical models show that police-reported official statistics in most low- and middle-income countries (LMICs) substantially underreport road traffic deaths and nonfatal injuries (figure 1.1), leading to the problem being ranked lower in national health and development priorities. Road safety advocates have been highlighting this issue for several years with the goal of encouraging countries to acknowledge the true burden of traffic injuries and scale up investments in road safety programs. However, with a few notable exceptions (the Islamic Republic of Iran and Thailand, for example), most LMICs have continued to rely on traffic police as their official source for traffic death injury statistics.

The Global Road Safety Facility conducted 15 interviews with road safety stakeholders to understand how they use epidemiological evidence from global health statistical models, official statistics, and other data sources in national policy dialogue. Interviewees included researchers, practitioners, and decision-makers from LMICs (Ethiopia, India, the Islamic Republic of Iran, and Nigeria) and international development agencies. Analysis of the interviews highlighted the following pertinent issues.

**Road safety stakeholders in LMICs are aware that estimates of road traffic deaths and injuries from global statistical models are usually much higher than official reports.** In most cases, this is based on knowledge about the Global Status Reports on Road Safety (GSRRS) estimates. All respondents described extensive use of GSRRS estimates in country dialogue on underreporting of official statistics. By contrast, although most respondents were aware of the Global Burden of Disease (GBD) project, many assumed that there was only a single set of estimates from global statistical models, which were the GSRRS estimates. Respondents noted that the World Health Organization engages extensively in national road safety dialogue, which is often anchored by the development and release of the GSRRS reports every two years. In producing the GSRRS reports, the World Health Organization relies on country-level and regional-level data coordinators, national consensus meetings, and official government clearances for the data provided for inclusion in GSRRS reports. This process results in extensive attention to the comparison of official statistics with GSRRS estimates in countries, resulting in most national practitioners being aware of the GSRRS estimates and associated claims of underreporting in official statistics. Several respondents noted that the GBD project is used extensively in dialogue within the health sector, which is not at the center of the policy discourse on road safety.

Among the reasons for why the GBD estimates are less used, respondents noted that GBD reports metrics, such as disability-adjusted life years lost, that are poorly suited for dialogue in the road safety community. Most practitioners do not know how to interpret disability-adjusted life years metrics and prefer estimates of the incidence of deaths and serious injuries, which are the main outcome measures used in road safety policy dialogue. Although GBD does not report the incidence of serious nonfatal injuries, it does report total nonfatal injuries, which most respondents did not realize. **However, many respondents described their extensive**

**use of GBD's online visualization tools for cause-of-death rankings and noted the vital importance of these rankings in advocacy work.** GSRRS does not report such rankings.

Many respondents did not realize that GBD and GSRRS were separate projects, but those who did were unaware of the large discrepancies in GBD and GSRRS estimates. In fact, except for three respondents whose professional work includes a strong focus on measurement, respondents were surprised to learn about the large discrepancies. When presented with these comparisons, several expressed frustrations with global modeling efforts and noted that such discrepancies do damage to their advocacy efforts. Some respondents saw the discrepancies as evidence that global statistical models (both GBD and GSRRS) are unreliable sources. One senior policymaker from a Sub-Saharan African country used the discrepancies to defend his position that their official statistics are broadly reliable (GSRRS 2018 estimates in the country are more than five times higher).

When asked whether they believed the true estimate could be much higher than official statistics, respondents usually noted that global models do not use local data on traffic crashes and rely primarily on regression models that should not be taken seriously. This widespread view appears to be largely informed by correct knowledge of GSRRS methods, in which epidemiological data on road traffic deaths are used only for countries with reliable vital registration data and thus exclude most LMICs. When respondents were told that GBD includes many national and subnational data sources from countries without high-quality vital registration, they were much more circumspect and expressed greater willingness to reconsider the validity of the modeled estimates. **Note that in these conversations, it was clear that the use of local epidemiological data in models was critical to convince stakeholders.**

By contrast, respondents provided inconsistent responses to whether it mattered who had constructed the estimates—that is, local or foreign researchers or agencies. Senior bureaucrats tended to dismiss reports from foreign research teams, but several researchers pointed out that in the politics of these debates in countries, the researchers' prominence—whether foreign or local—mattered substantially. They noted that national decision-makers often took foreign researchers more seriously, even when local researchers provided much stronger evidence.

The respondents who acknowledged underreporting in official statistics offered a similar set of reasons for the underreporting, primarily the state's weak capacity to do surveillance (investigate, register, and report all road traffic deaths). Many countries have medicolegal requirements to report all traffic deaths to police, but crash victims can have strong sociological or religious reasons to avoid police interactions. For example, police involvement and medicolegal investigations can introduce significant delays and result in autopsies that involve the dissection of the body for postmortem examination. Several respondents noted that in many cultures, burial or cremation as soon as possible after death shows respect for the dead and preserves the dignity of the deceased. They also noted that this issue may be more salient in Islamic law and cultural practices and may be an important reason for underreporting of road traffic deaths in some countries. The issue is also more significant in regions within countries where the presence of state institutions is weak, and where crash victims are often able to avoid involving the police. Finally, respondents noted that some other countries may not have any legal requirements to report to police. Most respondents suggested that the primary way to address underreporting in official statistics is to build state surveillance capacity through allocating resources to establish crash surveillance infrastructure, increase the human resources available for crash investigation, and run ongoing training programs.

When asked about their guess of the overall magnitude of underreporting in their country, it was striking that senior bureaucrats and researchers tended to consistently respond with a low estimate of 15–30 percent, regardless of whether other sources suggested that underreporting was relatively low (for example, the Islamic Republic of Iran) or extremely high (for example, Nigeria, about 700 percent). Thus, it was clear that in debates about underreporting, most stakeholders do not contest estimates of deaths that are less than about 30 percent higher than official statistics. However, respondents typically asked for evidence when presented with estimates that were substantially higher (for example, greater than 100 percent). In these conversations, it was clear that evidence that came from nationally representative surveys or population registries commissioned by government agencies was considered much more legitimate than estimates from global statistical models. Respondents from the Islamic Republic of Iran noted that convincing evidence that the death toll was likely much higher than official statistics came from improvements in their national forensic medicine and death registration systems. In India, similar evidence that the death toll may be substantially higher than official statistics began to accumulate after the Registrar General included a verbal autopsy–based cause-of-death component in a large routine demographic survey (the Sample Registration System) starting in 1998. Note that Ethiopia conducted a nationally representative health survey in 2016, the 2016 Demographic and Health Survey, that included questions that allow estimating road traffic mortality. When asked about this survey, both respondents from Ethiopia noted that it is an important source of health data in the country, but they were unaware of the use of these estimates in the national dialogue about underreporting as yet.

When asked about how to estimate the magnitude of underreporting in official statistics, respondents often recommended conducting record linkage studies, even though such methods would be poorly suited for an unbiased estimate of underreporting. Unless the linked data sources are independent, record linkage will underestimate underreporting. Notably, respondents provided examples of studies that linked hospital and police data primarily to highlight that concerns about underreporting were overstated. For example, a respondent from a Sub-Saharan African country insisted that the police register about 60 percent of traffic deaths in the country (GSRRS suggests that only 16 percent are registered), based on a study that linked records from police and hospitals on a major highway corridor. However, the study is likely to severely underestimate underreporting because it did not include settings where underreporting is expected to be much higher (rural roads, for example). Furthermore, police are much more likely to register deaths that occur at hospitals. But respondents who work at multilateral agencies pointed out that such record linkage studies are common and are the main methods that countries use to assess underreporting.

## Implications for Strengthening Statistics for Use in Safety Advocacy

National decision-makers are much more willing to acknowledge underreporting in official statistics of road traffic injuries when alternate estimates are derived from local epidemiological data. Therefore, it is important that global statistical models increase their use of local data sources, which will reduce the modeled uncertainty in estimates and the discrepancies between GBD and GSRRS while increasing the perceived legitimacy of statistical estimates in national policy discourse. Although both GBD and GSRRS rely heavily on national vital registration systems, these are not available in most LMICs. However, LMICs often have other sources of epidemiological data on the incidence of injuries, such as national health surveys and censuses, that global models should include as data sources (box 1.2). Therefore, there is a need for a systematic assessment of the availability of nationally representative data sources for measuring the incidence of road traffic injuries in LMICs. A recent joint publication from the World Bank and the International Transport Forum, *Guidelines*

*for Conducting Road Safety Data Reviews*, also emphasizes the need for a thorough road safety data review in countries and developed guidelines for it.[12] Such data review can help countries understand the importance of road safety data by pinpointing possible sources of underreporting of casualties, help make maximum use of all available data, and possibly identify additional data. Task teams from the World Bank and other international agencies can facilitate this dialogue with country officials to initiate such data review.

Making a convincing case for underreporting in official statistics requires detailed country case studies that compare data sources. These country reports should include explicit comparisons of official statistics and global statistical estimates with local data sources whenever such sources are available. Such comparisons can also provide insights into the sources of discrepancies between GBD and GSRRS and how to address them.

Relatively few LMICs have alternate epidemiological data sources available for assessing the quality of official reporting. Therefore, it is important for task teams to engage in policy dialogue with the national statistics and surveillance office and encourage the inclusion of road traffic injury modules in upcoming national health surveys and strengthening other surveillance systems (such as vital registration systems) that can be used to assess the level of underreporting in official statistics.

12 Martensen, H., G. Duchamp, V. Feypell, V. I. Raffo, F. A. Burlacu, B. Turner, and M. Paala. 2022. *Guidelines for Conducting Road Safety Data Reviews*. Washington, DC: World Bank.

# 3. National Epidemiological Data Sources for Estimating Road Traffic Injuries

Epidemiological data on the incidence of road traffic injuries are often available from sources other than official statistics, which are usually derived from police reports in most countries (box 3.1). These include vital registers, nationally representative health surveys, and verbal autopsies. Among these, high-quality national vital registration statistics are the preferred data source for estimating cause-of-death patterns and are the primary source of information for estimating national road traffic mortality in global health statistical models. Although almost all countries in high-income regions have high-quality vital registration data, the completeness and quality of cause coding of vital registration statistics varies dramatically across LMICs.[13] Many countries in Latin America have reasonably high-quality data (rated three stars or better on the Institute for Health Metrics and Evaluation's five-star rating scale; figure 3.1), but most countries in Africa do not have usable vital registration data (most are rated 0 stars), with some notable exceptions such as South Africa (rated four stars). In these regions, alternative data sources are needed for estimating road traffic deaths in most LMICs.

**Box 1.2.** Key Data Sources

This report refers to several key epidemiological data sources that injury researchers can use to estimate the incidence of road traffic deaths and nonfatal injuries in low- and middle-income countries (LMICs). A detailed description of such data sources is available in the 2014 Global Road Safety Facility Report, *Burden of Road Injuries in Sub-Saharan Africa*.

**Vital registration systems:** Health researchers typically consider high-quality civil registration and vital statistics systems among the most important data sources for estimating national road traffic mortality. Notably, high-quality data from these systems are available from several countries in Latin America (for example, Brazil). However, most LMICs in other global regions do not have such data because of low completeness (low proportions of deaths are recorded) and poor quality of cause-of-death coding (many deaths are coded to unspecified or partially specified causes).[a]

**National population censuses:** LMICs sometimes include a mortality module in their censuses to estimate adult mortality and maternal mortality. Occasionally, these modules include additional questions that allow estimating road traffic injury mortality (for example, in Tanzania; figure B1.2.1).

13 Johnson, S. C., M. Cunningham, I. N. Dippenaar, F. Sharara, E. E. Wool, K. M. Agesa, C. Han et al. 2021. "Public Health Utility of Cause of Death Data: Applying Empirical Algorithms to Improve Data Quality." *BMC Medical Informatics and Decision-Making* 21: 175. doi:10.1186/s12911-021-01501-1.

