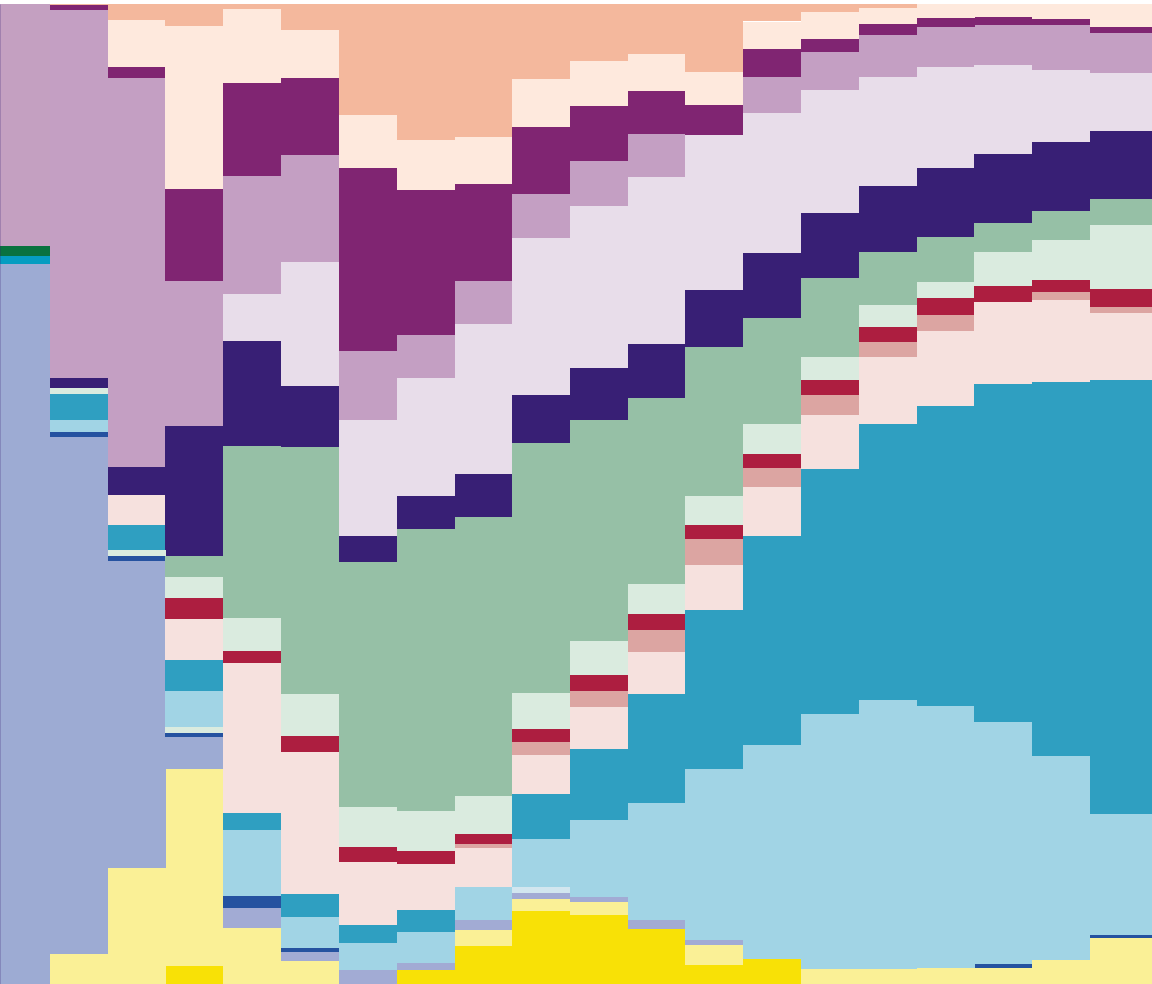
THE GLOBAL BURDEN OF DISEASE: GENERATING EVIDENCE, GUIDING POLICY

LATIN AMERICA & CARIBBEAN REGIONAL EDITION

INSTITUTE FOR HEALTH METRICS AND EVALUATION
UNIVERSITY OF WASHINGTON

HUMAN DEVELOPMENT NETWORK
THE WORLD BANK



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This report was prepared by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington and the Human Development Network at the World Bank based on seven papers for the Global Burden of Disease Study 2010 (GBD 2010) published in *The Lancet* (2012 Dec 13; 380). GBD 2010 had 488 co-authors from 303 institutions in 50 countries. The work was made possible through core funding from the Bill & Melinda Gates Foundation. The views expressed are those of the authors.

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ABOUT IHME

The Institute for Health Metrics and Evaluation (IHME) is an independent global health research center at the University of Washington that provides rigorous and comparable measurement of the world's most important health problems and evaluates the strategies used to address them. IHME makes this information freely available so that policymakers have the evidence they need to make informed decisions about how to allocate resources to best improve population health.

To express interest in collaborating, participating in GBD training workshops, or receiving updates of GBD or copies of this publication, please contact IHME at:

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ABOUT THE HUMAN DEVELOPMENT NETWORK AT THE WORLD BANK GROUP

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The World Bank's Human Development Network (HDN) invests in creating equal opportunities for people to live healthy and productive lives, secure meaningful jobs, and protect themselves from crises. HDN takes a lifecycle and systems approach to help developing countries deliver equitable and effective education; health, nutrition, and population; and social protection and labor services. HDN works across all development sectors and with ministries of finance to demonstrate how these investments in people promote inclusive development; long, healthy, and productive lives; economic growth; and country competitiveness. HDN focuses on results through building strong, integrated systems and country capacity; promoting evidence-based policy and program decision-making; and leveraging partnerships with donors and development agencies, civil society, the private sector, and communities to deliver country-tailored solutions. HDN's work helps support the most effective

policies, tools, and instruments to make a real difference toward the broader goal of ending extreme poverty and building shared prosperity.

For more information, go to www.worldbank.org/health.

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GLOSSARY

Years of life lost (YLLs): Years of life lost due to premature mortality.

Years lived with disability (YLDs): Years of life lived with any short-term or long-term health loss, adjusted for severity.

Disability-adjusted life years (DALYs): The sum of years lost due to premature death (YLLs) and years lived with disability (YLDs). DALYs are also defined as years of healthy life lost.

Healthy life expectancy, or health-adjusted life expectancy (HALE): The number of years that a person at a given age can expect to live in good health, taking into account mortality and disability.

Sequelae: Consequences of diseases and injuries.

Health states: Groupings of sequelae that reflect key differences in symptoms and functioning.

Disability weights: Number on a scale from 0 to 1 that represents the severity of health loss associated with a health state.

Risk factors: Potentially modifiable causes of disease and injury.

Uncertainty intervals: A range of values that is likely to include the correct estimate of health loss for a given cause. Narrow uncertainty intervals indicate that evidence is strong, while wide uncertainty intervals show that evidence is weaker.

INTRODUCTION

The Global Burden of Disease (GBD) approach is a systematic, scientific effort to quantify the comparative magnitude of health loss due to diseases, injuries, and risk factors by age, sex, and geography for specific points in time. Box 1 describes the history of GBD. The latest iteration of that effort, the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010), was published in *The Lancet* in December 2012. The intent is to create a global public good that will be useful for informing the design of health systems and the creation of public health policy. It estimates premature death and disability due to 291 diseases and injuries, 1,160 sequelae (direct consequences of disease and injury), and 67 risk factors for 20 age groups and both sexes in 1990, 2005, and 2010. GBD 2010 produced estimates for 187 countries and 21 regions. In total, the study generated over 1 billion estimates of health outcomes.

GBD 2010 was a collaborative effort among 488 researchers from 50 countries and 303 institutions. The Institute for Health Metrics and Evaluation (IHME) acted as the coordinating center for the study. The collaboration strengthened both the data-gathering effort and the quantitative analysis by bringing together some of the foremost minds from a wide range of disciplines. Our intention is to build on this collaboration by enlarging the network in the years to come. Similarly, IHME and its collaborators hope to expand the list of diseases, injuries, and risk factors included in GBD and routinely update the GBD estimates. Continual updates will ensure that the international community can have access to high-quality estimates in the timeliest fashion. Through sound measurement, we can provide the foundational evidence that will lead to improved population health.

