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Comparing road safety performance across countries: Do data source and type of mortality indicator matter?

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ABSTRACT

This study examined the impact of data source estimates (World Health Organization (WHO) versus Global Burden of Disease (GBD)) and the type of mortality indicator (population-based versus exposure-based mortality) on road safety performance evaluation. Data were derived from WHO publications and the GBD results tool, and we calculated mortality rate ratio (MRR) and differences in country ranking between the two data sources, plus differences in country rankings and in mortality changes between 2010 and 2013 for population-based and vehicle-based mortality. Of 172 countries in both datasets, 32 countries (19%) had low consistency across the two data sources (MRR ≤ 0.49 or ≥1.51). Using population-based mortality data to rank the 172 countries, 77 (45%) had ≥ 20 position difference between the two data sources. Population-based vs. vehicle-based mortality data yielded ≥ 20 position difference in 33 countries for WHO estimates and 42 for GBD estimates. Among the 80 countries having comparable population-based and vehicle-based GBD mortality rates over time, 9 countries displayed opposite changing directions – that is, the change increased in one mortality indicator but decreased in the other indicator between 2010 and 2013. Data source and type of mortality indicators yield a substantial impact on ranking road safety performance across countries, as they are widely used for decision-making by global and national policy-makers and injury researchers. The differences between WHO and GBD estimates may arise from inconsistencies in data input and estimation models. Exposure-based indicators should be preferred in road safety evaluation when data are available. Advanced research is needed to interpret large country variations in road traffic mortality and mortality progress and to develop strategies to narrow the gaps across countries.

1. Introduction

“By 2020, halve the number of global deaths and injuries from road traffic accidents.” is one target of the Sustainable Development Goals (SDGs) published by the United Nations (UN) in 2015 (United Nations, 2015). To monitor progress and determine whether this and other SDG goals are met at a global level and across countries, and to identify possible challenges in the process of implementation, is a top priority of global and national policy-makers and public health and injury researchers (Maurice, 2016). Using a health-related SDG index (including age-standardized road traffic mortality), for example, the Global Burden of Disease (GBD) 2015 SDG collaborators measured advances of 188 countries between 2000 and 2015 and compared country differences in progress (GBD 2015 SDG Collaborators, 2016). Reliable mortality statistics form an essential base to measure progress in the SDG goal for road traffic safety, but achieving such data is challenging as high-quality data are unavailable in many countries (Sankoh, 2017).

Two of the most influential and widely-used data sources for road traffic mortality are the regularly updated estimates from World Health Organization (WHO) publications and the Global Burden of Disease (GBD) estimates (World Health Organization, 2009, 2013, 2015; GBD 2015 Mortality and Causes of Death Collaborators, 2016; GBD 2013 Mortality and Causes of Death Collaborators, 2015GBD 2013 Mortality and Causes of Death Collaborators, 2015). Both provide open access, country-specific road traffic injury estimate statistics. Up to today, agreement between the two data sources for road traffic mortality, however, remains unreported.

One complication is that both data sources report only estimated

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population-based road traffic mortality even though population-based mortality is considered less useful for many purposes than exposure-based mortality such as vehicle-based mortality and miles-travelled based mortality (World Health Organization, 2009, 2013, 2015; Institute for Health Metrics and Evaluation, 2018; Beck et al., 2007; Dhondt et al., 2013). In fact, research suggests that using different indicators will lead to different, even opposite results (Sá et al., 2016). For example, in Malaysia, population-based indicator presented an increasing tendency in road traffic mortality from 1975 to 1999, but vehicle-based indicator showed a deceasing trend (World Health Organization, 2004). Application of vehicle-based indicators to evaluate global and national progress in SDGs target for road traffic safety would be valuable (GBD 2015 SDG Collaborators, 2016GBD 2015 SDG Collaborators, 2016; Ning et al., 2016).

We therefore designed this study to address two critical research questions: a) to what extent do the road traffic mortality estimates from WHO or GBD agree with each other? and b) how consistent are population-based and vehicle-based mortality in evaluating road traffic safety performance?

2. Method

2.1. Data sources

WHO estimates were derived from WHO publications, which include number of deaths and population-based mortality from road traffic crashes in 182 countries/territories in 2010 and 180 countries/territories in 2013. They also include the number of registered motor vehicles in 121 countries in 2010 and 127 countries in 2013 (World Health Organization, 2013, 2015).