### Questions Related to Road Traffic Deaths in the Mortality Module of a Census

(31) Was there any death which occurred in this household during the last 12 months? YES=1 NO=2 ☐

IF THE ANSWER IS YES RECORD THE NUMBER OF DEATHS ☐☐

IF THE ANSWER IS NO GO TO QUESTION 39

| Death Number | Was the deceased a male or a female?<br><br>Male =1<br>Female =2 | How old was the deceased at the time of death?<br><br>WRITE AND SHADE AGE IN COMPLETED YEARS. IF UNDER ONE YEAR WRITE AND SHADE "00" IF 97 YEARS OR ABOVE WRITE '97' | What was the cause of death?<br><br>Road Accident = 1<br>Other Injuries = 2<br>Suicide = 3<br>Violence = 4<br>Sickness/Disease = 5<br>Martenal Death = 6<br>Other (Specify) = 7 | IF DEATH IS OF A WOMAN AGED BETWEEN 12 AND 49 YEARS | | |
|---|---|---|---|---|---|---|
| | | | | Did the death occur during pregnancy?<br><br>YES = 1<br>NO=2<br>IF THE ANSWER IS YES, GO TO QUESTION 39 | Did the death occur during childbirth<br><br>YES = 1<br>NO=2<br>IF THE ANSWER IS YES, GO TO QUESTION 39 | Did the death occur during the 6 weeks period following the end of pregnancy, irrespective of the way the pregnancy ended?<br><br>YES = 1<br>NO = 2 |

*Source:* Tanzania 2012 census questionnaire.

**Verbal autopsy:** Many LMICs use a verbal autopsy to assess causes of death. This involves a process in which family members of the deceased are asked about the circumstances and symptoms prior to death using a structured questionnaire. In some countries (for example, China, India, Tanzania, and Zambia), verbal autopsies have been performed as part of nationally representative mortality surveys.

**National household surveys:** Many countries, including in the most information-poor regions, conduct household health surveys regularly that include questions about the incidence of fatal and nonfatal road traffic injuries. The national health and statistical agencies conduct these surveys, often in partnership with international agencies. For example, figure B1.2.2 is an excerpt from the injury module included in the Demographic and Health Survey conducted in Ethiopia in 2016. The survey, which is supported by the United States Agency for International Development, has been conducted in more than 90 countries

### Questions Related to Road Traffic Deaths in the Mortality Module of a Census

| | | | | | |
|---|---|---|---|---|---|
| 146 | In the last 12 months, was any child or adult OF YOUR HOUSEHOLD killed or injured in any incident with injuries severe enough that for at least one day they could not carry out their normal activities? | | YES . . . . . 1<br>NO . . . . . 2 | | |
| 149 | Could you tell me in what type of accident (NAME) was injured or killed? | ROAD TRAFFIC ACCIDENT . . . 01<br>VIOLENCE/ASSAULT . . . . . 02<br>FIRE/BURNING . . . . . 03<br>ANIMAL BITE . . . . . 04<br>ACCIDENTAL FALL . . . . . 05<br>DROWNING . . . . . 06<br>POISONING . . . . . 07<br>KICKED BY CATTLE . . . . . 08<br>FALL FROM TREE/BUILDING /ANIMAL BACK . . . . . 09 | 151 | Is (NAME) still alive? | YES . . . . . 1<br>NO . . . . . 2<br>(GO TO 154) |
| | | | 152 | For how long did (NAME)'s injury prevent her/him from carrying out her/his normal daily activities? | LESS THAN 7 DAYS . . . . . 1<br>BETWEEN 8 TO 30 DAYS . . . . . 2<br>BETWEEN 2 TO 6 MONTHS . . . . . 3<br>LONGER THAN 6 MONTHS . . . . . 4<br>DON'T KNOW . . . . . 8 |

*Source:* Ethiopia 2016 Demographic and Health Survey questionnaire.

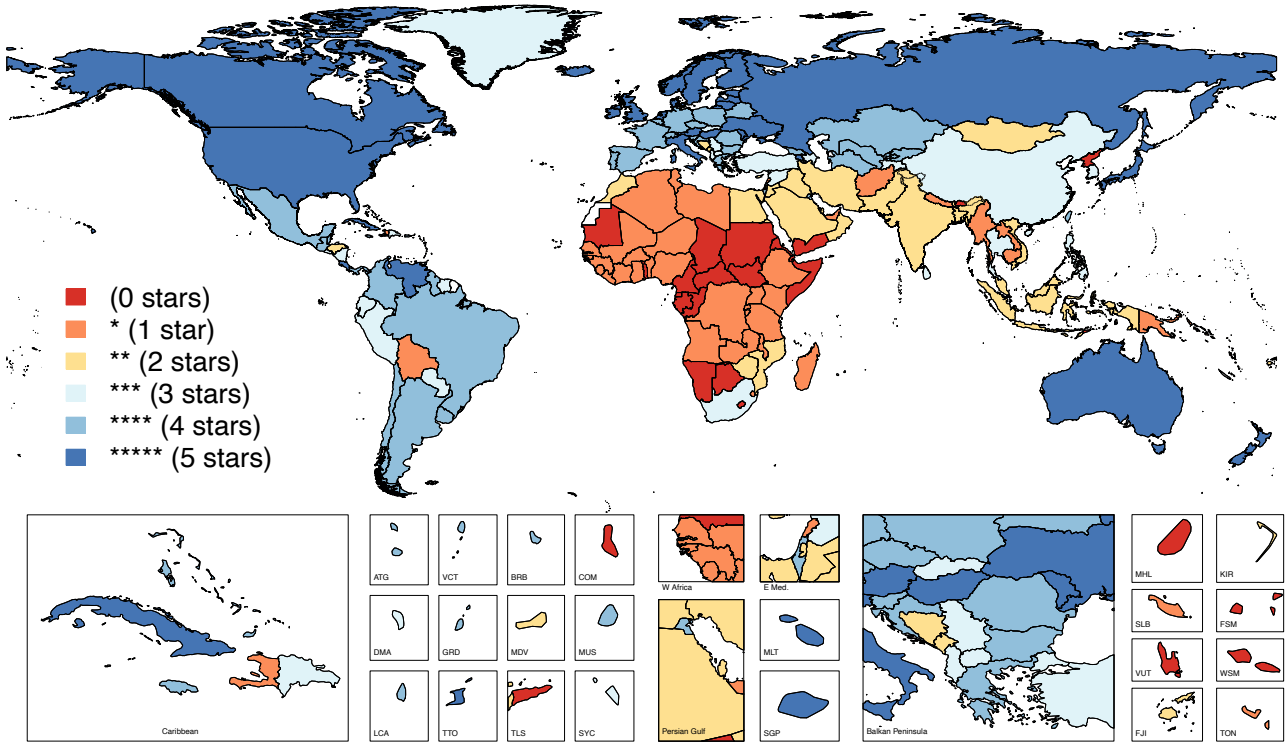
**Traffic police reports:** In most countries, official statistics of road traffic deaths and nonfatal injuries are available from their national traffic police. The Global Status Reports on Road Safety currently aggregate this information from most countries. Older data are available from the International Road Federation's World Road Statistics database.

*Sources:* GRSF, World Bank.

a. Johnson, S. C., M. Cunningham, I. N. Dippenaar, F. Sharara, E. E. Wool, K. M. Agesa, C. Han et al. 2021. "Public Health Utility of Cause of Death Data: Applying Empirical Algorithms to Improve Data Quality." *BMC Medical Informatics and Decision-Making* 21 (1): 175. doi:10.1186/s12911-021-01501-1.

Household surveys and decennial censuses sometimes include questions about the deaths of household members or involvement in nonfatal road traffic injuries, or both. Therefore, a systematic review was conducted to assess the availability of questions relevant to estimating road traffic deaths and injuries in nationally representative household surveys and population censuses in LMICs. The review aimed to identify where these data sources can be used to estimate road traffic deaths and injuries and find opportunities to strengthen such measurements in future data collection.[14]

**Figure 3.1.** Quality of National Vital Registration and Verbal Autopsy Data (1980–2018) for Estimating Causes of Death




*Source:* Institute for Health Metrics and Evaluation.

# Method

A search was conducted for nationally representative household surveys and population censuses in LMICs that included questions that allow estimation of (i) the incidence of road traffic deaths; (ii) incidence of nonfatal road traffic injuries; (iii) prevalence of permanent disability because of road traffic injuries; and (iv) household ownership of bicycles, motorcycles, cars, and other vehicles. Vehicle ownership was included because vehicles are important covariates of road traffic injuries and thus important for improving estimates in countries where epidemiological measurements on road traffic injuries are sparse or unavailable. For (i)–(iii), data sources for the broader categories of unintentional injuries or all injuries were also included for two reasons. First, traffic

14 The detailed findings of this study were published in Mitra S., K. Neki, L. W. Mbugua, H. Gutierrez, L. Bakdash, M. Winer, R. Balasubramaniyan et al. 2021. "Availability of Population-Level Data Sources for Tracking the Incidence of Deaths and Injuries from Road Traffic Crashes in Low-Income and Middle-Income Countries." *BMJ Global Health* 6: e007296. doi:10.1136/bmjgh-2021-007296.

injuries are the leading cause of unintentional injuries (70 percent of unintentional injury deaths) and total injuries (28 percent of injury deaths), suggesting that improving the accuracy of unintentional and total injury measurement could reduce the uncertainty in traffic injury estimates substantially. Second, these surveys represent a measurement opportunity. Relatively small changes to the questions in future rounds of these surveys could enable direct measurement of road traffic injuries.

The International Household Survey Network (IHSN) repository was the main data source for survey instruments.[15] It is the most comprehensive collection of metadata and documents (including questionnaires) on household surveys conducted in LMICs. IHSN includes information about most health surveys conducted by national governments and international development agencies, such as the Demographic and Health Surveys,[16] Multiple Indicator Cluster Surveys,[17] and the Living Standards Measurement Surveys.[18] For questionnaires that were not in IHSN, other major data repositories were searched, including the MEASURE Evaluation project and the Global Health Data Exchange websites,[19, 20] and national statistical websites. The main data source for national population and housing census instruments was the Integrated Public Use Microdata Series (International).[21] For countries whose questionnaires were not in these collections, the United Nations Statistical Division's Population Censuses' Datasets (1995–Present),[22] Global Health Data Exchange, and national statistical websites were searched. Attention was restricted to nationally representative surveys since the year 2000 and excluded surveys that were subnational or household surveys with a sample size of less than 2,000.

## Key Findings

The review found that it is common for LMICs to collect nationally representative data that allow estimating the incidence of road traffic deaths and injuries. The study identified 802 nationally representative surveys and population censuses conducted in 127 LMICs since 2000. More than three-quarters (77 percent) of the global LMIC population had at least one survey or census since 2000 that asked about causes of death and had traffic crashes as an option, ranging from a low of 20 percent for Middle East and North Africa to a high of 100 percent for South Asia (table 3.1). Population coverage was slightly higher for information on deaths caused by unintentional or all injuries (85 percent of the global LMIC population, ranging from 28 percent in Europe and Central Asia to 100 percent in South Asia). Population coverage for nonfatal injuries was higher than for deaths. Ninety percent of the global LMIC population had at least one survey or census since 2000 that asked about involvement of respondents or household members in a road traffic crash, ranging from a low of 48 percent in Europe and Central Asia to a high of 100 percent in South Asia. As with mortality, population coverage was slightly higher for information on unintentional or all injuries. The review also assessed the availability of data on vehicle ownership because it is among the most important covariates of traffic injuries

15 See the International Household Survey Network at https://ihsn.org/.

16 USAID (United States Agency for International Development). n.d. "The DHS Program." Accessed March 20, 2021.

17 UNICEF (United Nations Children's Fund). "Surveys, UNICEF MICS [Multiple Indicator Cluster Surveys]: UNICEF Data: Monitoring the Situation of Children and Women." Accessed March 20, 2021.

18 World Bank. n.d. "The Living Standards Measurement Study (LSMS)." Accessed March 20, 2021.

19 University of North Carolina at Chapel Hill. n.d. "MEASURE Evaluation." Accessed March 20, 2021.

20 IHME (Institute for Health Metrics and Evaluation). n.d. "Global Health Data Exchange." Accessed March 20, 2021.

21 Minnesota Population Center (IPUMS International). "Harmonized International Census Data for Social Science and Health Research." Accessed March 20, 2021.

22 United Nations Statistical Division (UNSTAT). "Population Censuses' Datasets (1995–Present)." Accessed March 20, 2021.

in global statistical models. Of the current global LMIC population, 97 percent had at least one measurement since 2000 of household ownership of bicycles, motorcycles, and cars. Population coverage of vehicle ownership was the highest (greater than 99 percent) for Sub-Saharan Africa, South Asia, and East Asia and Pacific.