Over the last two decades, the global health landscape has undergone rapid transformation. People around the world are living longer than ever before, and the population is getting older. The number of people in the world is growing. Many countries have made remarkable progress in preventing child deaths. As a result, disease burden is increasingly defined by disability instead of premature mortality. The leading causes of death and disability have changed from communicable diseases in children to non-communicable diseases in adults. Eating too much has overtaken hunger as a leading risk factor for illness. While there are clear trends at the global level, there is substantial variation across regions and countries. Nowhere is this contrast more striking than in sub-Saharan Africa, where communicable, maternal, nutritional, and newborn diseases continue to dominate.

In the Latin America and Caribbean region, many of the leading causes of health loss were non-communicable diseases. Similar to global trends, communicable, maternal, nutritional, and newborn causes are becoming less important in this region as non-communicable diseases kill more people prematurely and cause increasing disability. However, HIV/AIDS increased in most countries in Latin America and the Caribbean over the past 20 years and was a leading cause of loss of healthy life in

certain countries. Road injuries and violence were also dominant causes of health loss in the region. High blood pressure, dietary risks, alcohol use, and other risk factors contributed to the rise of burden from non-communicable diseases in Latin America and the Caribbean, while risks related to illness in children remained prominent in some countries, including Bolivia and Haiti.

As demographic changes such as population growth and increasing average age have caused burden from non-communicable diseases to increase in Latin America and the Caribbean, GBD found that many countries are making progress in some of these conditions. This progress can be seen when using measurements called age-standardized rates, which remove the effects of demographic changes to isolate health improvements. Age-standardized rates of non-communicable diseases, such as ischemic heart disease and stroke, have declined over time in many countries in Latin America and the Caribbean. At the same time, age-standardized rates of diabetes, musculoskeletal disorders, and drug use disorders are rising in a large number of countries, underscoring the mixed success in combatting different non-communicable diseases in the region.

This publication summarizes the global GBD 2010 findings as well as the regional findings for Latin America and the Caribbean. It also explores intraregional differences in diseases, injuries, and risk factors. The overall findings for the region are summarized in the next section.

MAIN FINDINGS FOR LATIN AMERICA AND THE CARIBBEAN

- Latin America and the Caribbean made dramatic progress in reducing mortality and prolonging life since 1970. In Brazil, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Peru, and Saint Lucia, the average age of death rose 30 years or more between 1970 and 2010.
- Over the last 20 years, the region has made substantial health progress. Latin America and the Caribbean succeeded in decreasing premature death and disability from most communicable, newborn, nutritional, and maternal causes. Diarrheal disease was the number one cause of disease burden in the region in 1990, but dropped to the 20th leading cause in 2010. HIV/AIDS remains a persistent challenge. It was one of the top five causes of disease burden in nine countries in the region in 2010. However, age-standardized rates of HIV/AIDS began dropping in most countries in the region in 2005.
- Despite improvements, substantial burdens of communicable, newborn, nutritional, and maternal causes persist in low- and lower-middle-income countries in Latin America and the Caribbean, including Bolivia, Guatemala, Guyana, and Haiti.
- Between 1990 and 2010, demographic changes and risk factors contributed to rising disease burden from many non-communicable causes, particularly ischemic heart disease, mental disorders such as depression and anxiety, musculoskeletal disorders including low back pain and neck pain, diabetes, and chronic

Box 1: History of the Global Burden of Disease and innovations in GBD 2010

The first GBD study was published as part of the *World Development Report 1993*. This original study generated estimates for 107 diseases, 483 sequelae (non-fatal health consequences), eight regions, and five age groups.

The authors' inspiration for the study came from the realization that policymakers lacked comprehensive and standardized data on diseases, injuries, and potentially preventable risk factors for decision-making. A second source of inspiration was the fact that disease-specific advocates' estimates of the number of deaths caused by their diseases of interest far exceeded the total number of global deaths in any given year. GBD authors chose to pursue a holistic approach to analyzing disease burden to produce scientifically sound estimates that were independent of the influence of advocates.

The GBD 1990 study had a profound impact on health policy as it exposed the hidden burden of mental illness around the world. It also shed light on neglected health areas such as the premature death and disability caused by road traffic injuries. Work from this study has been cited over 4,000 times since 1993.

The study also sparked substantial controversy. Many disease-specific advocates argued that the original GBD underestimated burden from the causes they cared about most. The use of age weighting and discounting also caused extensive debates. Age weighting assumed that a year of life increased in value until age 22, and then decreased steadily. Discounting counted years of healthy life saved in the present as more valuable than years of life saved in the future. Also controversial was the use of expert judgment to estimate disability weights (estimations of the severity of non-fatal conditions). As a result of this feedback and consultation with a network of philosophers, ethicists, and economists, GBD no longer uses age weighting and discounting. Also, GBD 2010 updated its methods for determining disability weights and used data gathered from thousands of respondents from different countries around the world.

GBD 2010 shares many of the founding principles of the original GBD 1990 study, such as using all available data on diseases, injuries, and risk factors; using comparable metrics to estimate the impact of death and disability on society; and ensuring that the science of disease burden estimation is not influenced by advocacy.

Despite these similarities, GBD 2010 is broader in scope and involved a larger number of collaborators than any previous GBD study. While the original study had the participation of 100 collaborators worldwide, GBD 2010 had 488 co-authors. Thanks to that network, the study includes vast amounts of data on health outcomes and risk factors. Researchers also made substantial improvements to the GBD methodology, summarized in Box 2 and described in detail in the Annex of this report and in the published studies. Among these improvements, highlights include using data collected via population surveys to estimate disability weights for the first time, greatly expanding the list of causes and risk factors analyzed in the study, providing detailed analysis of the effect of different components of diet on health outcomes, and reporting of uncertainty intervals for all metrics. GBD 2010 researchers reported uncertainty intervals to provide full transparency about the weaknesses and strengths of the analysis. Narrow uncertainty intervals indicate that evidence is strong, while wide uncertainty intervals show that evidence is weaker.

kidney disease. Diabetes is a major public health problem in the Caribbean, where it ranked among the top five causes of health loss in many countries. Today, drug and alcohol use disorders are causing more early death and disability in Latin America and the Caribbean than two decades ago.

- Although health systems in Latin America and the Caribbean are grappling with a larger burden from non-communicable diseases than ever before, progress is being made in certain areas. Researchers can remove the impact of demographic changes to isolate what is important for comparisons of health performance. This involves the use of a health performance metric called age-standardized rates. Using this metric reveals that many countries in the Latin American and Caribbean region succeeded in reducing ischemic heart disease and stroke between 1990 and 2010. At the same time, age-standardized rates of diabetes, musculoskeletal disorders, and drug use disorders rose in multiple countries during this period.
- Dietary risks such as low fruit, nut and seed, and whole grain intake and high sodium consumption are a leading risk factor for premature death and disability in the region. High body mass index, high blood pressure, high fasting glucose (blood sugar), and alcohol use are also top contributors to health loss in many countries. Risk factors that primarily cause illness in children, such as household air pollution, iron deficiency, and suboptimal breastfeeding, were important in lower-income countries of the region, including Bolivia and Haiti.
- As countries in Latin America and the Caribbean have become more developed, road injuries have taken a growing toll on human health. Also, many countries in the region suffered from increasing levels of health loss as a result of interpersonal violence. Brazilian men, for example, lost nearly 3 million years of healthy life in 2010 as a result of such violence.
- Disease and injury trends within Latin America and the Caribbean differ dramatically across countries in the region. Ischemic heart disease was the leading cause of health loss in 12 countries in the region, but the top causes in other countries were as diverse as interpersonal violence, lower respiratory infections, diabetes, HIV/AIDS, and road injuries.
- The leading causes of disability in Latin America and the Caribbean, including low back pain, neck pain, and other musculoskeletal disorders, as well as mental disorders such as depression and anxiety, largely mirrored global trends. In contrast to global trends, asthma and drug use disorders were larger causes of disability in the region, and iron-deficiency anemia and chronic obstructive pulmonary disease were less prominent in the region than in the world as a whole.
- When comparing countries' health performance, low- and low-middle-income countries in the region had the highest age-standardized rates of premature death and disability due to communicable, newborn, nutritional, and maternal conditions while upper-middle-income countries had rates that were more comparable to developed countries. Generally, upper-middle-income countries performed better than the regional average for most causes of premature death while low- and lower-middle-income countries did not tend to perform as well, but there were important exceptions to this trend.

