

GLOBAL HEALTH LOSS DUE TO INJURIES AND POLLUTION FROM ROAD TRANSPORT

MOTORIZED ROAD TRANSPORT AND HEALTH LOSS

Injuries and air pollution generated by motorized road transport were associated with six of the top 10 causes of death and five of the top 10 causes of premature death and disability, also known as disability-adjusted life years (DALYs), in 2010 (Table 1). In fact, the top three causes of death, premature mortality (YLLs), and premature death and disability are diseases that are linked to air pollution, which is closely associated with motorized road transport. Overall, injuries and air pollution from road transport caused 1.5 million deaths globally, representing 2.9% of deaths from all causes. Together, they were the sixth-leading cause of death in 2010, with a death toll exceeding those from HIV/AIDS, tuberculosis, malaria, and diabetes. They were responsible for 79.6 million healthy life years lost, or DALYs, which is 3.2% of the total global burden of disease and injuries.

Table 1: Leading causes of death worldwide, associated DALYs, and burden attributable to motorized road transport, 2010

Rank	Cause	Global burden of disease		Burden attributable to motorized road transport	
		Deaths	DALYs	Deaths	DALYs
1	Ischemic heart disease	7,029,270	129,795,464	90,639	1,909,563
2	Stroke	5,874,181	102,238,999	58,827	1,148,699
3	COPD	2,899,941	76,778,819	17,266	346,376
4	Lower respiratory infections	2,814,379	115,227,062	5,670	489,540
5	Lung cancer	1,527,102	32,405,411	11,395	232,646
6	HIV/AIDS	1,465,369	81,549,177	–	–
7	Diarrheal diseases	1,445,798	89,523,909	–	–
8	Road injury	1,328,536	75,487,102	1,328,536	75,487,104
9	Diabetes mellitus	1,281,345	46,857,136	–	–
10	Tuberculosis	1,195,990	49,399,351	–	–
	All other causes	24,207,527	1,682,995,639	–	–
	Total	52,769,676	2,482,258,070	1,512,333	79,613,928

Note: In the “burden attributable to motorized road transport” column, emissions from road transport contribute to deaths and DALYs from ischemic heart disease, stroke, COPD, lower respiratory infections, and lung cancer. Road transport accidents contribute to deaths and DALYs from road injury.