Figures 3.2 and 3.3 restrict attention to the period since 2010 and highlight that many LMICs have included questions on road traffic injuries in recent surveys. Although there were only 21 LMICs with data sources since 2010 that included questions on road traffic deaths, there were many more on mortality (41 LMICs, 74 data sources) because of the less-specific causes (unintentional or all injury), of which 20 countries (41 data sources) were from Sub-Saharan Africa. The review found 75 data sources since 2010 from 62 countries that included questions on nonfatal injuries sustained by household members in road traffic crashes (figure 3.3). Of these, 21 data sources (18 countries) were from East Asia and Pacific, 19 (16 countries) were from Latin America and the Caribbean, and 16 (13 countries) were from Sub-Saharan Africa. Almost twice as many (144 data sources, 87 countries) had information on the less specific category of unintentional or all injury.

**Table 3.1.** Percentage of Population in LMICs with at Least One Measurement since 2000, by World Bank Region and Country Income Group

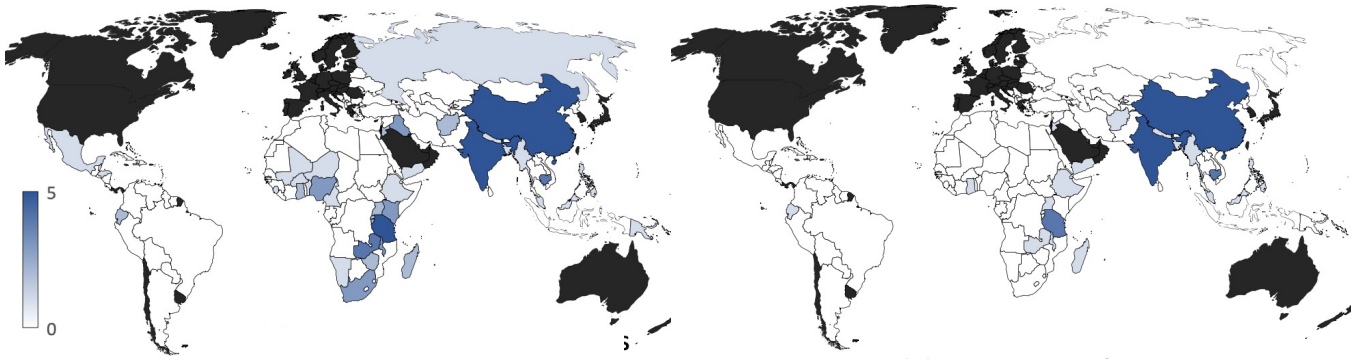
| World Bank Region | Country income group | Population (2019) | Vehicle ownership | | | Deaths | | Nonfatal | | Disability | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bicycle (%) | Motorcycle (%) | Car (%) | Injury/ accident (%) | Traffic (%) | Injury/ accident (%) | Traffic (%) | Injury/ accident (%) | Traffic (%) |
| **East Asia and Pacific** | Low | 25,716,644 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Lower middle | 548,547,392 | 100 | 100 | 100 | 52 | 50 | 100 | 98 | 4 | 3 |
| | Upper middle | 1,773,213,090 | 100 | 100 | 100 | 85 | 85 | 85 | 85 | 80 | 80 |
| | Total | 2,347,477,126 | 99 | 99 | 99 | 77 | 76 | 88 | 88 | 61 | 61 |
| **Europe and Central Asia** | Low | — | — | — | — | — | — | — | — | — | — |
| | Lower middle | 102,978,646 | 100 | 100 | 100 | 47 | 47 | 93 | 87 | 0 | 0 |
| | Upper middle | 322,773,474 | 92 | 93 | 93 | 80 | 80 | 87 | 82 | 47 | 47 |
| | Total | 425,752,120 | 94 | 94 | 94 | 72 | 72 | 89 | 83 | 35 | 35 |
| **Latin America and the Caribbean** | Low | 11,824,835 | 100 | 100 | 100 | 100 | 0 | 100 | 100 | 100 | 0 |
| | Lower middle | 50,449,534 | 100 | 100 | 100 | 52 | 34 | 100 | 100 | 23 | 0 |
| | Upper middle | 556,291,832 | 88 | 91 | 99 | 77 | 77 | 92 | 92 | 33 | 23 |
| | Total | 618,566,202 | 90 | 92 | 99 | 75 | 72 | 93 | 93 | 34 | 20 |
| **Middle East and North Africa** | Low | — | — | — | — | — | — | — | — | — | — |
| | Lower middle | 208,609,121 | 93 | 93 | 100 | 43 | 42 | 100 | 100 | 72 | 8 |
| | Upper middle | 192,013,433 | 44 | 86 | 92 | 23 | 0 | 52 | 52 | 0 | 0 |
| | Total | 400,622,554 | 69 | 90 | 96 | 33 | 22 | 77 | 77 | 38 | 4 |
| **South Asia** | Low | 62,746,290 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 52 | 0 |
| | Lower middle | 1,804,274,175 | 100 | 100 | 100 | 100 | 100 | 98 | 98 | 78 | 77 |
| | Upper middle | 1,730,713 | 100 | 26 | 100 | 74 | 74 | 100 | 100 | 0 | 0 |
| | Total | 1,868,751,178 | 100 | 100 | 100 | 100 | 100 | 98 | 98 | 77 | 74 |
| **Sub-Saharan Africa** | Low | 571,386,919 | 100 | 100 | 100 | 85 | 71 | 93 | 70 | 48 | 31 |
| | Lower middle | 476,809,078 | 100 | 100 | 100 | 87 | 26 | 77 | 32 | 17 | 7 |
| | Upper middle | 63,908,068 | 98 | 98 | 98 | 93 | 93 | 93 | 93 | 86 | 86 |
| | Total | 1,112,104,065 | 100 | 100 | 100 | 87 | 53 | 86 | 55 | 37 | 24 |
| **Global** | | 6,347,521,125 | 97 | 98 | 99 | 82 | 75 | 90 | 85 | 57 | 51 |

*Source:* Global Road Safety Facility; World Bank.
*Note:* — = not available.

**Figure 3.2.** Availability of Nationally Representative Data Sources for Estimating Injury Deaths and Total Injuries since 2010

a. Unintentional or all injuries

b. Road traffic injuries

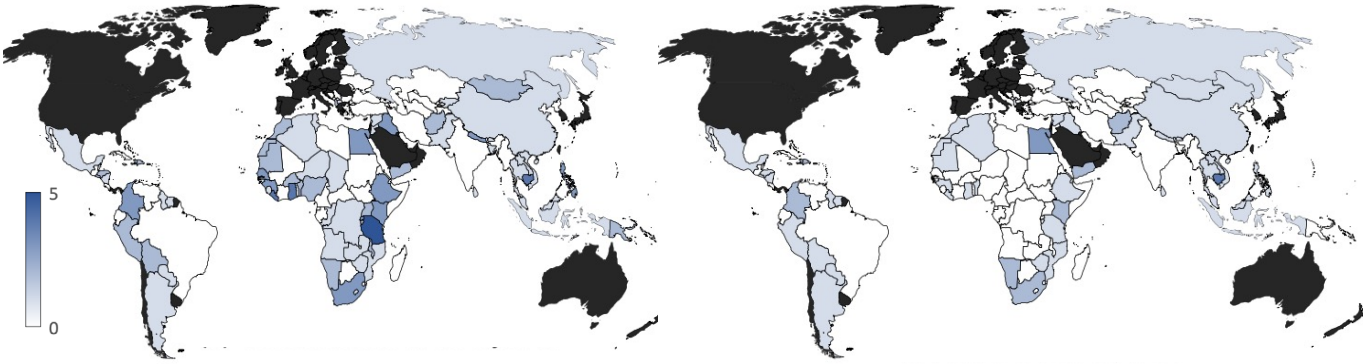



*Source:* Global Road Safety Facility; World Bank.
*Note:* Black denotes high-income countries excluded from the review.

**Figure 3.3.** Availablity of Nationally Representative Data Sources for Estimating Nonfatal Traffic Injuries and Total Injuries since 2010

a. Unintentional or all injuries

b. Road traffic injuries




*Source:* Global Road Safety Facility; World Bank.
*Note:* Black denotes high-income countries excluded from the review.

# Implications

Various factors—including the need to track progress toward the Sustainable Development Goals—have resulted in a large increase in the use of household surveys and censuses to improve measurement of population health for many health domains in countries with weak health surveillance infrastructure.[23, 24] But despite the general increase in health surveys, there has been no accompanying increase in the measurement of road traffic injuries, which shows that the road safety community has failed to leverage these new measurement opportunities. The general increase in health surveys is reflected in the large and increasing amount of data sources on household ownership of vehicles, which is usually measured in household asset inventories that provide a proxy measure for household income or wealth.[25] Although these questions are not intended for estimating traffic injuries, reliable measures of bicycle and motor vehicle ownership and use are arguably the most important covariates of traffic injuries and thus important for estimating injuries in countries with little local data on deaths or injuries. Both Global Burden of Disease (GBD) and the Global Status Reports on Road Safety use vehicle registration data in their estimation models, but bicycles are never included in vehicle registration, and in many countries, unregistered motorcycles are common, especially in LMICs.[26, 27, 28] Vehicle registration may also overrepresent the vehicle fleet, because vehicles in many LMICs are registered only once (at the start of their use) and not removed from registration after they are scrapped.[29, 30] Thus, household surveys and censuses should be used to validate and correct information from national motor vehicle registries in global statistical models.

Although improved measurements of vehicle ownership will help fill information gaps in global statistical models, direct measurements of road traffic deaths and injuries are much more important for providing reliable estimates and shaping national policy dialogue. Relatively few censuses and surveys in the last decade have allowed direct measurement of national road traffic deaths. The few such sources that do exist are in global regions that have little other nationally representative data, and thus estimates of traffic mortality have substantial uncertainty. For instance, Cambodia, Tanzania, Tonga, and Vietnam have questions in their national censuses on household deaths caused by road traffic injuries. GBD and the Global Status Reports on Road Safety provide widely differing estimates for road traffic deaths (figure 1.2) but do not include any nationally representative data on road traffic mortality from these countries. Clearly, these censuses can help reduce the uncertainty in estimates of road traffic deaths in these countries. Including the data sources identified in this study should be an urgent priority for global statistical models.

Data sources that measure road traffic deaths were rare, but there were many sources for the less-specific category of deaths caused by unintentional or all injuries. This was also true for data sources for incidence of nonfatal injuries and prevalence of disabilities. However, there is relatively little policy interest in measuring

23 Demombynes, G., and J. Sandefur. 2014. "Costing a Data Revolution." Center for Global Development Working Paper 383, Center for Global Development, Washington, DC.

24 IEAG (Independent Expert Advisory Group on a Data Revolution for Sustainable Development). 2014. *A World That Counts: Mobilising the Data Revolution for Sustainable Development*. New York: UN.

25 Po, J., J. E. Finlay, M. B. Brewster, and D. Canning. 2012. "Estimating Household Permanent Income from Ownership of Physical Assets." Program on the Global Demography of Aging Working Paper 97, Center for Population and Development Studies, Harvard University, Cambridge, MA.

26 Face of Malawi. 2020. "Several Unlicensed Motorcycles Impounded by Police in Lilongwe." Face of Malawi, August 12, 2020.

27 Salau, G. 2020. "Unregistered Motorbikes Worsening Lagos' Security Challenges." *The Guardian* (Niger), January 26, 2020.

28 World Bank. 2015. "Federative Republic of Brazil: National Road Safety Capacity Review." Report AUS13128, World Bank, Washington DC.

29 World Bank 2015, "Federative Republic of Brazil."

30 Goel, R., D. Mohan, S. K. Guttikunda, and G. Tiwari. 2016. "Assessment of Motor Vehicle Use Characteristics in Three Indian Cities." *Transportation Research Part D: Transport and Environment* 44 (May): 254–65. https://doi.org/10.1016/j.trd.2015.05.006.

these categories, and the World Health Organization and GBD do not use the data in disease modeling. Regarding deaths, these questions are usually included in censuses and surveys to measure maternal mortality,[31] from which injury deaths need to be excluded. For nonfatal injuries, such questions were typically in surveys that aimed to measure health care utilization. Relatively minor modifications to these nonspecific questions (for example, by including an additional follow-up question to include traffic injuries or by modifying the response options) could make them important sources for estimates of the incidence of deaths and nonfatal injury and of permanent disability caused by road traffic injuries. The marginal costs of modifications to censuses and surveys that will already be conducted are small compared with the value of the additional measurements on traffic injuries.