Box 2: Global Burden of Disease methodology

GBD uses thousands of data sources from around the world to estimate disease burden. As a first step, GBD researchers estimate child and adult mortality using data sources such as vital and sample registration systems, censuses, and household surveys. Years lost due to premature death from different causes are calculated using data from vital registration with medical certification of causes of death when available, and sources such as verbal autopsies in countries where medical certification of causes of death is lacking. Years lived with disability are estimated using sources such as cancer registries, data from outpatient and inpatient facilities, and direct measurements of hearing, vision, and lung function testing. Once they have estimated years lost due to premature death and years lived with disability, GBD researchers sum the two estimates to obtain disability-adjusted life years. Finally, researchers quantified the amount of premature death and disability attributable to different risk factors using data on exposure to, and the effects of, the different risk factors. For more information about the GBD methods, see the Annex of this report as well as the published papers.

THE GBD APPROACH TO TRACKING HEALTH PROGRESS AND CHALLENGES

For decision-makers striving to create evidence-based policy, the GBD approach provides numerous advantages over other epidemiological studies. These key features are further explored in this report.

A CRITICAL RESOURCE FOR INFORMED POLICYMAKING

To ensure a health system is adequately aligned to a population's true health challenges, policymakers must be able to compare the effects of different diseases that kill people prematurely and cause ill health. The original GBD study's creators developed a single measurement, disability-adjusted life years (DALYs), to quantify the number of years of life lost as a result of both premature death and disability. One DALY equals one lost year of healthy life. DALYs will be referred to by their acronym, as "years of healthy life lost," and "years lost due to premature death and disability" throughout this publication. Decision-makers can use DALYs to quickly compare the impact caused by conditions such as cancer and depression since the conditions are assessed using a comparable metric. Considering the number of DALYs instead of causes of death alone provides a more accurate picture of the main drivers of poor health. Thanks to the use of this public health monitoring tool, GBD 2010 researchers found that in most countries, as mortality declines, disability becomes increasingly important. Information about changing disease patterns is a crucial input for decision-making, as it illustrates the challenges that individuals and health care providers are facing in different countries.

In addition to comparable information about the impact of fatal and non-fatal conditions, decision-makers need comprehensive data on the causes of ill health that are most relevant to their country. The hierarchical GBD cause list (available on IHME's website at http://ihmeuw.org/gbdcauselist) has been designed to include the diseases, injuries, and sequelae that are most relevant for public health policymaking. To create this list, researchers reviewed epidemiological and cause of death data to identify which diseases and injuries resulted in the most ill health. Inpatient and outpatient records were also reviewed to understand the conditions for which patients sought medical care. For example, researchers added chronic kidney disease to the GBD cause list after learning that this condition accounted for a large number of hospital visits and deaths.

GBD provides high-quality estimates of diseases and injuries that are more rigorous than those published by disease-specific advocates. GBD was created in part due to researchers' observation that deaths estimated by different disease-specific studies added up to more than 100% of total deaths when summed. The GBD approach ensures that deaths are counted only once. First, GBD counts the total number of deaths in a year. Next, researchers work to assign a single cause to each death using a variety of innovative methods (see Annex). Estimates of cause-specific mortality are then compared to estimates of deaths from all causes to ensure that the cause-

specific numbers do not exceed the total number of deaths in a given year. Other components of the GBD estimation process are interconnected with similar built-in safeguards, such as for the estimation of impairments that are caused by more than one disease.

Beyond providing a comparable and comprehensive picture of causes of premature death and disability, GBD also estimates the disease burden attributable to different risk factors. The GBD approach goes beyond risk factor prevalence, such as the number of smokers or heavy drinkers in a population. With comparative risk assessment, GBD incorporates both the prevalence of a given risk factor as well as the relative harm caused by that risk factor. It counts premature death and disability attributable to high blood pressure, tobacco and alcohol use, lack of exercise, air pollution, poor diet, and other risk factors that lead to ill health.

The flexible design of the GBD machinery allows for regular updates as new data are made available and epidemiological studies are published. Similar to the way in which a policymaker uses gross domestic product data to monitor a country's economic activity, GBD can be used at the global, national, and local levels to understand health trends over time.

Policymakers in Brazil, Colombia, Mexico, Norway, Saudi Arabia, and the United Kingdom are exploring collaborations with IHME to adopt different aspects of the GBD approach. In the past, many countries in the Latin American and Caribbean region have carried out burden of disease studies, including Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Peru, and Uruguay. In this region, GBD serves as an important tool for decision-making in health along with other tools such as cost effectiveness studies of health interventions, social values, and political economy. Box 3 contains some decision-makers' and policy-influencers' reflections about the value of using GBD tools and results to inform policy discussions.

Box 3: Views on the value of GBD for policymaking

"While the GBD 2010 offers significant epidemiologic findings that will shape policy debates worldwide, it also limns the gaps in existing disease epidemiology knowledge and offers new ways to improve public health data collection and assessment." **Dr. Paul Farmer**, *Chair, Department of Global Health and Social Medicine, Harvard Medical School*

"With a subnational burden of disease study, Mexico was able to see clearly where it should focus its limited health resources. Those findings led to a major health reform that transformed the approach to improving population health through universal coverage." **Julio Frenk**, *Dean of Harvard School of Public Health and former Minister of Health in Mexico*

"At UNICEF we've always had a focus on metrics and outcomes as a driver of the work we do. We welcome the innovation, energy, and attention that this work is bringing to the importance of holding ourselves accountable to meaningful outcomes and results." **Dr. Mickey Chopra**, *UNICEF Chief of Health/Associate Director of Programmes*

GBD data visualization tools (see Box 4) on the IHME website allow users to interact with the results in a manner not seen in past versions of the study. Users report that the visualization tools provide a unique, hands-on opportunity to learn about the health problems that different countries and regions face, allowing them to explore seemingly endless combinations of data. The following list illustrates the range of estimates that can be explored using the GBD data visualization tools:

- Changes between 1990 and 2010 in leading causes of death, premature death, disability, and DALYs as well as changes in the amount of health loss attributable to different risk factors across age groups, sexes, and locations.
- Rankings for 1990 and 2010 of the leading causes of death, premature death, disability, and DALYs attributable to risk factors across different countries and regions, age groups, and sexes.
- Changes in trends for 21 cause groups in 1990 and 2010 in different regions, sexes, and metrics of health loss.
- The percentage of deaths, premature deaths, disability, or DALYs in a country or region caused by myriad diseases and injuries for particular age groups, sexes, and time periods.
- The percentage of health loss by country or region attributable to specific risk factors by age group, sex, and time period.

In addition to promoting understanding about the major findings of GBD, these visualization tools can help government officials build support for health policy changes, allow researchers to visualize data prior to analysis, and empower teachers to illustrate key lessons of global health in their classrooms.

To use the GBD data visualization tools, visit www.ihmeuw.org/GBDcountryviz.

Box 4: GBD data visualization tools

For the first time in the history of GBD research, IHME has developed many free data visualization tools that allow individuals to explore health trends for different countries and regions. The visualization tools allow people to view GBD estimates through hundreds of different dimensions. Only a few examples are explored in the figures throughout this document. We encourage you to visit the IHME website to use the GBD data visualization tools and share them with others.

THE EGALITARIAN VALUES INHERENT IN GBD

When exploring the possibility of incorporating GBD measurement tools into their health information systems, policymakers should consider the egalitarian values on which this approach is founded.

The core principle at the heart of the GBD approach is that everyone should live a long life in full health. As a result, GBD researchers seek to measure the gap between this ideal and reality. Calculation of this gap requires estimation of two different components: years of life lost due to premature death (YLLs) and years lived with disability (YLDs).

To measure years lost to premature death, GBD researchers had to answer the question: "How long is a 'long' life?" For every death, researchers determined that the most egalitarian answer to this question was to use the highest life expectancy observed in the age group of the person who died. The Annex contains more information about the estimation of YLLs.

In order to estimate years lived with disability, or YLDs, researchers were confronted with yet another difficult question: "How do you rank the severity of different types of disability?" To determine the answer, researchers created disability weights based on individuals' perceptions of the impact on people's lives from a particular disability, everything from tooth decay to schizophrenia.