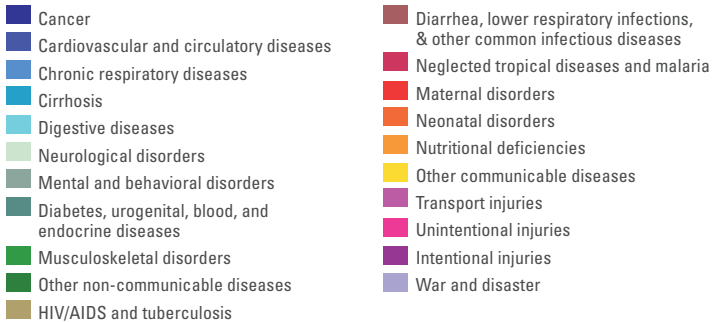
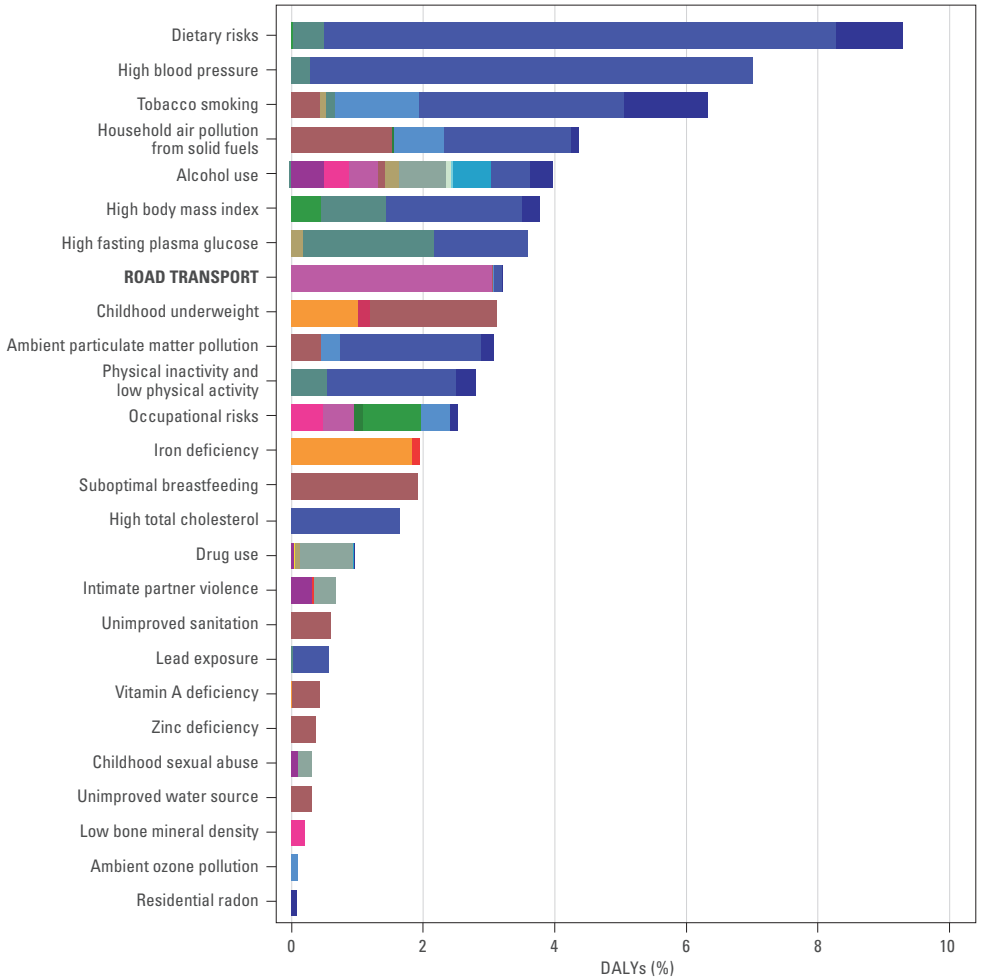
Injuries resulting from road crashes account for 95% of the combined burden of ill health from motorized road transport. Road injuries killed 1.33 million people globally in 2010 and were the eighth-leading cause of death, accounting for 2.5% of all global deaths. The road injury death toll exceeded that from diseases such as tuberculosis and malaria that receive substantial attention in the global health research and development community. They were the 10th-leading cause of healthy life years lost, contributing 3.0% of the total global health burden. They were also the eighth-leading cause of premature mortality.

In addition to injuries, pollution from vehicles causes a broad range of acute and chronic health effects, ranging from minor physiologic disturbances to death from respiratory and cardiovascular diseases. In 2010, we estimate that exposure to pollution from vehicles, in terms of particulate matter pollution ($PM_{2.5}$) derived from vehicular emissions, resulted in 184,000 deaths globally. This includes 91,000 deaths from ischemic heart disease, 59,000 deaths from stroke, and an additional 34,000 deaths due to lower respiratory infections, chronic obstructive pulmonary disease (COPD), and lung cancer combined. As explained in Annex 1, we expect that these results underestimate the health loss attributable to pollution from vehicles.

While this report was being prepared, the International Council for Clean Transportation (ICCT) completed an analysis of the mortality attributable to ambient $PM_{2.5}$ from motor vehicles, using similar methodology but some different input data-sets.¹⁴ Overall, the results of this analysis were similar to ours. The ICCT estimated 230,000 deaths per year in 2005, compared to the 184,000 deaths per year in 2010 that we estimate. As in our analysis, the ICCT found that the greatest disease burden attributable to air pollution from motor vehicles was observed in East Asia, followed by Western Europe, South Asia, and North America. In both our work and the ICCT analysis, mortality rates attributable to ambient $PM_{2.5}$ from motor vehicles were highest in Western, Central, and Eastern Europe, high-income Asia Pacific countries, and North America.

Figure 1 compares the combined burden of injuries and air pollution from motorized road transport with other leading risk factors. In 2010, road transport ranked eighth, with a burden comparable to alcohol use, which is also a key contributor to the burden of road injuries. It ranked ahead of important global health risks such as childhood malnutrition and risks faced in the workplace.