The analysis also shows that an opportunistic approach will not be sufficient to enable tracking of progress toward the goals of the United Nations Second Decade of Action for Road Safety. That would require systematic identification of upcoming censuses and surveys in LMICs, and working to include carefully crafted and globally standardized injury modules that allow measurement of both the magnitude and trend in road traffic deaths and severe injuries. These modules need to be tested and validated to address known issues with survey-based measurements, such as differential item functioning, memory decay (including for prominent memories), and telescoping.[32, 33, 34, 35] Well-designed surveys can reduce bias by using large samples, questions that restrict reporting to recent events, and reporting of currently owned and used vehicles only. Injury modules also need to be calibrated so they measure injuries using a common definition of severity.[36] Finally, there is a need for household survey instruments calibrated to measure severe injuries based on, for instance, the duration of treatment or the impact on daily activities. Such modifications to upcoming national health surveys can dramatically increase the information available for estimating the incidence of road traffic injuries in LMICs.

## Action for Task Teams to Engage in Policy Dialogue for Improving Data Quality

Governments need to understand both why and how to improve the official statistics of road injuries and their relevance in policy and investment decisions, mainly for health and road infrastructure. It can easily be dismissed as something not of priority concern because of a lack of data and facts, and thus it is a missed opportunity in prioritizing in national policy agenda. To counter limited or lack of understanding that road injuries are the seventh leading cause of population health loss,[37] the first step is to build internal and client

31 Hill, K., P. Johnson, K. Singh, A. Amuzu-Pharin, and Y. Kharki. 2018. "Using Census Data to Measure Maternal Mortality: A Review of Recent Experience." *Demographic Research* 39 (1): 337–64. doi:10.4054/DemRes.2018.39.11.

32 Abdalla, S., N. Abdelgadir, S. Shahraz, and K. Bhalla. 2014. "Respondents' Recall of Injury Events: An Investigation of Recall Bias in Cross-Sectional Injury Data from the Sudan Household Health Survey 2010." *International Journal of Injury Control and Safety Promotion* 22 (3): 1–9. doi:10.1080/17457300.2014.908222.

33 Wright, D. B. 1993. "Recall of the Hillsborough Disaster over Time: Systematic Biases of 'Flashbulb' Memories." *Applied Cognitive Psychology* 7 (2): 129–38. doi:10.1002/acp.2350070205.

34 Ricker, T. J., E. Vergauwe, and N. Cowan. 2016. "Decay Theory of Immediate Memory: From Brown (1958) to Today (2014)." *Quarterly Journal of Experimental Psychology* 69 (10): 1969–95. doi:10.1080/17470218.2014.914546.

35 Hardt, O., K. Nader, and L. Nadel. 2013. "Decay Happens: The Role of Active Forgetting in Memory." *Trends in Cognitive Sciences* 17 (3): 111–20. doi:10.1016/j.tics.2013.01.001.

36 Segui-Gomez, M., and E. J. MacKenzie. 2003. "Measuring the Public Health Impact of Injuries." *Epidemiologic Reviews* 25 (1): 3–19. doi:10.1093/epirev/mxg007.

37 Vos et al., "Global Burden of 369 Diseases and Injuries."

understanding and generate awareness of the burden of road traffic injuries and disabilities supported by country-level data and evidence. For that to happen, potential actions are:

- Transport and health task team leaders need to initiate discussion on the burden of road injuries while engaging in the country's development agenda. For maximum impact, the discussion should not be an afterthought. It is critical for the task team to recommend the need for a road safety data review and engage with local experts to assess the availability of survey data and their completeness (as stated in the Implications section) and use them to update official estimates, especially when there is a large discrepancy between official statistics and the global estimates.
- Task team leaders need to recommend that the national statistical and surveillance offices modify existing questions or include questions to capture the cause of death in any upcoming censuses and health surveys.

# 4. Results from Four Country Case Studies

Four country case studies were conducted to illustrate the nature of the discrepancies between official statistics and statistical estimates and assess how to address them. Because countries without high-quality vital registration systems tend to have larger inconsistencies in estimates, three low- and middle-income countries (LMICs) without high-quality vital registration data were included—one in Southeast Asia (Cambodia) and two in Sub-Saharan Africa (Ethiopia and Tanzania). In these countries, the core focus was to identify nationally representative epidemiological data sources and compare estimates of road traffic deaths and injuries with official statistics and Global Burden of Disease (GBD) and Global Status Reports on Road Safety (GSRRS) estimates. The fourth case study assessed road traffic deaths in Brazil, which has relatively high-quality vital registration data.[38] This study focused on assessing the quality of the vital registration data and its implications on recent trends in road traffic death estimates.[39]

## Discrepancies in Estimates of Road Traffic Deaths and Injuries in Cambodia, Ethiopia, and Tanzania

### Methods

Building on the inventory of data sources for the three countries identified in the global search for nationally representative data sources (chapter 3), the project conducted a PubMed and Google Scholar search to identify data sources from these three countries cited in published studies. The search strategy used was as follows:

(((traffic injuries)) AND (Cambodia or Ethiopia or Tanzania)) AND ((“1990”[Date - Publication]: “3000”[Date - Publication]))

Additional snowball searches were conducted based on the articles retrieved, seeking to identify nationally representative data sources. Finally, online searches were conducted for government publications that report road safety statistics, and official statistics of road traffic deaths in these countries were extracted. Microdata of the sources identified were acquired wherever possible, and estimates of the incidence of road traffic injuries and household ownership of bicycles and motor vehicles were extracted. Where microdata were not available, estimates reported in secondary sources (for example, published tabulations) were extracted.

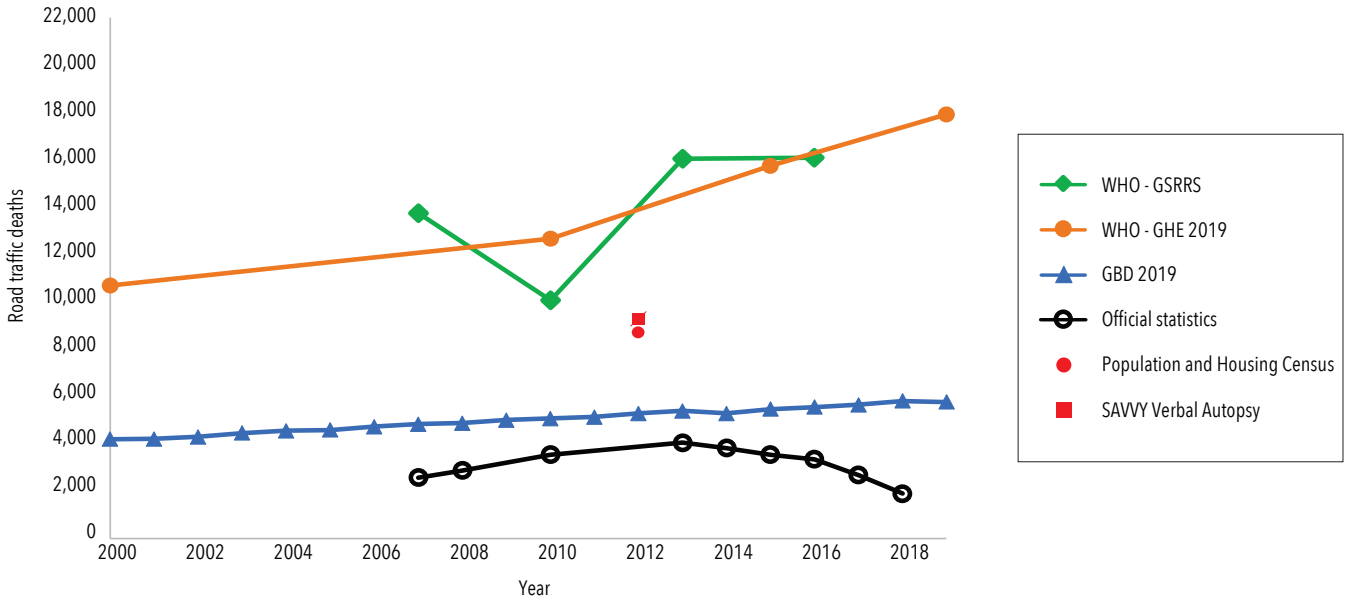
38 Johnson et al., “Public Health Utility Cause of Death Data.”

39 Vos et al., “Global Burden of 369 Diseases and Injuries.”

## Key Findings

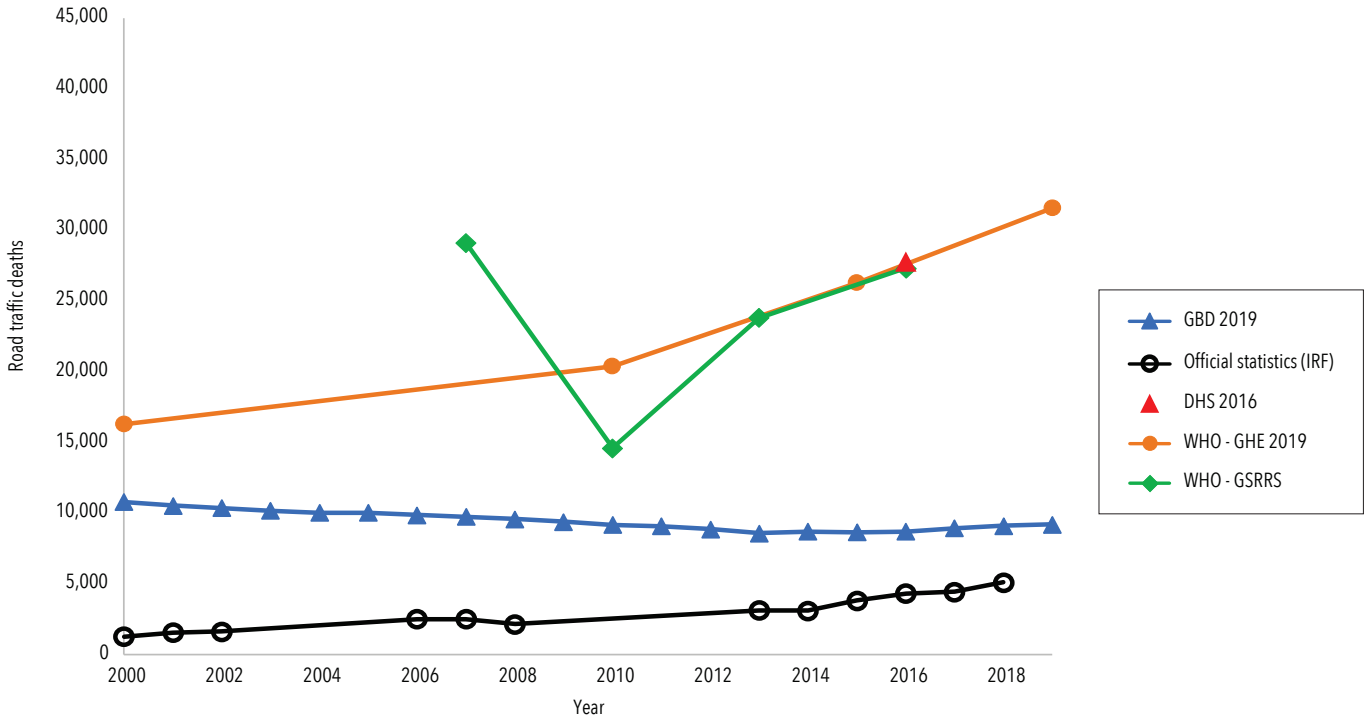
Figures 4.1, 4.2, and 4.3 compare official statistics of traffic deaths (shown in black) in the three countries against GBD estimates (blue), GSRRS estimates (green), GHE (orange), and the analysis of surveys and censuses (red). In all three countries, official statistics are substantially lower than the estimates, suggesting large underreporting in official reporting. However, the figures also show significantly large variations in the modeled estimates. In Ethiopia and Tanzania, GSRRS estimates are much higher than GBD estimates and do not have overlapping uncertainty ranges. In Tanzania (figure 4.1), for instance, GBD 2019 estimated 5,608 deaths (95th uncertainty intervals: 4,506–7,014) in 2016, but GSRRS 2018 estimates were almost three times higher (16,252 deaths; 95th confidence interval [CI]: 13,130–19,374).
This discrepancy existed in all previous revisions, with GSRRS estimates always being substantially higher than GBD. Similarly, in Ethiopia (figure 4.2), the most recent GSRRS estimate (27,326 in 2016) is more than three times the current GBD estimates (8,718) for that year.