GBD REGIONAL CLASSIFICATIONS

GBD 2010 created regions based on two criteria: epidemiological similarity and geographic closeness. The GBD regional groupings differ from the World Bank regional classification system. More information about GBD regional classifications can be found on the IHME website: www.ihmeuw.org/gbdfaq.

Rather than using the GBD regional classifications, this report provides findings based on the countries in World Bank's regional definition of Latin America and the Caribbean. Figures reflect World Bank regional classifications. GBD, however, does not produce estimates for territories or countries with fewer than 50,000 people or countries that have only recently come into existence.

RAPID HEALTH TRANSITIONS: GBD 2010 RESULTS

In most countries in the Latin America and Caribbean region, loss of healthy life, or DALYs, from non-communicable diseases are rising while DALYs from communicable, newborn, nutritional, and maternal causes are declining. To help decision-makers establish health service priorities within countries when faced with limited resources, we will explore changes in disease burden around the globe, in the Latin America and Caribbean region, and in specific countries in this section. In another section entitled "Using GBD to assess countries' health progress," we will compare how well countries are performing in health relative to other countries in the region using a metric called age-standardized rates.

In terms of disease burden at the global level, GBD 2010 found that the leading causes of DALYs have evolved dramatically over the past 20 years. Figure 1 shows the changes in the global leading causes of DALYs in 1990 and 2010. Communicable, newborn, maternal, and nutritional causes are shown in red, non-communicable diseases appear in blue, and injuries are shown in green. Dotted lines indicate causes that have fallen in rank during this period, while solid lines signal causes that have risen in rank.

Causes associated with ill health and death in adults, such as ischemic heart disease, stroke, and low back pain, increased in rank between 1990 and 2010, while causes that primarily affect children, such as lower respiratory infections, diarrhea, preterm birth complications, and protein-energy malnutrition, decreased in rank. Unlike most of the leading communicable causes, HIV/AIDS and malaria increased by 353% and 18%, respectively. Since 2005, however, premature mortality and disability from these two causes have begun to decline. Four main trends have driven changes in the leading causes of DALYs globally: aging populations, increases in non-communicable diseases, shifts toward disabling causes and away from fatal causes, and changes in risk factors.

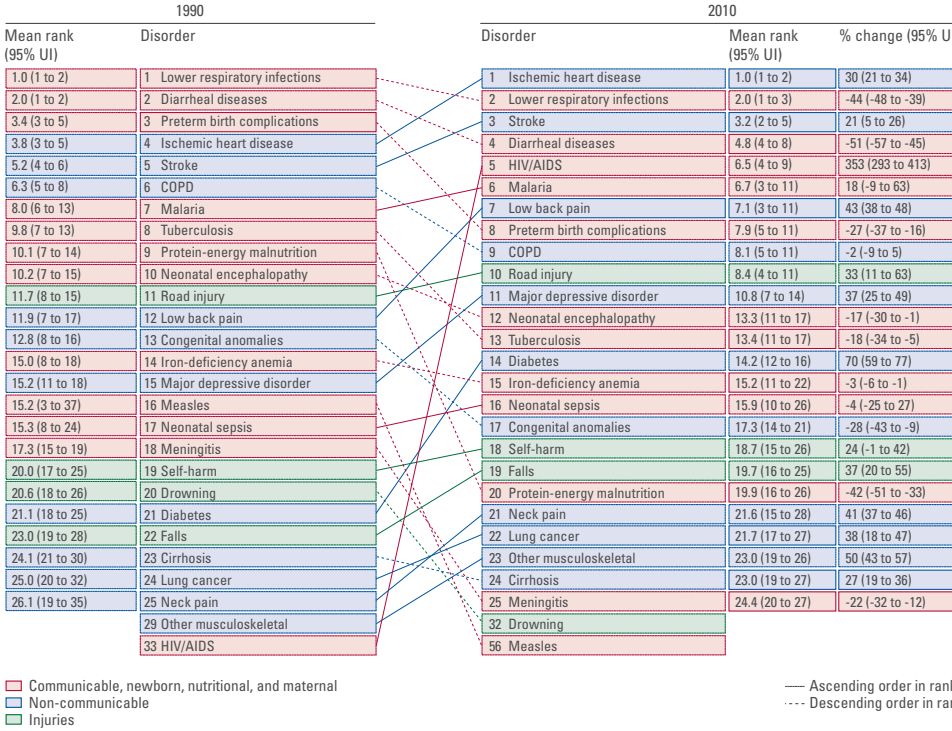
To provide a closer look at the epidemiological changes occurring at the regional level, Figure 2 shows how DALYs have changed over time in Latin America and the Caribbean. Figures showing changes in the leading causes of DALYs by country can be found in the Annex of this report.

Ischemic heart disease was the leading cause of DALYs in Latin America and the Caribbean in 2010, as it was at the global level, rising from fourth to first place between 1990 and 2010. As a result of the Haiti earthquake, injuries from forces of nature became a main cause of DALYs in this region in 2010. This cause ranked 174th in 1990. DALYs due to interpersonal violence, another type of injury, increased by 35% between 1990 and 2010 and moved up in rank from the fifth- to the third-largest

cause of DALYs. This trend reflects epidemics of violence in countries such as Brazil and Guatemala, where interpersonal violence is a top cause of health loss. As countries in Latin America and the Caribbean have become more developed, DALYs from road injuries increased by 27% and the cause rose in rank from seventh in 1990 to fourth in 2010. Road injuries were the leading cause of DALYs in Ecuador in 2010.

Most communicable, newborn, maternal, and nutritional causes of DALYs dropped in rank in Latin America and the Caribbean as many non-communicable causes rose in rank, mirroring global trends. However, the burden due to some communicable diseases remains large: DALYs due to HIV/AIDS increased 94% between 1990 and

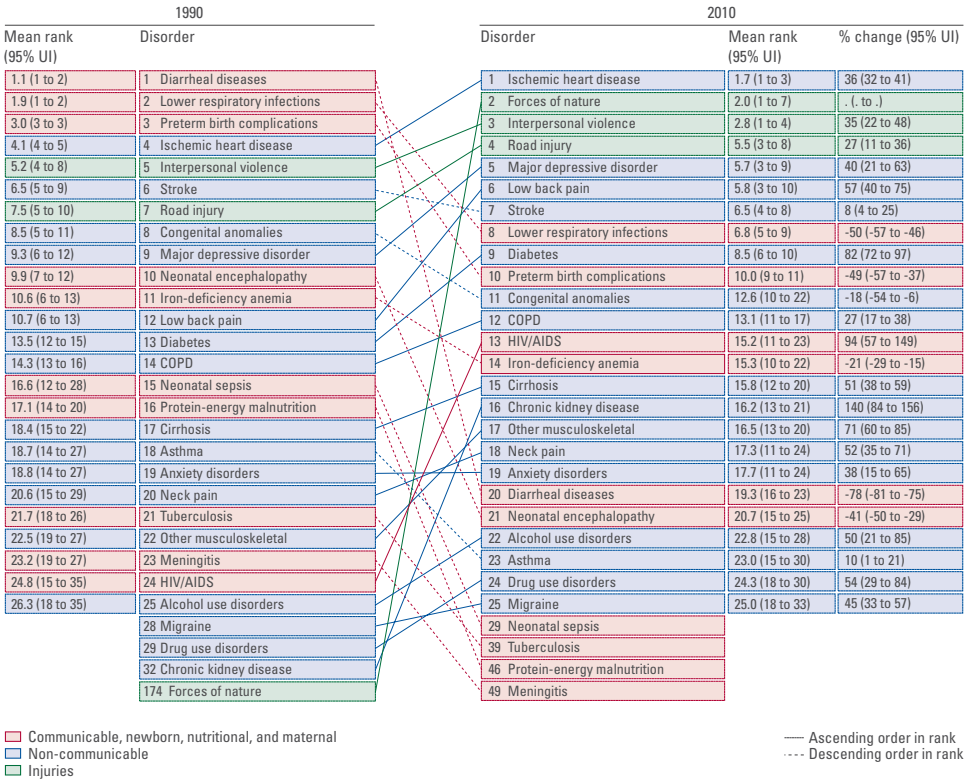
Figure 1: Global disability-adjusted life year ranks, top 25 causes, and percentage change, 1990-2010



Note: Solid lines indicate a cause that has moved up in rank or stayed the same. Broken lines indicate a cause that has moved down in rank. The causes of DALYs are color coded, with blue for non-communicable diseases, green for injuries, and red for communicable, newborn, nutritional, and maternal causes of DALYs. COPD: Chronic obstructive pulmonary disease. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdarrowdiagram.