Figure 1: Percentage of global health loss that can be attributed to motorized road transport compared with other leading risk factors, 2010

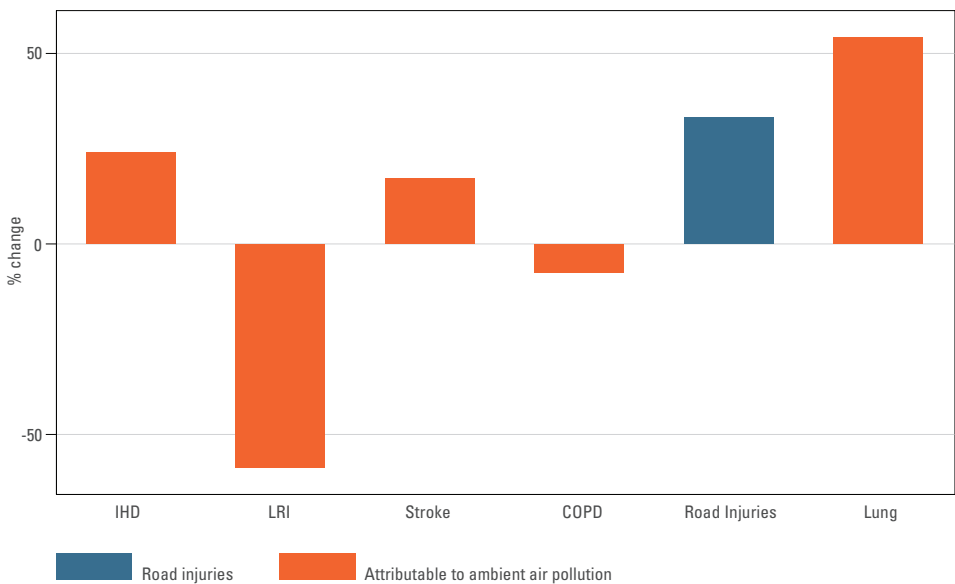


THE BURDEN OF DISEASE FROM ROAD TRANSPORT IS GROWING IN RAPIDLY MOTORIZING COUNTRIES

GBD 2010 estimates show that over the last two decades, the Global Burden of Disease has transitioned from communicable, maternal, neonatal, and nutritional disorders toward non-communicable diseases and injuries. Similarly, the contribution of risk factors has shifted from those that cause communicable diseases among children to risk factors that lead primarily to non-communicable diseases and injuries among adults.

In this report, we have estimated the health effects of pollution from vehicles only for the year 2010. However, it is important to note that overall ambient air pollution, of which air pollution from vehicles is a component, contributed to increases in premature death and disability from certain diseases as shown in Figure 2. The figure illustrates changes in the proportion of the burden attributable to overall ambient air pollution estimated in GBD 2010 and to road injuries between 1990 and 2010. Although disease burden from lower respiratory infections attributable to ambient air pollution declined and COPD has remained relatively stable, there have been large increases in disease burden from ischemic heart disease, stroke, lung cancer attributable to ambient air pollution, and road injuries.

Figure 2: Global shifts in healthy years lost due to road injuries and ambient air pollution from all sources, 1990 to 2010

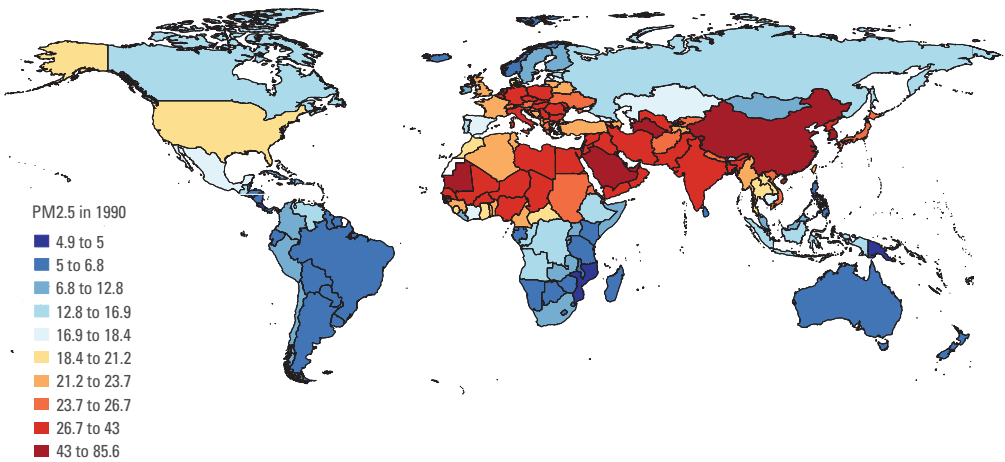


Note: This figure illustrates time trends of health effects from all sources of air pollution estimated in GBD 2010. In this report, we assess the health effects of pollution from vehicles for only one year, 2010. IHD: ischemic heart disease; LRI: lower respiratory infections; COPD: chronic obstructive pulmonary disease.