**Figure 4.1.** Discrepancies in Estimates of Road Traffic Deaths and Official Statistics in Tanzania



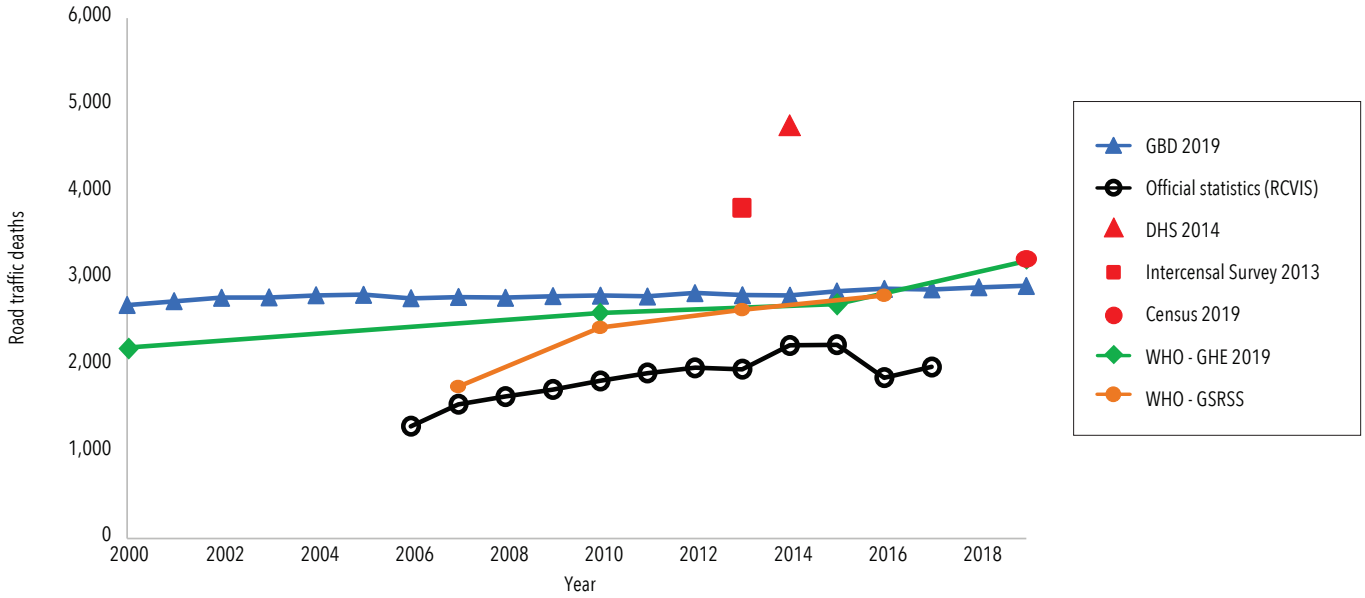

*Source:* Global Road Safety Facility; World Bank.
*Note:* IHME = Institute for Health Metrics and Evaluation; GBD = Global Burden of Disease; GSRRS = Global Status Reports on Road Safety; SAVVY = Sample Vital Registration with Verbal Autopsy; WHO = World Health Organization.

**Figure 4.2.** Discrepancies in Estimates of Road Traffic Deaths and Official Statistics in Ethiopia




*Source:* Global Road Safety Facility; World Bank.
*Note:* DHS = Demographic and Health Surveys; GBD = Global Burden of Disease; GSRRS = Global Status Report on Road Safety; IRF = International Road Federation; WHO = World Health Organization.

**Figure 4.3.** Discrepancies in Estimates of Road Traffic Deaths and Official Statistics in Cambodia



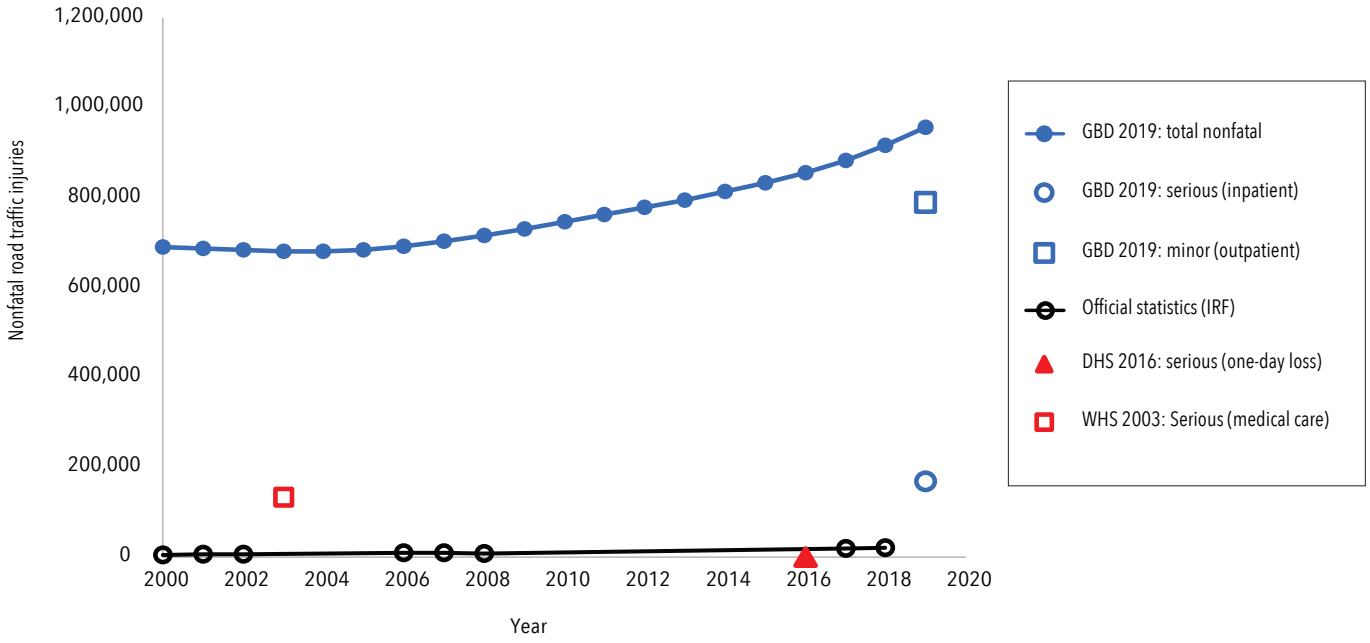

*Source:* Global Road Safety Facility; World Bank.
*Note:* DHS = Demographic and Health Surveys; GBD = Global Burden of Disease; GHE = Global Health Estimates; GSRRS = Global Status Report on Road Safety; RCVIS = Road Crash and Victim Information System; WHO = World Health Organization.

Figures 4.1–4.3 also show the large instabilities in GBD and GSRRS estimates of road traffic deaths . This is particularly true for GBD estimates, which often change substantially between GBD revisions, as evident in Ethiopia (figure 4.2) and Cambodia (figure 4.3). For instance, in Ethiopia, GBD 2019 estimates for the year 2013 (8,591 deaths) are less than half of GBD 2013 estimates (17,845) for that year. Similarly, the GSRRS 2007 estimate (29,114) was more than twice the GSRRS 2010 estimate (14,606). In Cambodia, GBD 2013 increased estimates by about 48 percent, compared with GBD 2010; GBD 2015 revised them downward by 22 percent; and GBD 2017 revised them upward by about 38 percent before GBD 2019 reverted estimates to approximately GBD 2015 levels. Notably, GBD updates can result in revisions that do not have overlapping uncertainty ranges, and the differences between revisions are statistically significant, as illustrated in Ethiopia (figure 4.2). As with GBD, GSRRS estimates can also vary substantially between revisions, but the variations are comparatively smaller.

Local epidemiological data from the countries show a fair amount of consistency, help resolve the differences between GBD and GSRRS, and provide credible evidence of large underreporting in official statistics. In Tanzania (figure 4.1), estimates based on analysis of the 2012 census (9,382 deaths; 95th CI: 7,565–11,199) are similar to the estimates from the 2011–14 Sample Vital Registration with Verbal Autopsy (8,778 deaths; 95th CI: 7,631–9,925) but were about halfway between GBD and World Health Organization (WHO) estimates. These estimates based on the census and the Sample Vital Registration with Verbal Autopsy are more than twice the deaths reported in official statistics from Tanzania (3,885 deaths in 2013), providing a more reliable estimate of the extent of police underreporting than possible with GBD and GSRRS. In Ethiopia (figure 4.2), where only one local epidemiological measurement is available, the DHS 2016 estimate of 27,838 deaths (95th CI: 15,938–39,738) aligns well with the GSRRS 2018 estimate (27,326 deaths; 95th CI: 21,494–33,159) but is 3.2 times the GBD 2019 estimate for that year. The DHS 2016 estimate is 6.4 times the official figure for that year. Finally, unlike estimates in Ethiopia and Tanzania, the most recent revisions of GBD and GSRRS estimates in Cambodia (figure 4.3) are similar to each other. Remarkably, the most recent census estimate (3,220 deaths, 2019) is consistent with GBD and GSRRS estimates. However, note that estimates based on the three DHS surveys in Cambodia are consistently higher than census estimates, likely because these are based on small sample sizes and therefore have large uncertainty intervals.

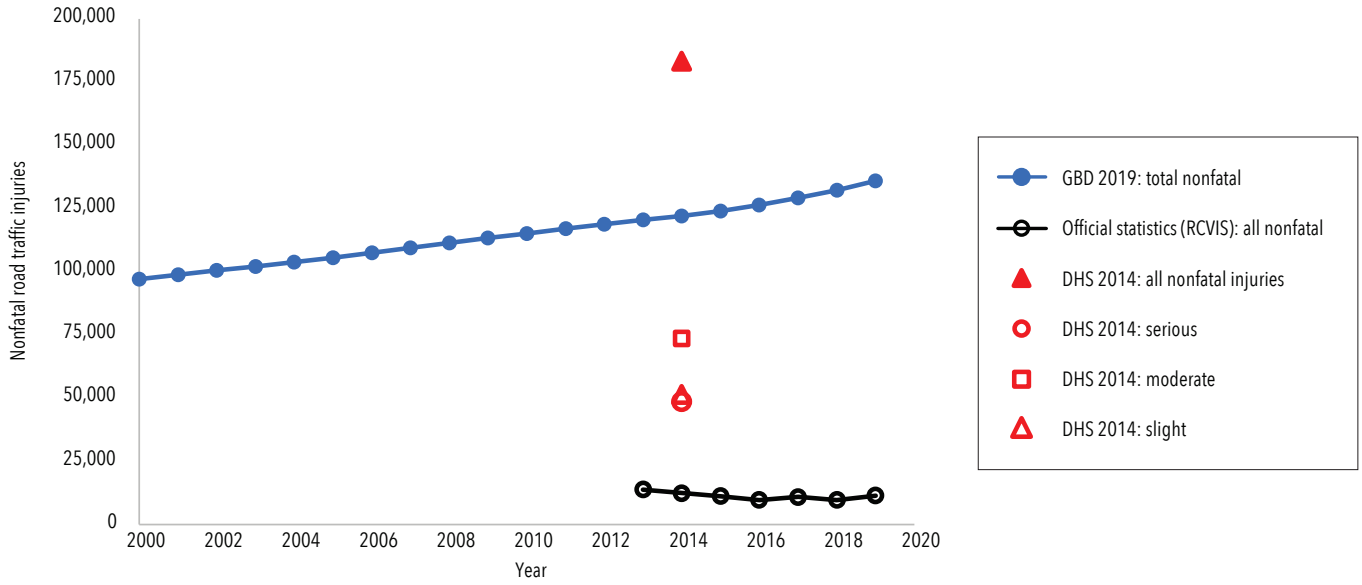
Figures 4.4 and 4.5 compare official statistics of nonfatal traffic injuries (shown in black) against GBD estimates (blue) and estimates from local epidemiological data (red) in Ethiopia and Cambodia. GSRRS is not included because it does not provide estimates of nonfatal injuries. As with the estimates of fatalities, GBD estimates of nonfatal injuries appear to be unstable across revisions. In Ethiopia (figure 4.4), GBD 2019 estimates of total nonfatal injuries are consistent with GBD 2010 estimates, but they are 2.6 times the estimates from the GBD 2017 revision (882,162 versus 339,143 in 2017). However, GBD 2019 estimates of inpatient injuries (that is, injuries that would warrant hospital admission) are notably consistent with DHS 2016 estimates (106,050 injuries, 95th CI: 81,728–130,372) and consistent with World Health Survey 2003, despite the differing definitions of injury severity. By contrast, GBD's estimates of nonfatal injuries in Cambodia (figure 4.5) are somewhat lower than survey estimates (total injury estimates are 33 percent lower than DHS 2014). Finally, in both countries, the results shown confirm the very large underreporting in official statistics. For instance, in Ethiopia, the DHS 2016 estimate of serious injuries is 5.7 times the official report of total nonfatal injuries.