2010, and HIV/AIDS was the leading cause of DALYs in Belize, Jamaica, and Suriname. Worldwide, the increase in HIV/AIDS was even more dramatic and rose 353% during this 20-year period. At the same time, certain non-communicable diseases were much more prominent causes of premature death and disability in Latin America and the Caribbean compared to the world as a whole. Depression was the fifth leading cause of DALYs in this region but was the 11th cause globally. At the country level, depression ranked among the five leading causes of DALYs in 13 countries in Latin America and the Caribbean. Diabetes, a leading cause of DALYs in many Caribbean countries, also ranked higher in Latin America and the Caribbean than at the global level. Chronic kidney disease was the 16th cause of health loss in the region, but was not one of the top 25 causes of DALYs at the global level. Cirrhosis also ranked higher in this region compared to the world (15th compared to 23rd), ranking as high as sixth in Mexico and 10th in Guatemala.

Figure 2: Disability-adjusted life year ranks, top 25 causes, and percentage change in Latin America and Caribbean, 1990-2010

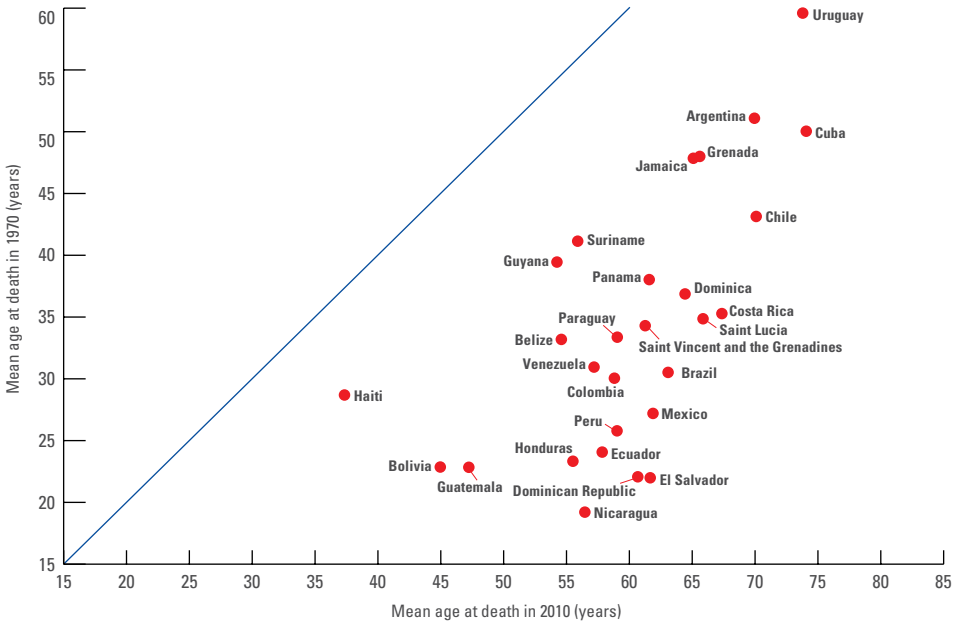


Note: Solid lines indicate a cause that has moved up in rank or stayed the same. Broken lines indicate a cause that has moved down in rank. The causes of DALYs are color coded, with blue for non-communicable diseases, green for injuries, and red for communicable, newborn, nutritional, and maternal causes.

MOST OF THE WORLD'S POPULATION IS LIVING LONGER AND DYING AT LOWER RATES

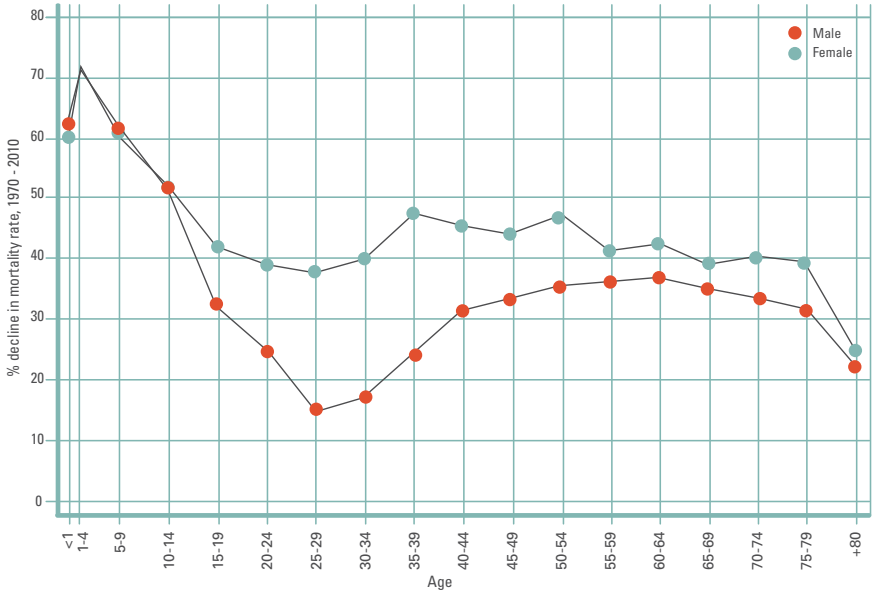
In much of the world, GBD 2010 found that people are living to older ages than ever before, and the entire population is getting older. Since 1970, the average age of death has increased 20 years globally. Dramatic changes have occurred during this period in Latin America, Asia, and the Middle East, where the average age of death increased by 30 years or more. Sub-Saharan Africa, however, has not made nearly as much progress as other developing regions, and people in this part of the world tend to die at much younger ages than in any other region. Progress in sub-Saharan Africa has in particular been held back by the HIV/AIDS epidemic, maternal deaths, and child mortality caused by infectious diseases and malnutrition, but some of these trends have begun to change in the past decade.

Figure 3: Average age of death for countries in Latin America and Caribbean, 1970 compared with 2010



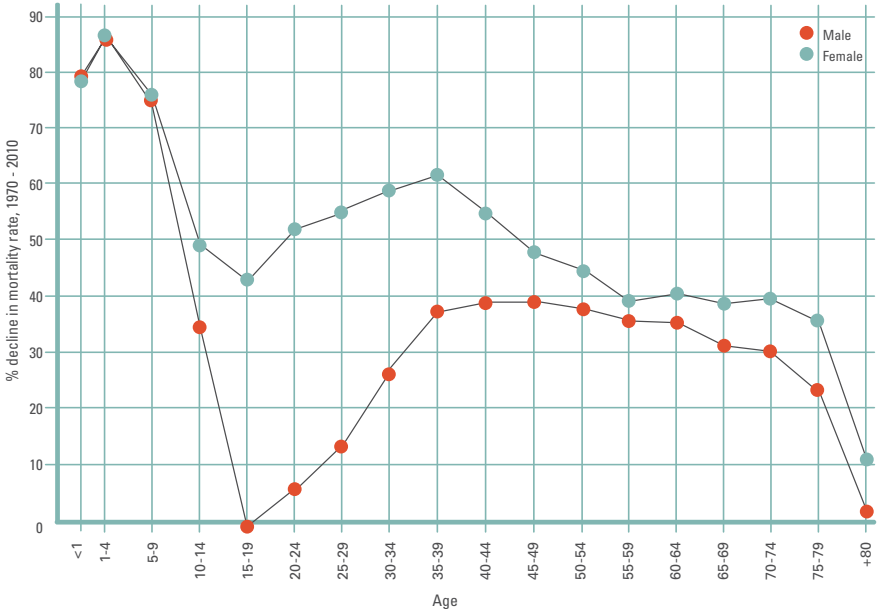
Note: Countries falling on the right side of the 45-degree-angle line had a higher average age of death in 2010 compared to 1970.

Figure 4: Global decline in age-specific mortality rate, 1970-2010



Note: Higher values indicate greater declines in mortality; lower values indicate smaller declines in mortality.