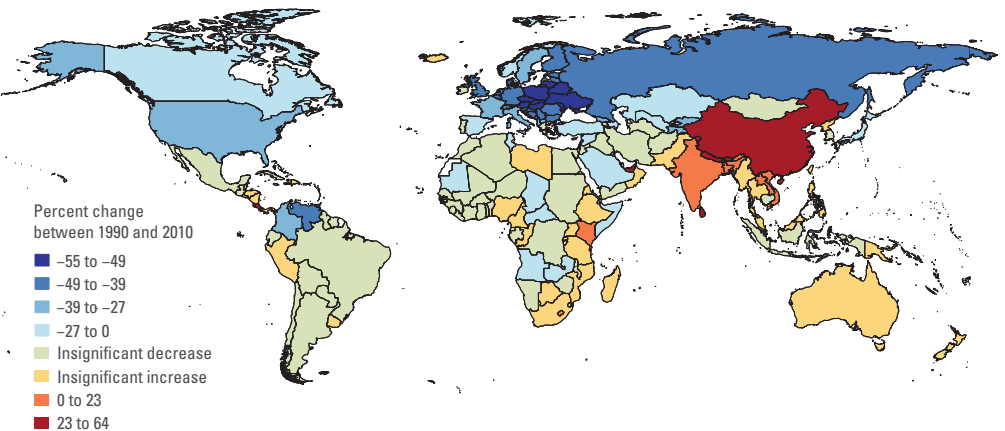
Figure 3 illustrates the vast differences across regions and countries in overall ambient air pollution and the changes over two decades. These results are broadly consistent with other reports. (Brauer et al.¹⁵ provide a detailed review.) Although pollution levels were relatively high in 1990 in many countries in Western and Central Europe, these regions have seen considerable declines over 20 years. Declines in air pollution have also occurred in North America. In contrast, ambient pollution levels in South Asia and East Asia were already high and have increased further during this period.

Figure 3: Overall ambient air pollution levels (PM_{2.5}), 1990 (a), and change in ambient air pollution levels (PM_{2.5}), 1990 to 2010 (b)

(a) Air pollution in 1990



(b) Change in air pollution, 1990 to 2010

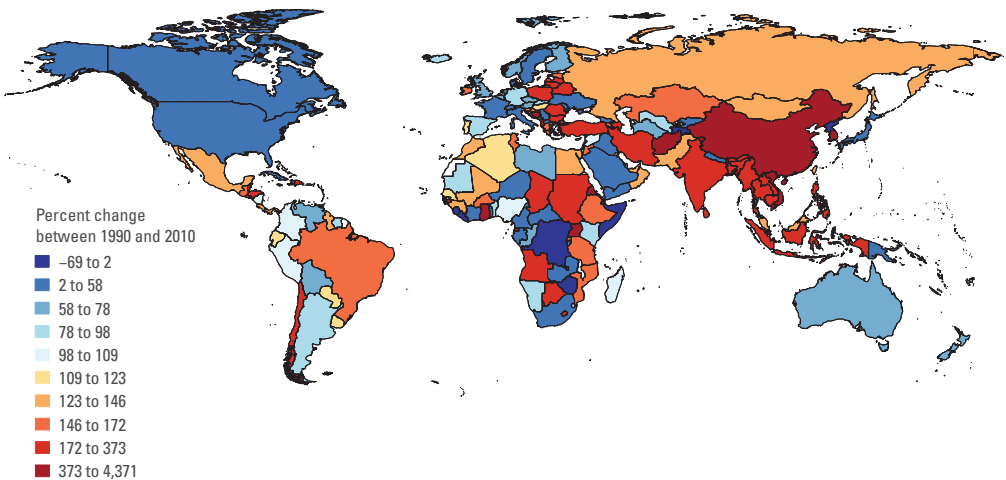


Note: These figures illustrate estimates and change in all sources of air pollution. All estimates are adjusted for population size.

Although we are unable to assess trends in pollution from vehicles with the currently available epidemiological information, a comparison with growth in motor vehicle fleets is instructive. Figure 4 illustrates that while motor vehicle fleets have grown in all countries, many of the countries with the largest increases (including China and India) are the same as those with rapid increases in overall air pollution. However, it should be noted these regions would have also experienced concomitant growth in other sources of air pollution, notably from industrial sources.