**Figure 4.4.** Various Estimates of Nonfatal Road Traffic Injuries in Ethiopia Compared with Official Statistics




*Source:* Global Road Safety Facility; World Bank.
*Note:* DHS = Demographic and Health Surveys; GBD = Global Burden of Disease; IRF = International Road Federation; WHS= World Health Survey.

**Figure 4.5.** Various Estimates of Nonfatal Road Traffic Injuries in Cambodia Compared with Official Statistics




*Source:* Global Road Safety Facility; World Bank.
*Note:* Official statistics (black) are based on GSRRS 2009, RCVIS, and the Ministry of Public Works 2021. DHS = Demographic and Health Surveys; GBD = Global Burden of Disease; RCVIS = Road Crash and Victim Information System.

# Implications

## Uncertainty in Global Statistical Models of Road Traffic Deaths and Injuries

The findings show that there are large discrepancies in the GBD and GSRRS estimates of road traffic deaths. In general, both GBD and GSRRS estimate road traffic deaths based on covariates that describe the country's income level, motorization levels, health system, demographic characteristics, and transportation system. However, the methodological details differ in important ways. Notably, WHO's models are calibrated only on countries with high-quality national vital registration data, but GBD incorporates many more sources (such as health surveys, verbal autopsies, and data representative at the subnational level). Such differences often result in large discrepancies between country-level estimates. In fact, changes in the modeling strategies between the various revisions of GBD alone result in large changes in estimates.[40]

Importantly, GBD and GSRRS estimates did not include any of the surveys and censuses analyzed from these countries. GBD 2019 did include other surveys from Ethiopia and Tanzania, but these were regional surveys and were not representative of the national population. The inclusion of local epidemiological data sources in global statistical models—especially data sources that are representative of the national population—will likely reduce the discrepancies in estimates and increase the reliability of country estimates. In the GBD, it is important for the project to include all data identified in the systematic review of surveys and censuses (chapter 3). Including such data in GSRRS estimates would be more difficult in their current methodological framework. However, it is recommended that GSRRS develop the ability to incorporate the types of data sources that are often available in LMICs (for example, household health surveys, verbal autopsies, and census mortality modules).[41]

## Implications for Strengthening National Crash Surveillance

The case studies focused on the need to improve statistical estimates of road traffic injuries in the three countries by using reliable local epidemiological data sources. Such work is important because it can help country stakeholders acknowledge the true magnitude of the problem and prioritize road safety appropriately in the policy agenda. The analysis makes it clear that official statistics in the three countries underreport road traffic deaths significantly, as is the case in most LMICs.

However, such survey-based measurements and statistical estimates (for example, GBD and GSRRS) cannot provide all the information needed for running effective road safety programs. The Safe System approach recommended by WHO and the World Bank requires reliable, timely, and detailed data on crash circumstances and risk factors. The approach involves developing a road safety strategy based on assessing population-level risks and allocating resources to the most cost-effective interventions. Surveillance data are needed for setting meaningful targets for final outcomes (that is, road traffic deaths and injuries), intermediate outcomes (for example, helmet and seat belt use), and the institutional outputs (for example, enforcement levels) needed to achieve these outcomes. Finally, data are needed for monitoring the safety program's performance and to allow ongoing recalibration. Therefore, countries will need to make a major investment in developing the capacity of their police to do routine surveillance of traffic injuries and key risk factors. In this context, periodic survey-based measurements of traffic deaths and injuries can provide an external benchmark to assess the completeness of statistics produced by national crash surveillance systems and monitor progress toward building institutional capacity for traffic injury surveillance.

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40 Gutierrez, H., S. Mitra, K. Neki, L. W. Mbugua, R. Balasubramaniyan, M. Winer, J. Roberts et al. 2022. "Comparing Estimates of Road Traffic Deaths and Non-fatal Road Traffic Injuries in Cambodia." *Injury Prevention* 28 (4): 340–46. doi:10.1136/injuryprev-2021-044504.

41 Mitra et al., "Availability of Population-Level Data Sources."

# Discrepancies in Estimates of Road Traffic Deaths in Brazil

A 2015 World Bank review of Brazil's road safety management capacity noted a substantial difference between road traffic deaths reported in official statistics and motor vehicle insurance claims.[42] This discrepancy has persisted since then: insurance claims reported 27.5 percent more road traffic deaths than the official statistics in 2019. Furthermore, GBD estimates for the same year exceeded official statistics by 46 percent. There is also a discrepancy in trends. Official statistics from Brazil report that traffic deaths peaked in 2012 and have declined by 29 percent in 2019, suggesting remarkable success in improving road safety. By contrast, GBD 2019 estimates for Brazil are relatively flat, with traffic deaths declining by less than 10 percent over the same period.

Unlike Cambodia, Ethiopia, and Tanzania, Brazil has a high-quality vital registration data system that can be used to estimate road traffic deaths. Therefore, this analysis aimed to construct estimates of road traffic deaths in Brazil using vital registration data, assess the quality of the official statistics, and provide insights into the nature of underreporting. This analysis aimed to answer two important questions: (i) Are official statistics of road traffic deaths in Brazil underreported? If so, by how much? and (ii) Are road traffic deaths declining as rapidly as suggested by official statistics?

## Methods

Death registration data for Brazil were extracted from the WHO Mortality Database (June 2021 revision).[43] In Brazil, where death registration is also the source of information for official reporting of road traffic deaths, deaths coded to road traffic injuries in the WHO Mortality Database correspond to the official road traffic death statistics. All deaths coded to injuries were classified into 48 mutually exclusive categories of specified external causes of death that constitute the reporting categories recommended by the injury expert group of the GBD 2010 study, and 21 categories of partially specified external causes.[44] National road traffic deaths were estimated by reattributing (proportionately within age and sex groups) deaths coded to partially specified causes and adjusting for completeness of death registration.

## Key Findings

A substantial number of deaths in Brazil's vital registration system are coded to partially specified cause categories that affect estimates of road traffic deaths in different ways. The proportion of deaths coded to transport that are unknown (that is, unknown if they are road traffic or another mode of transport) is relatively small (2.7 percent of transport deaths in 2019). Similarly, the proportion of unintentional injury deaths that are unknown (that is, unknown if they are road traffic or other type of unintentional injury) was also relatively small (2.6 percent of unintentional injury deaths). The proportion of injuries that are not specified further (that is, unknown if they are road traffic or other type of intentional or unintentional injury) are larger and show an unusual temporal pattern, with elevated values in 2008 (6 percent of all injuries) and a spike in 2019 (8.4 percent). Almost all the deaths (98 percent, 11,822 deaths in 2019) coded to this partially specified cause group carried the ICD-10 code Y34: unspecified event, undetermined intent. Finally, the proportion of deaths coded

42 World Bank 2015, "Federative Republic of Brazil."

43 WHO Mortality Database, World Health Organization, Geneva, (accessed February 21, 2022), https://www.who.int/data/data-collection-tools/who-mortality-database.

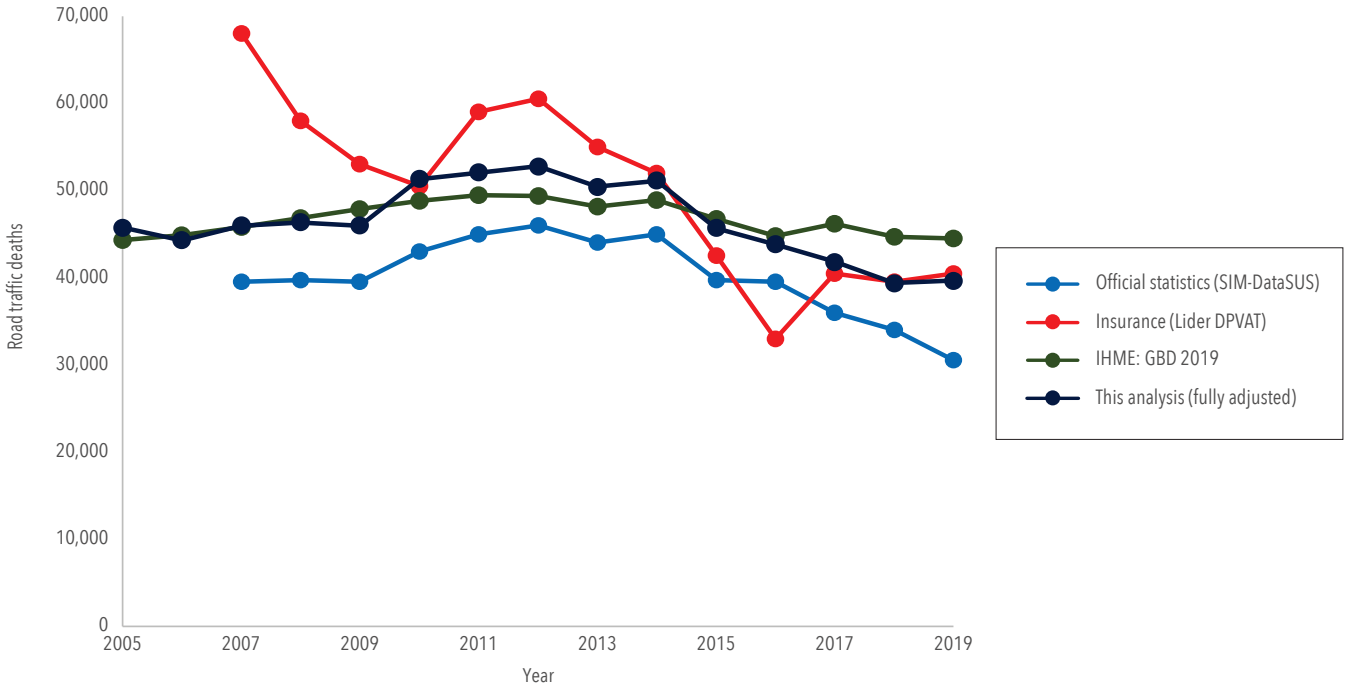
44 Bhalla, K., S. Shahraz, J. P. Abraham, D. Bartels, and P. H. Yeh. 2011. *Road Injuries in 18 Countries: Methods, Data Sources, and Estimates of the National Incidence of Road Injuries*. Boston, MA: Department of Global Health and Population, Harvard School of Public Health.

to the broadest group of unspecified causes (unknown cause of death) declined from 12 percent in 2002 to less than 5 percent in 2019, suggesting strong improvements in the quality of cause coding in Brazil. Simultaneously, the completeness of death registration in Brazil has improved in the last decades to 95.5 percent in 2019.

Figure 4.6 compares the fully adjusted estimate with official statistics, insurance claims, and GBD estimates. Insurance claims (shown in red) have been higher than official statistics every year except for 2016. Over the 13-year period 2007–19, there were 25 percent more insurance claims (130,500 deaths) than officially reported deaths. This suggests that official statistics in Brazil possibly underreport road traffic deaths. Estimates from GBD suggest that the true death toll in 2019 is 46 percent higher than official statistics and only slightly higher (10 percent) than insurance claims. The analysis shows that the adjustments for completeness and partially specified cause coding bridge much of the gap between official statistics and GBD estimates. In fact, the fully adjusted estimates in the last three years are similar to the deaths reported by insurance claims. However, although the fully adjusted estimates are lower than GBD for 2015–19, they were higher than GBD for 2010–14. Thus, the fully adjusted estimates suggest a sharper decline in traffic deaths in recent years than GBD estimated.

Figure 4.7 helps explain the difference in trends predicted by GBD and the fully adjusted estimates. The figure shows a screenshot from the GBD 2019 Causes of Death Visualization Tool, comparing how well the GBD 2019–modeled estimates (shown in red) fit the input data based on vital registration (yellow circles).[45] The input data shown have already been adjusted to account for deaths coded to partially specified causes and corrected for completeness (that is, the input data shown are equivalent to the fully adjusted estimate). It is evident that the GBD 2019 estimates do not track the rapidly increasing deaths in the underlying data during the late 2000s and the rapidly declining trends in the last decade.