The online GBD results tool provided the number of deaths and population-based mortality from road traffic crashes in 188 countries/territories during the same years (Institute for Health Metrics and Evaluation, 2018). Because WHO publications and GBD estimates both suggest that their more recent data are more reliable than previous data (World Health Organization, 2015; GBD 2015 Mortality and Causes of Death Collaborators, 2016), we decided to use only the latest year for which both data sources provided data (2013) to conduct our consistency analysis, with the exception of our examination of percent change in mortality for the GBD data. In each GBD update, data of previous years are updated accordingly using the improved models and newly added data (GBD 2015 Mortality and Causes of Death Collaborators, 2016), so GBD updates are comparable over time. The WHO research group used different covariates in statistical models for the two years and did not update the estimates of 2010 using the latest models, so WHO estimates were deemed scientifically invalid to compare between 2010 and 2013 (World Health Organization, 2015).

2.2. Statistical analysis

We used the following strategies to assess the effects of data source (WHO estimates vs. GBD estimates) and indicator (population-based vs. vehicle-based mortality).

(1) Mortality rate ratio (MRR) and difference in country rank among the countries included in both the WHO and GBD 2013 data were calculated to measure the consistency of data source. MRRs close to 1 and country rank differences approaching zero indicated high consistency of data source (WHO estimates vs. GBD estimates). Based on the ratio of mortality between the two data sources, we classified data consistency into three classes: high consistency ($0.90 \le MRR \le 1.10$), moderate consistency ($0.50 \le MRR \le 0.89$ or $1.11 \le MRR \le 1.50$), and low consistency ($MRR \le 0.49$ or ≥ 1.51). Although we recognize rankings are subject to fluctuations over time, especially for small countries, country rank was considered because it is often used to compare performance across countries.
(2) For both WHO estimates and GBD estimates, we respectively calculated country rank differences among the countries having the latest data for both population-based and vehicle-based mortality to quantify agreement between population-based and vehicle-based road traffic mortality. Country rank differences close to zero suggested high consistency.
(3) For GBD estimates, we compared differences in percent change between 2010 and 2013 for population-based and vehicle-based mortality to assess their consistency. Equal percent change in mortality indicated high consistency between population-based and vehicle-based mortality.

3. Results

3.1. Consistency between WHO estimates and GBD estimates

Of the 172 countries having both WHO and GBD estimates for 2013, 42 countries (24%) showed high consistency in population-based mortality between the two data sources (MRR: 0.90–1.10), 98 countries (57%) presented moderate consistency (MRR: 0.50-0.89 or 1.11–1.50), and 32 countries (19%) demonstrated low consistency (MRR: ≥1.51 or ≤0.49) (Fig. 1). The largest inconsistency occurred for the Federated States of Micronesia, with a mortality rate of 15.20 per 100,000 population according to the GBD data but only 1.90 per 100,000 population in the WHO data. Population-based 2013 road traffic mortality rates for the 172 countries from both data sources are listed in online supplemental Table A.1.

Next, we used population-based road traffic mortality in 2013 to rank the 172 countries (Fig. 2). Two countries - United Kingdom and Slovakia - had the exact same positions in sorting the 172 countries using both WHO estimates and GBD 2015 estimates - and an additional 37 of 172 countries (22% total) displayed a ≤5 position rank difference. However, we found large rank differences between the two data sources for other countries, with 80 countries (47%) having a ≥20 position rank difference and seven countries having a ≥80 position difference. The biggest country rank difference occurred for Zimbabwe, which ranked 166th using GBD data but 58th using WHO data. Detailed country ranks based on population-based 2013 road traffic mortality rates from both data sources are available in online supplemental Table A.1.

3.2. Consistency between population-based and vehicle-based mortality

For the 122 countries with data concerning the number of motor vehicles in 2013, we first calculated separate vehicle-based road traffic mortality for both WHO and GBD 2015 estimates. Next, we ranked the 122 countries using each data source and calculated the difference in

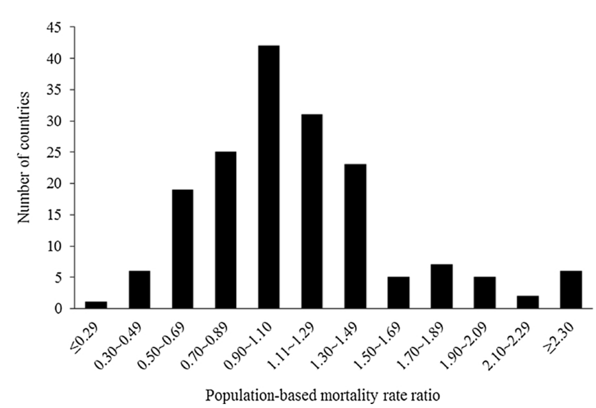

Fig. 1. Road traffic mortality rate ratio from GBD and WHO estimates for 172 countries in 2013.