Aside from changes in motor vehicle ownership rates, regional trends in overall air pollution are partly explained by efforts to reduce pollution from vehicles in many high-income regions, including Western Europe and North America. For example, a recent analysis projected a reduction of nearly 40% in deaths attributable to air pollution from transportation (of which about 50% is due to road transport) in the US from 2005 to 2016.¹⁶

Figure 4: Change in motor vehicle ownership per capita, 1990 to 2010



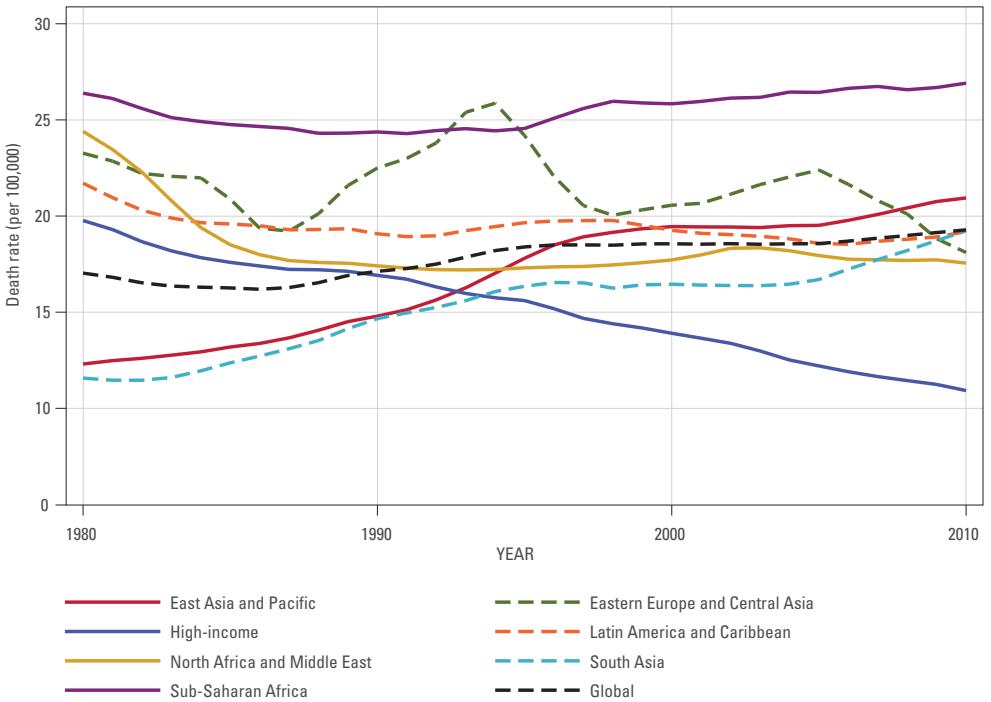
Note: Vehicles per capita are shown. National vehicle fleet was an input used in the GBD 2010 study and was estimated based on analysis of data from multiple sources including the International Road Federation's World Road Statistics Database.

The trends in road injuries have strong parallels with trends in overall air pollution (Figure 5). Since 1980, road injury death rates have steadily declined in most high-income countries. Improvements in road safety in these regions have been well documented.¹⁷ This progress began in the early 1970s, when most high-income countries established national road safety agencies, which instituted a wide array of programs promoting more stringent safety standards for vehicles, roads, and road users. Many middle-income regions succeeded in stemming the growth of road injury death rates. In Central Latin America, road injury death rates have declined by 28% since 1980. In Central Europe and Eastern Europe, road injury death rates have declined by 30% and 20%, respectively. Although the pace of improvement has been slower than that witnessed in high-income regions, these declines occur at a time when motor vehicle ownership rates in these regions have continued to increase.

In contrast to successes seen in other areas of the world, East Asia and South Asia, the two most populous regions of the world, have witnessed the highest increases in road injury death rates (Figure 5). In East Asia, which includes China, road injury death rates have grown by 77% since 1980. Similarly, in South Asia, which includes India, death rates grew by 66%. These regions have also witnessed among the fastest growth in motor vehicle ownership (Figure 4) and highway infrastructure, highlighting the urgent need for better safety management in regions undergoing rapid growth in motorized transport. Unless the death rates in these regions decrease, the goals of the UN Decade of Action for Road Safety will likely not be achieved.

Globally, rates of death from road injury have risen slowly over the last two decades, and this general trend appears to be continuing (Figure 5). This finding differs from the WHO's 2013 *Global Status Report on Road Safety*, which reported that road deaths have plateaued since 2007. The report suggested that "interventions to improve global road safety have mitigated the expected rise in the number of deaths." However, our analysis shows that it is difficult to draw such conclusions from currently available data.