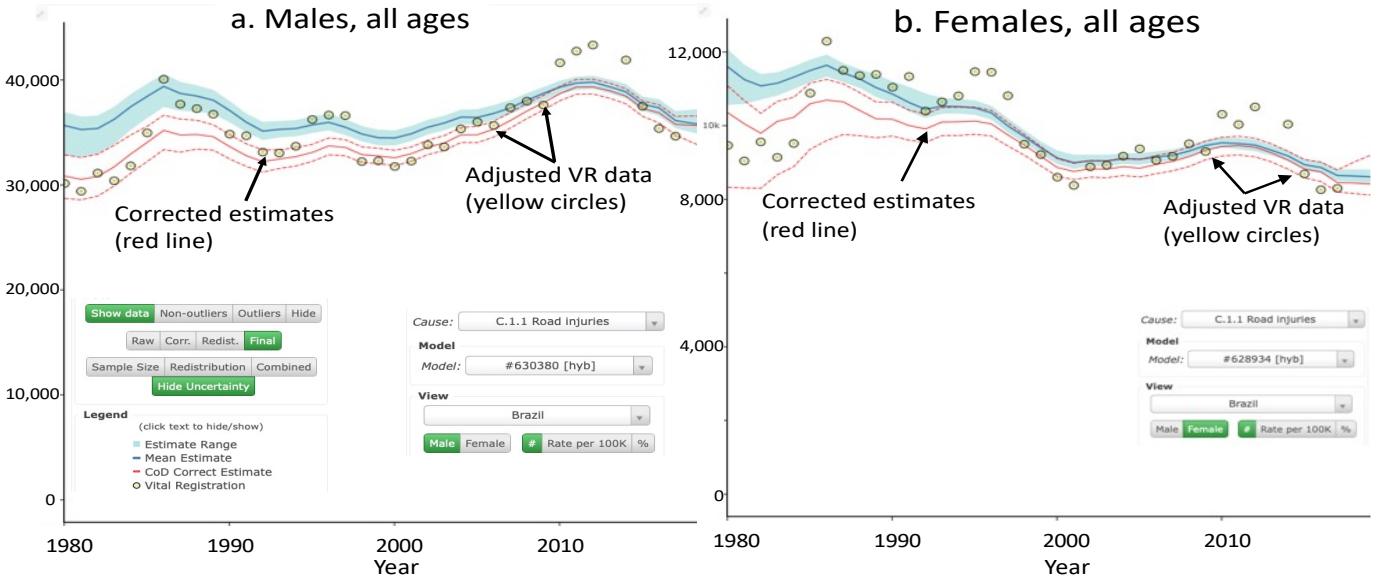
**Figure 4.6.** Comparison of the Fully Adjusted Estimate with Official Statistics, Insurance Claims, and GBD Estimates




*Source:* Global Road Safety Facility; World Bank.
*Note:* GBD = Global Burden of Disease; IHME = Institute for Health Metrics and Evaluation; Lider DPVAT = Danos Pessoais Causados Por Veiculos Automotores de Via Terrestre; SIM-DataSUS = Sistema de Informação sobre Mortalidade-Departamento de Informática do Sistema Único de Saúde.

45 See the Causes of Death Visualization Tool (CoD Viz) at https://vizhub.healthdata.org/cod/.

**Figure 4.7.** Comparison of the GBD 2019 Estimates for Brazil to the Adjusted Vital Registration Data Used as GBD 2019 Model Inputs




*Source:* Global Road Safety Facility; World Bank.
*Note:* GBD = Global Burden of Disease; VR = vital registration.

# Implications

## Learning from Brazil's Experience

The analysis confirms that road traffic deaths in Brazil have declined by 25 percent since 2012, driven by strong declines in pedestrian deaths and motor vehicle occupant deaths. This is a remarkable achievement because most LMICs have failed to show meaningful progress during the last decade, despite extensive global advocacy.[46, 47] Assessing what has driven these declines in road traffic injuries was beyond the scope of this study, but several recent and ongoing road safety initiatives may result in improving road safety in Brazil. A before-and-after evaluation of the Federal Highway Police's Rodovida campaign, which included an enforcement and promotion campaign on federal roads, shows beneficial effects on the risk of serious crashes.[48] Efforts to enforce drink-driving laws in some states have benefited from legislative change that allows police to use behavioral evidence of intoxication for drivers who refuse to take a breath test.[49] Additionally, attention is increasing to improvements to the safety of road infrastructure and the urban built environment—the state of Bahia committed to a minimum three-star International Road Assessment Program safety rating (moderate risk) for new and rebuilt roads.[50] Evaluations of the Bloomberg Philanthropies

46 United Nations Road Safety Collaboration (UNRSC). 2020. *Global Plan for the Decade of Action for Road Safety 2011–2020*. Geneva: World Health Organization.

47 WHO (World Health Organization). 2021. *Global Plan: Decade of Action for Road Safety 2021–2030*. Geneva: World Health Organization.

48 World Bank 2015, "Federative Republic of Brazil."

49 World Bank 2015, "Federative Republic of Brazil."

50 World Bank 2015, "Federative Republic of Brazil."

Initiative for Global Road Safety's activities in Brazil report improved safety of infrastructure,[51] and reduced speeding in São Paulo and Fortaleza.[52, 53] A high-level evaluation of the effect of these and other interventions on the national road traffic injury toll should be undertaken to explain what has worked in Brazil and provide guidance to other LMICs.

## Need for a National Road Traffic Injury Surveillance System

This analysis has focused on the effect of the quality of death registration data on estimates, but note that death registers, like national health surveys, are poorly suited to providing the information needed for effective road safety management (identifying risk factors, developing a safety strategy, implementing targeted interventions, and evaluating outcomes). As noted in this chapter's implications section, this requires detailed information about crash circumstances, vehicles involved, road environment, and behavioral risk factors, which in most countries can be collected only by crash site investigations conducted by traffic police. In Brazil, federal and state traffic police databases are a good starting point for such a database, but they do not cover all roadways. Expanding the coverage of the Federal Highway Police database, as the 2015 World Bank national road safety capacity review recommends,[54] could be an effective solution to a comprehensive and complete national road traffic database. Finally, guidance provided in the recent World Bank and International Transport Forums publication, *Guidelines for Conducting Road Safety Data Reviews*,[55] should be followed for all provinces to ensure the use of all available road safety data—including the insurance data in this case—for better monitoring and evaluations of what worked and what may be improved.

## Implications for Global Modeling Efforts

Although it was not the focus of attention for this study, a large discrepancy between GBD and GSRRS estimates of traffic deaths in Brazil is surprising and problematic. In 2019, GBD estimates were 31.5 percent higher than GSRRS estimates, and the two estimates had nonoverlapping uncertainty ranges. Discrepancies between GBD and GSRRS estimates are understandable in information-poor contexts or when one of the projects incorporates data sources that the other project does not use. For instance, estimates differ substantially in Sub-Saharan African countries, where these studies have limited nationally representative information on road traffic mortality. However, the discrepancy for Brazil is unexpected because both studies use the same underlying data source (national death registration data) and conceptually similar methods for estimating mortality from such data. Notably, Brazil's death registration data are considered high quality. For example, the Institute for Health Metrics and Evaluation rates the quality of Brazil's death registration data at four out of five stars, which is the same rating it gives to many Western European countries.[56] These discrepancies show that even in countries with arguably the best health sector data, global health statistical projects like GBD and Global Health Estimates will disagree substantially on their point estimates and have nonoverlapping uncertainty estimates. This implies that estimates based on health sector data will likely always

51 Hendrie, D., G. Lyle, and M. Cameron. 2021. "Lives Saved in Low- and Middle-Income Countries by Road Safety Initiatives Funded by Bloomberg Philanthropies and Implemented by Their Partners between 2007–2018." *International Journal of Environmental Research and Public Health* 18 (21): 11185. doi:10.3390/ijerph182111185.

52 Andreuccetti, G., V. Leyton, H. Barbosa Carvalho, D. M. Sinagawa, H. S. Bombana, J. C. Ponce, K. A. Allen, A. I. Vecino-Ortiz, and A. A. Hyder. 2019. "Drink Driving and Speeding in São Paulo, Brazil: Empirical Cross-Sectional Study (2015–2018)." *BMJ Open* 9 (8): e030294. doi:10.1136/bmjopen-2019-030294.

53 Global Designing Cities Initiative. 2021. "Streets for Life in Brazil: Speed Reduction Initiatives in Recife and Salvador." Accessed July 17, 2022.

54 World Bank 2015, "Federative Republic of Brazil."

55 Martensen et al., *Guidelines for Conducting Road Safety Data Reviews*.

56 GBD 2015 Mortality and Causes of Death Collaborators. 2016. "Global, Regional, and National Life Expectancy, All-Cause Mortality, and Cause-Specific Mortality for 249 Causes of Death, 1980–2015: A Systematic Analysis for the Global Burden of Disease Study 2015." *The Lancet* 388 (10053): 1459–544. doi:10.1016/S0140-6736(16)31012-1.

have high (unmodeled) uncertainty (in the 30–50 percent range), and global health researchers should not expect more accuracy with the current methods.

A closely related issue is the ability of GBD to correctly estimate trends in road traffic deaths and monitor progress toward the goals of the United Nations Second Decade of Action for Road Safety, which aim to reduce road traffic deaths by half by 2030. GBD estimates show a much flatter trend during the last decade than official statistics and the fully adjusted estimate, both of which suggest that Brazil has made modest progress in reducing traffic deaths. The issue appears to be that GBD models do not track the trends apparent in the (adjusted) underlying data closely. GBD modeling strategy involves using a tool called the Cause of Death Ensemble model (CODEm) that runs many different models (including different statistical approaches, different units of analysis, and different choices of covariates) and uses an ensemble of models that perform best in out-of-sample prediction tests.[57, 58] Finally, CODEm ensures consistency across all cause-specific models by scaling their total to match all-cause deaths in each age, sex, country, and year. Ensemble models have been shown to outperform the best component models for diseases and a range of other fields,[59] but regarding road traffic deaths in Brazil, current GBD models do not track the underlying data. This study suggests that the Institute for Health Metrics and Evaluation should invest additional effort in improving the modeling of road traffic deaths, including focus on better trend modeling, so that GBD estimates can be used to track progress toward the goals of the Second Decade of Action for Road Safety.

## Actions for Task Teams to Initiate Country Case Studies

Governments need to understand the value of improving the official statistics using all available road safety data, specifically with epidemiological data available in the countries. In case such data are not readily usable, modifying or including suitable questionnaires in censuses and health surveys should be initiated. Task team leaders need to drive a step-by-step approach for the inclusion of data-driven road safety to attain the goals of the United Nations Second Decade of Action of Road Safety through their engagement by (i) raising interest (for example, presenting facts and figures and highlighting any discrepancies and what is still unknown); (ii) initiating road safety data review and developing a fact base for the country (for example, conducting case studies with road safety data and necessary technical assistance with the help of Global Road Safety Facility); and (iii) actions (for example, funding specific projects targeting legislation, enforcement, infrastructure, and health aspects of road safety to ensure reductions in road crash injuries).

57 Foreman, K. J., R. Lozano, A. D. Lopez, and C. J. I. Murray. 2012. "Modeling Causes of Death: An Integrated Approach Using CODEm." *Population Health Metrics* 10 (1). doi:10.1186/1478-7954-10-1.

58 James, S. L., L. R. Lucchesi, C. Bisignano, C. D. Castle, Z. V. Dingels, J. T. Fox, E. B. Hamilton et al. 2020. "Morbidity and Mortality from Road Injuries: Results from the Global Burden of Disease Study 2017." *Injury Prevention* 26 (Supplement 2): 043302. doi:10.1136/injuryprev-2019-043302.

59 Foreman et al., "Modeling Causes of Death."

# 5. Discussion and Recommendations

## Increasing the Use of Local Epidemiological Data

National governments worldwide will need to direct substantial resources to road safety if they are to achieve the goals of the United Nations (UN) Second Decade of Action for Road Safety. However, the official statistics reported by the most low- and middle-income countries (LMICs) are significantly lower than the estimates of road traffic deaths and injuries from global statistical models. Consequently, persuading national decision-makers to acknowledge the magnitude of the road safety problem is an important goal of global road safety efforts.