Figure 5: Decline in age-specific mortality rate in Latin America and Caribbean, 1970-2010



Note: Higher values indicate greater declines in mortality; lower values indicate smaller declines in mortality. Points below zero indicate an increase in mortality.

In the Latin America and Caribbean region, the countries that made most progress in increasing the average age at death between 1970 and 2010 were Brazil, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Peru, and Saint Lucia (Figure 3). These countries achieved gains of 30 years or more. Most of the other countries in the region succeeded in extending the average age at death between 20 and 30 years. At the lower end, countries such as Guyana, Haiti, Suriname, and Uruguay increased the average age at death by 15 years or less between 1970 and 2010. On average, people in poorer countries tended to die at younger ages compared to richer countries in the region. For example, the average age of death in low-middle-income countries such as Belize, Bolivia, Guatemala, Guyana, and Honduras was 56 years and younger, but it was over 70 years in upper-middle-income countries such as Cuba, Chile, and Uruguay.

Another way to understand changes in global demographic trends is to explore reductions in mortality rates by sex and age group. Figure 4 shows how global death rates have declined in all age groups between 1970 and 2010. These changes have been most dramatic among males and females aged 0 to 9 years, whose death rates have dropped over 60% since 1970. Among age groups 15 and older, the decrease in female death rates since 1970 has been greater than the drop in male death rates. The gap in progress between men and women was largest between the ages of 15 to 54, most likely due to the persistence of higher mortality from injuries and alcohol and tobacco use among men.

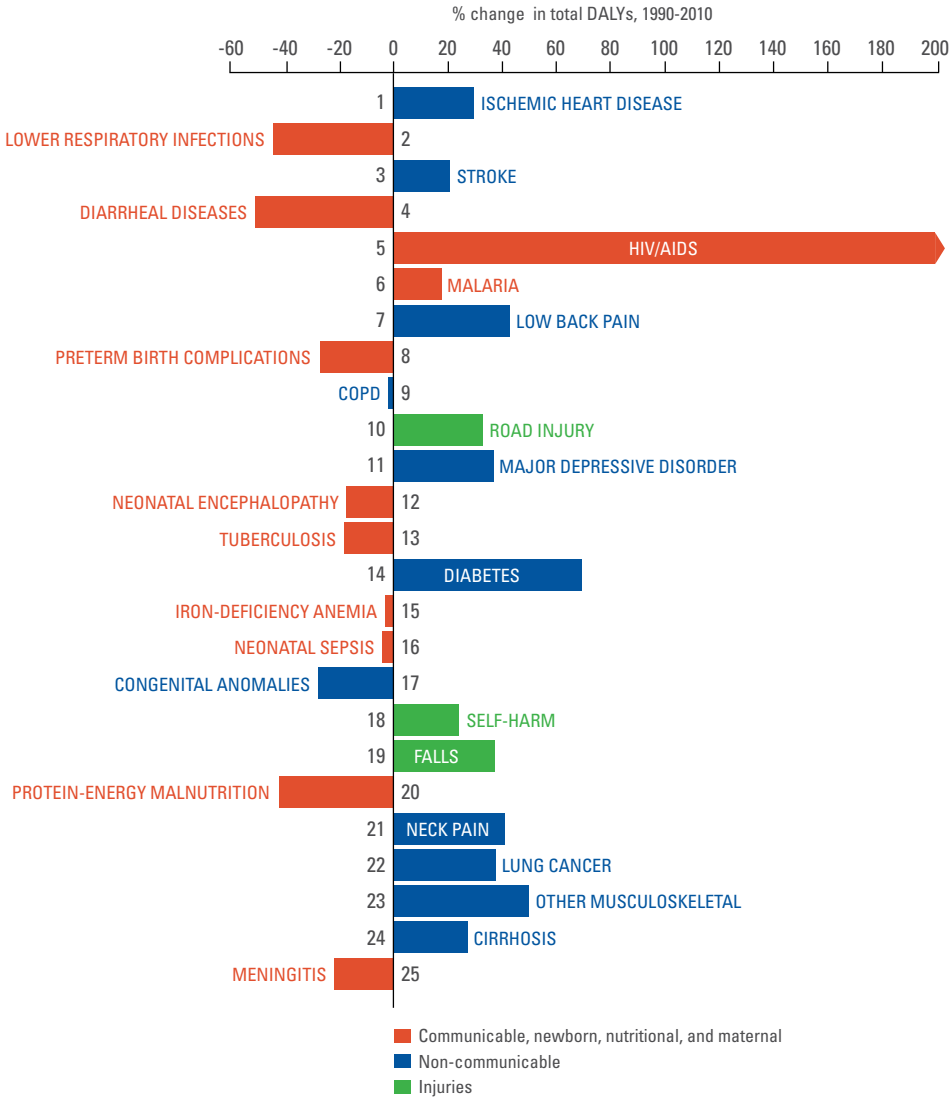
Figure 5 shows decreases in mortality rates in Latin America and the Caribbean, where death rates declined by more than 80% in both males and females aged 1 to 4 years between 1970 and 2010. As with the global results, women in nearly every age group in the region experienced greater declines in death rates than men. The most dramatic differences between males and females appeared in the age groups between 15 and 35. The mortality rate rose by 1% among males aged 15 to 19, largely due to deaths from road injuries and rising violence in the region.

LEADING CAUSES OF DEATH ARE SHIFTING TO NON-COMMUNICABLE DISEASES

In part because many people are living longer lives and the population is growing older, the leading causes of death have changed. Worldwide, the number of people dying from non-communicable diseases, such as ischemic heart disease and diabetes, has grown by 30% since 1990. To a lesser extent, overall population growth also contributed to this increase in deaths from non-communicable diseases.

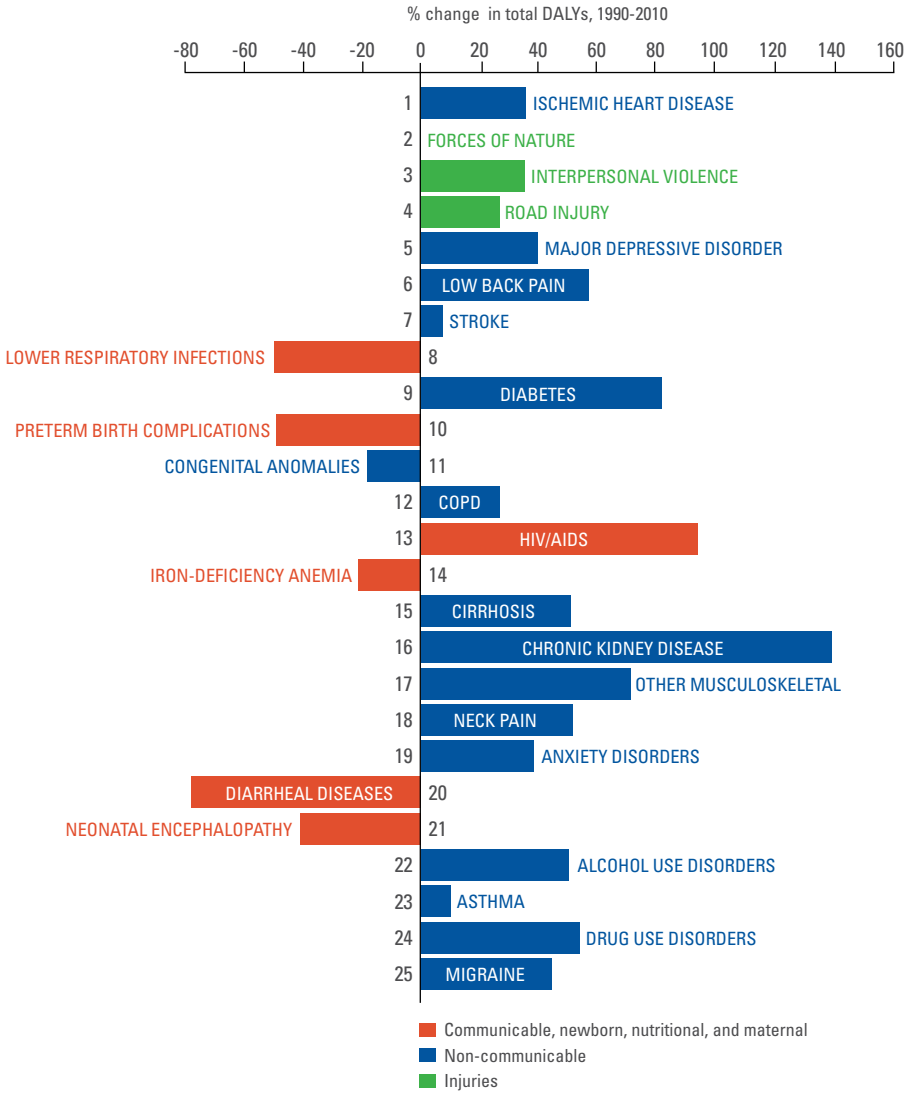
The rise in the total number of deaths from non-communicable diseases has increased the number of healthy years lost, or DALYs, from these conditions. Figure 6 shows global changes in the 25 leading causes of DALYs between 1990 and 2010 ordered from highest to lowest ranking cause from top to bottom.