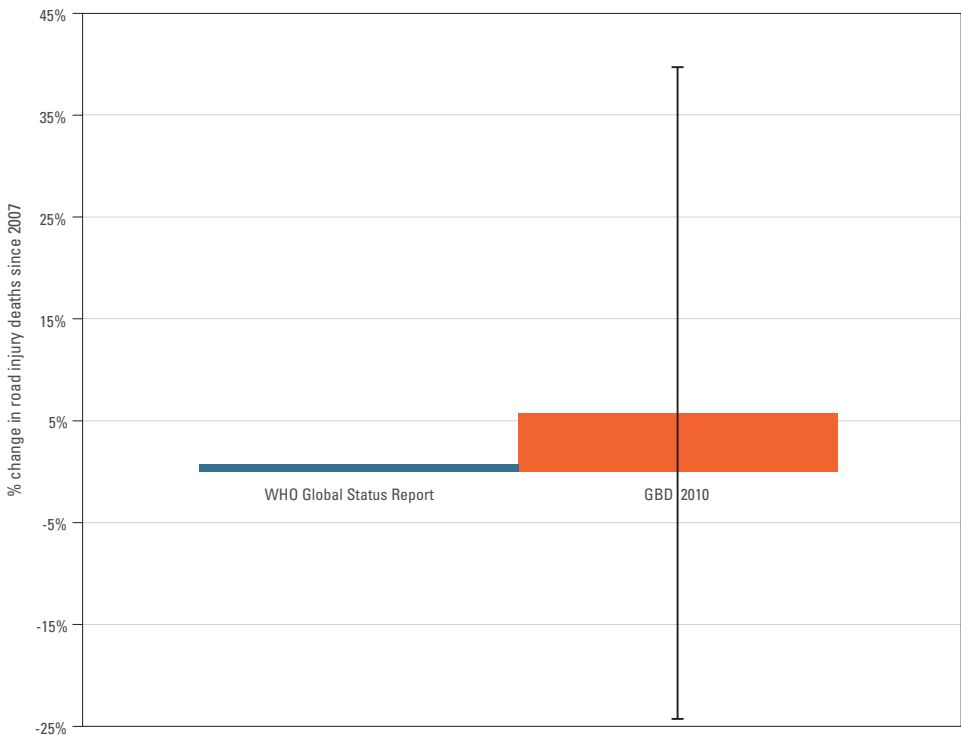
The WHO report based its findings on a cross-sectional analysis of the WHO Mortality Database and national official statistics in 2010, and a comparison of these estimates with another cross-sectional analysis for 2007 conducted previously. The report did not account for uncertainty in the two estimates. In contrast, we have used substantially more data spanning longer time periods and employed statistical models that predict cause of death trends more accurately than other methods. Our analysis (Figure 6) shows that although the GBD 2010 mean estimate of road injury deaths for 2010 is 7% higher than for 2007, the uncertainty in this change is too large (95% confidence interval [CI]: -23, 37) to draw conclusions about short-term trends.

Figure 5: Trends in road injury death rates, 1980 to 2010

Region	% Change from 1980 to 2010
Global	13.21
East Asia	77.23
Southeast Asia	53.90
Oceania	35.79
Eastern Europe	-20.49
Central Europe	-30.14
Central Asia	-12.04
Western Europe	-54.97
High-income Asia Pacific	-32.86
High-income North America	-44.18
Australasia	-58.10
Southern Latin America	-0.23
Caribbean	-4.46
Central Latin America	-28.45
Tropical Latin America	8.19
Andean Latin America	-9.94
North Africa and Middle East	-28.07
South Asia	66.24
Central sub-Saharan Africa	-26.40
Eastern sub-Saharan Africa	-8.79
Southern sub-Saharan Africa	29.78
Western sub-Saharan Africa	15.18

There is an urgent need to make all relevant data available and comparable to reduce the uncertainty in monitoring health impacts of transport. In particular, WHO and the World Bank have in-country networks with access to rich data on health outcomes and transport covariates. Pooling these together can create an unprecedented dataset to assess global injury metrics. GBD 2010 has already made substantial advances in developing the tools to combine data from a wide range of sources into coherent global health metrics. Further efforts to make transport and related health data available could narrow the existing gaps in our knowledge about global road safety.

Figure 6: Percentage change in global road deaths since 2007



Note: Vertical lines represent the uncertainty interval surrounding the estimate.