Global statistical models exist partly to provide credible information to support dialogue on the relative scale of population health problems and provide guidance on health investments. However, based on the findings from the stakeholder interviews (chapter 2), the most important way to persuade national stakeholders to address the issue of underreporting in official statistics is by showing that the higher global statistical estimates are consistent with local epidemiological data. For example, interviewees explained that in the Islamic Republic of Iran, comparisons with data from death registration and forensic medicine were critical for demonstrating that traffic deaths were much higher than officially reported. In India, where the civil registration system remains a poor source of information for health statistics, data from a nationally representative verbal autopsy (Sample Registration System) is providing similar evidence and is gaining increasing acceptance. In Sub-Saharan Africa, vital registration systems are weak in almost all countries, but other data sources can be leveraged. In Tanzania, the 2012 national census and a nationally representative verbal autopsy survey in the same year included questions about household deaths from road traffic crashes.[60] The two sources provided similar estimates of traffic deaths that were more than twice the official statistic. In Ethiopia, a recent nationally representative survey (Demographic and Health Survey [DHS] 2016) included questions that allow estimating traffic mortality, and the findings are consistent with Global Status Reports on Road Safety (GSRRS) estimates. Although the DHS estimates are not yet informing dialogue concerning underreporting of traffic deaths in Ethiopia, the findings from this study suggest that such evidence is critical for persuading decision-makers to use epidemiological data.

In fact, such nationally representative surveys and censuses that include road traffic injury deaths have been conducted in many LMICs,[61] but their findings are rarely used in policy dialogue about road safety. This study recommends that countries where such data sources exist (or where such questions will be included in upcoming surveys) should analyze the data and compare it with official statistics and estimates from Global

60 Mbugua, L. W., S. Mitra, K. Neki, H. Gutierrez, R. Balasubramaniyan, M. Winer, J. Roberts et al. 2022. "Estimates of Road Traffic Deaths in Tanzania." *Injury Prevention* 28 (5): 044555. doi:10.1136/injuryprev-2022-044555.

61 Mitra et al., "Availability of Population-Level Data Sources."

Burden of Disease (GBD) and GSRRS. The case studies conducted in this study for Cambodia,[62] Tanzania,[63] and Ethiopia (forthcoming) provide a template for such work. Ideally, such studies should be led by local researchers who understand the nature of the local debates and are in the best position to work with other advocates to convince the public and decision-makers. Furthermore, international agencies (such as the World Bank and other multilateral development banks) should support this work because their participation can lend additional credibility.

In other countries (those where epidemiological data sources that can challenge official statistics do not exist), there may be opportunities to include such measurements in future data collection. Many countries routinely conduct national health surveys, including some like the DHS (supported by the United States Agency for International Development) and the World Bank's Living Standards Measurement Survey. These agencies should collaborate with similar agencies to support the inclusion of road traffic injury modules in upcoming surveys. For example, such recommendations have already been initiated in the World Bank to include relevant questionnaires in the Living Standards Measurement Survey.[64] The marginal cost of modification to upcoming data collection activities is small compared with the value of such information. Task team leaders from the World Bank and counterparts from other international agencies need to engage in discussion with countries in their ongoing dialogue to improve country-reported statistics. For instance, in Nigeria, GSRRS estimates that official statistics record only 13 percent of traffic deaths, and national officials insist that underreporting is low, but Nigeria does not have any nationally representative sources for estimating road traffic mortality in the country that can help resolve this inconsistency. However, Nigeria conducts a DHS survey every five years (the next in 2023), and including a question on traffic deaths could make a large difference in convincing decision-makers in the country of the need for effective road safety interventions.

This report described the discrepancies in GBD and GSRRS estimates of road traffic injuries, which should be viewed in the broader context of these projects' strengths and weaknesses and their use in road safety advocacy. This chapter concludes by providing a comparison of the relative strengths of GBD and GSRRS and recommendations for both to improve global health statistical estimates.

## Key Strengths and Shortcomings of GBD and GSRRS Models

GBD and GSRRS produce estimates of road traffic deaths in all countries, but there are several important differences in the data sources the two projects use, their methodological approaches, and the injury metrics that they estimate. Although the estimates presented in the GSRRS report are used in World Health Organization (WHO) global road safety advocacy efforts, these estimates are updated from WHO's broader global health statistical models that are used to generate Global Health Estimates (GHE),[65] which provide a comprehensive and comparable set of estimates of mortality and morbidity broken down by age and sex for diseases and injuries, including road traffic injuries. GSRRS estimates use GHE estimates as a starting point but revise them based on country feedback and reanalysis using additional covariates of road traffic injuries.[66]

62 Gutierrez et al., "Comparing Estimates of Road Traffic Deaths."

63 Mbugua et al., "Estimates of Road Traffic Deaths in Tanzania."

64 Lebrand, M., and Q. Yin. 2022. "Improving Multi-Topic Household Surveys for Better Transport Policy Analysis." Policy Research Working Paper 9944, World Bank, Washington, DC.

65 WHO (World Health Organization). 2020. "WHO Methods and Data Sources for Country-Level Causes of Death 2000–2019." Global Health Estimates Technical Paper WHO/DDI/DNA/GHE/2020.2, World Health Organization, Geneva.

66 WHO, *Global Status Report on Road Safety 2018*.

From the perspective of road safety advocacy, the main differences between GBD and GSRRS are as follows:

- Road traffic injury data sources: GBD methods allow inclusion of many more local epidemiological data sources from LMICs than GSRRS for two reasons. First, both GBD and GSRRS rely heavily on national vital registration data to estimate road traffic deaths, but GSRRS uses a much higher quality threshold of vital registration data that are deemed acceptable for inclusion. Consequently, vital registration data from few LMICs are included in GSRRS estimates. Second, GSRRS uses only high-quality vital registration as input, but GBD methods allow the inclusion of other types of data sources, such as verbal autopsies and mortality modules in household surveys and censuses. As highlighted by a previous Global Road Safety Facility report,[67] these data sources can provide substantial insights into injury patterns in the most information-poor settings. However, as the systematic review and the country case studies presented in this report show, GBD can include many relevant road traffic injury data sources in addition to the many sources they are already using for improving estimates. An important implication is that GBD incorporates at least some local data sources on traffic injuries from far more LMICs than GSRRS.
- Outputs: GBD reports several road traffic injury metrics that are important for road safety advocacy but which GSRRS does not report. For example:
    - GBD reports estimates of both road traffic deaths and nonfatal injuries, but GSRRS reports only traffic fatalities. (Estimates of morbidity from traffic injuries are generated by GHE but not included in the GSRRS and related WHO road safety advocacy efforts). This is relevant because the UN Second Decade of Action for Road Safety aims to reduce both road traffic deaths and *injuries* by half by 2030.
    - GBD reports national cause-of-death rankings that allow comparing the scale of the road traffic injury problem to other health issues confronting countries. GSRRS does not report such rankings. (Rankings are generated by GHE but not included in the GSRRS).
    - GSRRS estimates, unlike GBD's, do not disaggregate road traffic deaths by the type of road user killed (pedestrian, motorcyclist, and so on). Although the appendixes of GSRRS reports include information on the proportions of road users killed, these are not modeled estimates but the data presented in official statistics collected from countries. In countries with large underreporting, the reported proportion of types of road users killed are likely to be highly biased.
- Vetting and dissemination of findings: The country case studies presented in this report show that GBD estimates can sometimes have unexpected patterns that do not align with knowledge in the road safety community. This suggests that road safety researchers do not vet GBD's estimates as carefully as GSRRS estimates, which appear to have fewer apparent discrepancies. In fact, GSRRS estimates are much more visible in the transport sector in LMICs, compared with GBD estimates, which are used much more in health sector dialogue, partly because WHO uses GSRRS extensively for country engagement in road safety.

In summary, national road safety researchers and practitioners are correct in noting that estimates of road traffic deaths from the GSRRS cannot be used to make persuasive arguments about underreporting because GSRRS does not use epidemiological data on traffic deaths from most LMICs. In fact, the methodological framework used for GSRRS estimates allows including only countries with high-quality death registration systems, which excludes nearly all countries where underreporting in official statistics is expected to be

67 Bhalla, K., J. Harrison, S. Shahraz, J. Abraham, D. Bartels, P.-H. Yeh, M. Naghavi et al. 2014. *Burden of Road Injuries in Sub-Saharan Africa: Data Sources, Methods, and Estimates of National Incidence of Road Injuries*. Boston, MA: Department of Global Health and Population, Harvard School of Public Health.

high. Therefore, GSRRS should extend its methods to at least incorporate nationally representative surveys that measure traffic mortality, where these are available. If that is not possible, this analysis recommends conducting studies that simply demonstrate the external validity of GSRRS by comparing its estimates with estimates from local epidemiological data sources. In contrast to GSRRS, the GBD methodological framework allows the incorporation of many more types of data sources. However, GBD has failed to include many known nationally representative surveys.[68] Therefore, future revisions of GBD should include such data, after which the use of GBD in global road safety advocacy efforts should increase.

## Recommendations to Improve Global Health Statistical Models

1. **Support the inclusion of questions on road traffic injuries in upcoming national surveys and censuses.** This study's systematic search for LMIC data sources found that national health surveys and censuses are conducted routinely in many countries where official reporting of road traffic deaths is suspected to be high. Some of these surveys and censuses have already included questions on road traffic injuries, but many opportunities exist for including such questions in upcoming data collection. International agencies that conduct such surveys—such as the United States Agency for International Development (DHS) and the World Bank (Living Standard Measurement Survey)—and other surveys conducted by countries should include questions related to the incidence road traffic injuries in upcoming data collection activities. For example the recently published working paper from the World Bank already provides such recommendations for integrating sample questions and standard guidelines.[69]

2. **Develop country reports that highlight the scale of the road safety problem using all available data sources.** Country reports that compare official statistics with local epidemiological data sources and estimates from GBD and GSRRS should be developed, using the case studies in this report as a starting template. These reports should be used as advocacy tools for persuading national stakeholders that the road safety problem is much larger than now perceived. Because the primary purpose of such reports is to engage in national policy dialogue, the reports should be initiated by World Bank task teams and the other international organizations engaged in road safety dialogue in countries—with the help of local researchers—to increase their quality, legitimacy, and political influence.

3. **Increase the use of local epidemiological data sources in global estimates by GBD and GSRRS.** GBD models need to be updated immediately to include the data sources on road traffic deaths and injuries identified in the systematic reviews because GBD methods already allow the inclusion of population-representative data sources. It is suggested that GBD include modeling of total unintentional injury deaths and total injury deaths because this will allow the substantial epidemiological data that are already available to inform the traffic injury estimates. Because vehicle fleet data are important to global models, GBD estimates will improve by incorporating data from household surveys in its vehicle covariate models.

   GSRRS models are able to use only high-quality vital registration data at present, but the project may consider including nationally representative surveys and censuses, which will likely require a relatively small extension of current GSRRS methods. GSRRS does not estimate deaths by transport mode but

68 Mitra et al., "Availability of Population-Level Data Sources."

69 Lebrand and Yin', "Improving Multi-Topic Household Surveys."

presents country-reported data that greatly underreport deaths among vulnerable road users in many LMICs, especially pedestrians and motorcyclists. WHO needs to consider extending its estimation methods to model deaths among different road users.

4. **Estimate serious and severe nonfatal injuries.** The Second UN Decade of Action for Road Safety aims to reduce both deaths and nonfatal injuries. GSRRS does not estimate nonfatal injuries, but GBD publishes estimates of total nonfatal road traffic injuries. GBD needs to develop these estimates further, increase the use of country data sources, and map these estimates to injury severity measures preferred by the injury community (for example, the Abbreviated Injury Scale).

5. **Improve the fit of GBD models to underlying road traffic injury mortality data.** GBD's road traffic death models (CODEm) do not fit the underlying death registration data in several instances, for example, estimates of total road traffic deaths in Brazil. The Institute for Health Metrics and Evaluation needs to investigate these issues and recalibrate models to follow patterns in underlying data better.

6. **Support greater collaboration among the Institute for Health Metrics and Evaluation, WHO, and the broader road safety community.** GBD and GSRRS have different strengths that are often complementary. However, there is little collaboration between the two projects, which does substantial harm to the use of their estimates in global road safety advocacy. The strengths of GSRRS include the extensive use of their estimates in country road safety dialogue. The strengths of GBD include its capability of including local data sources from many more countries, which vastly increases the probability that their estimates are considered seriously in national policy debates. Notably, only GBD's models can estimate the incidence of nonfatal injuries and allow tracking progress toward the goals of the Second UN Decade of Action for Road Safety. The two teams need to collaborate to release an annual global road safety report that includes findings from both projects.

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