Figure 6: Global shifts in leading causes of DALYs, 1990-2010



Note: The leading 25 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows indicate causes that have increased by a greater amount than shown on the x-axis.

Figure 7: Shifts in leading causes of DALYs in Latin America and Caribbean, 1990-2010



Note: The leading 25 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. DALYs were not quantified for forces of nature in 1990.

Figure 6 shows that among non-communicable diseases, diabetes and different types of musculoskeletal disorders, such as low back and other musculoskeletal disorders, increased the most between 1990 and 2010 in the world as a whole.

Figure 7 shows the changes in the leading causes of DALYs in Latin America and the Caribbean from 1990 and 2010. Of non-communicable diseases, conditions such as low back pain, diabetes, cirrhosis, and chronic kidney disease experienced the most growth in this region.

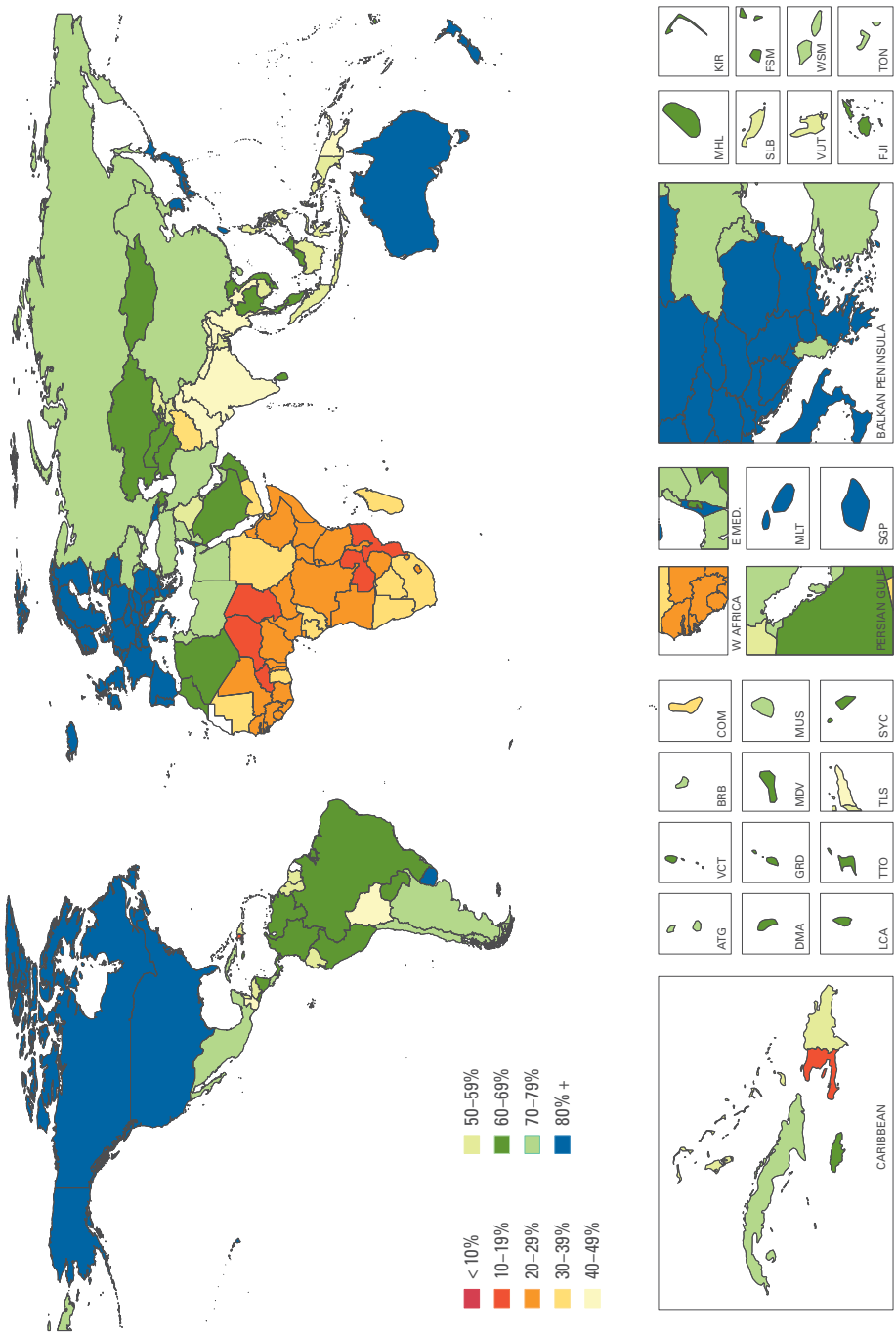
In many countries, non-communicable diseases account for the majority of DALYs. Figure 8 shows the percent of healthy years lost from this disease group by country in 2010. In most countries outside of sub-Saharan Africa, non-communicable diseases caused 50% or more of all healthy years lost, or DALYs. In Australia, Japan, and richer countries in Western Europe and North America, the percentage was greater than 80%.

Figure 8 also shows the major role played by non-communicable diseases in Latin America and the Caribbean. Uruguay had the highest percentage of DALYs due to non-communicable diseases (81%), while Haiti had the lowest percentage of DALYs from these conditions (15%).

An in-depth look at the country-level data reveals the specific diseases that are driving overall shifts from communicable to non-communicable diseases. As an example, Figure 9 displays the changes in the top 25 causes of DALYs in Mexican females between 1990 and 2010. The top causes are organized by ranking from top to bottom. Most non-communicable diseases rose over time, while communicable, newborn, nutritional, and maternal conditions have fallen during this period. Among the top five causes in 2010, chronic kidney disease increased the most (230%), followed by other musculoskeletal conditions (an 88% increase) and diabetes (a 71% increase). Among communicable, nutritional, newborn, and maternal conditions, lower respiratory infections and diarrheal diseases experienced the most dramatic declines, falling by 66% and 83%, respectively.

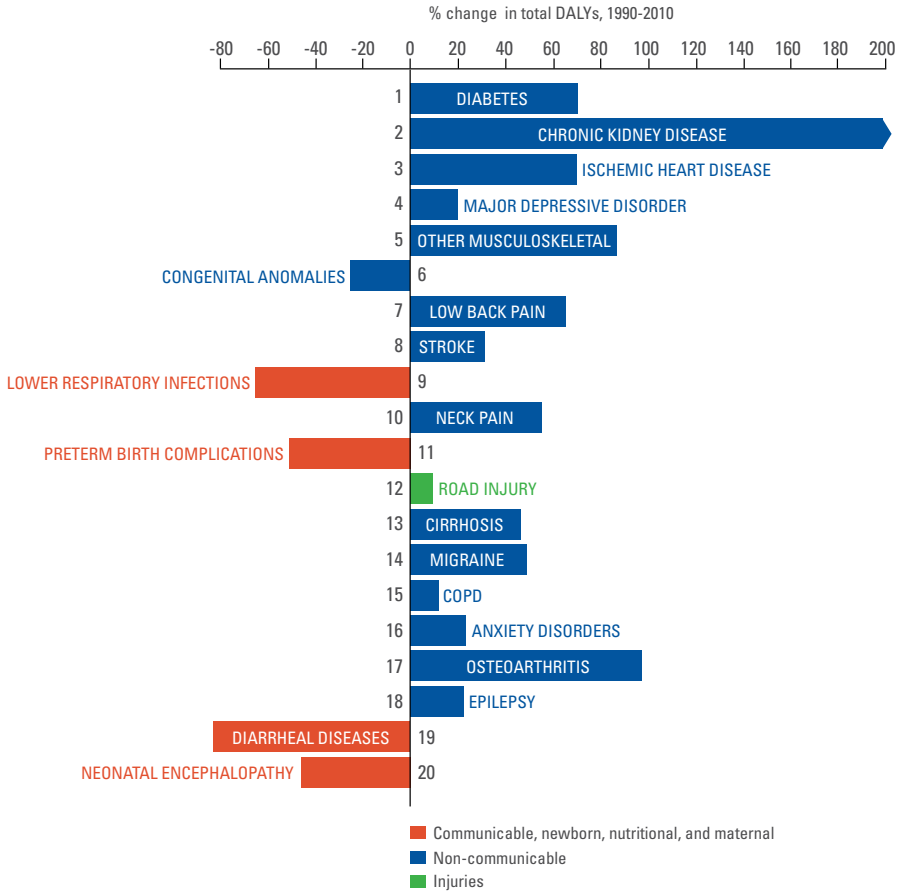
Figure 10 shows similar declines in DALYs among Mexican males from communicable, nutritional, and newborn conditions coupled with increases in non-communicable diseases between 1990 and 2010. Out of all the non-communicable diseases shown in this figure, chronic kidney disease increased the most over the period (368%). Increases were also seen in other causes such as diabetes (103%), ischemic heart disease (100%), and cirrhosis (57%). In addition to displaying the rising prominence of non-communicable diseases, this visualization shows that injuries are among the most dominant causes of health loss in men in Mexico. Overall, DALYs caused by interpersonal violence ranked the highest in 2010, while road traffic injuries ranked third.

Figure 8: Percent of global DALYs due to non-communicable diseases, 2010



Another visualization tool, GBD Compare, displays proportional changes in disease patterns over time using a treemap diagram. Figures 11a and 11b show how DALYs have changed in Paraguay between 1990 and 2010. In 1990, non-communicable diseases accounted for 50% of DALYs in both sexes, while communicable, nutritional, maternal, and newborn causes accounted for 41%. By 2010, they represented 64% and 24% of total disease burden, respectively. Premature death and disability from most communicable, nutritional, maternal, and newborn causes decreased during this period, with the exception of conditions including HIV/AIDS and iron-deficiency anemia. Diarrheal diseases were the primary cause of health loss in 1990,

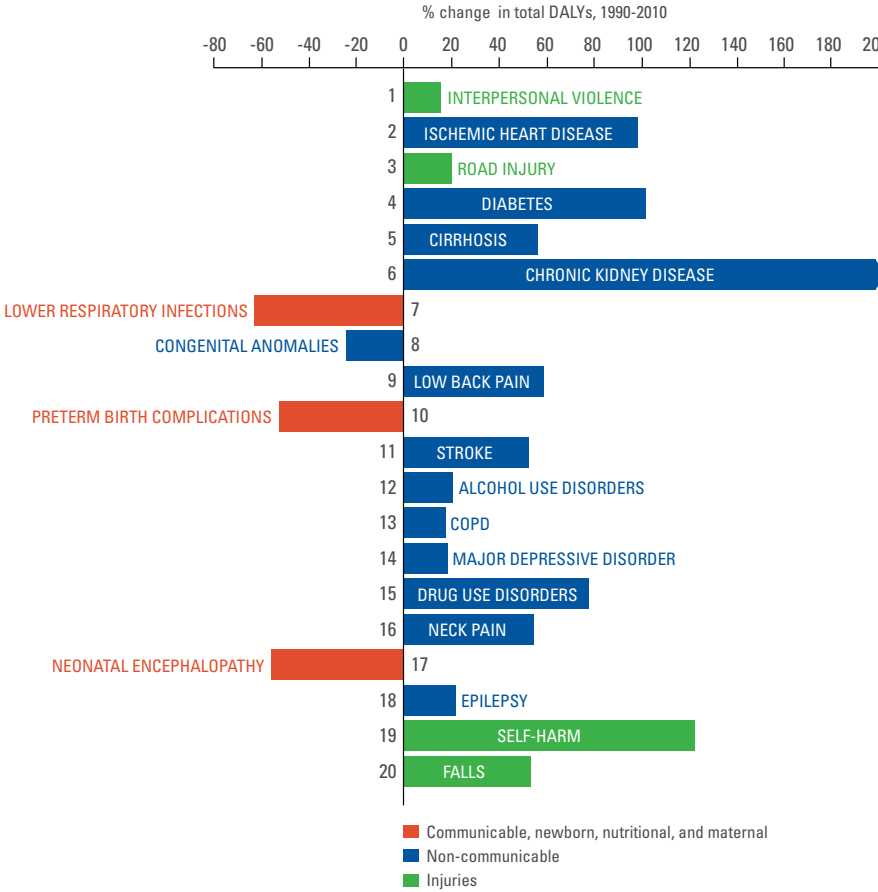
Figure 9: Shifts in leading causes of DALYs for females, Mexico, 1990-2010



Note: The leading 20 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows indicate causes that have increased by a greater amount than shown on the x-axis.

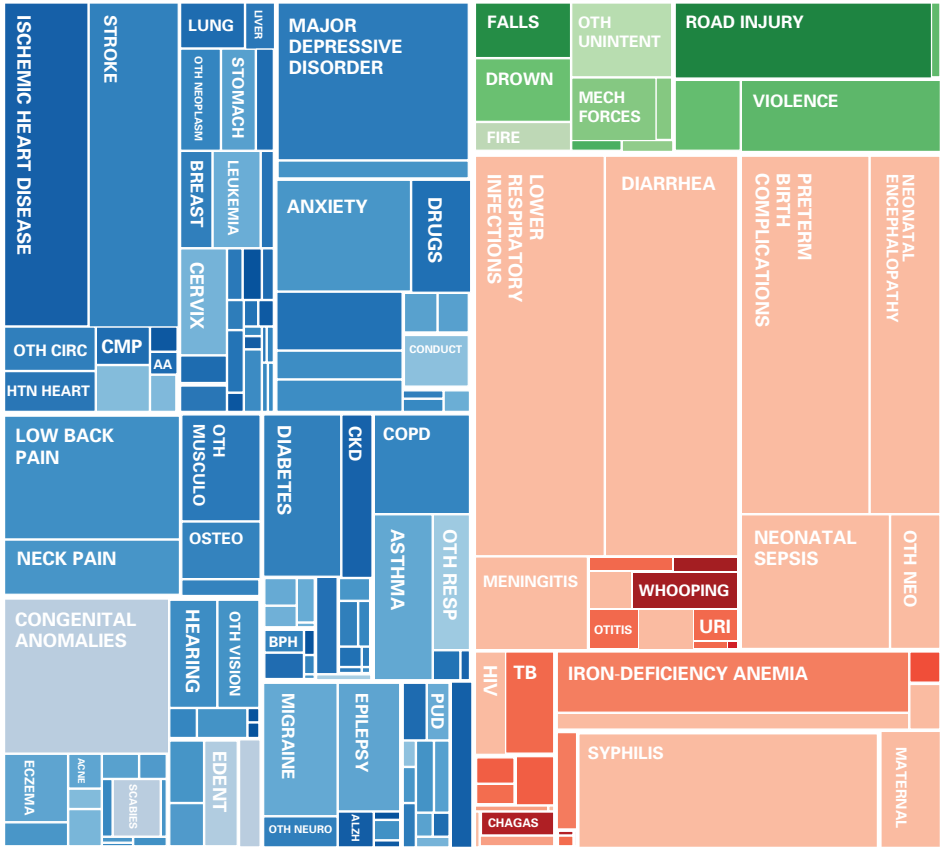
but declined by 64% to the thirteenth-highest cause. Other leading communicable and newborn causes, such as lower respiratory infections, preterm birth complications, and syphilis, also declined in importance during this period. At the same time, DALYs from many non-communicable causes rose. Increases occurred in causes such as ischemic heart disease (82%), stroke (66%), depression (64%), low back pain (77%), diabetes (199%), chronic kidney disease (230%), and neck pain (71%). Between 1990 and 2010, health loss from road traffic injuries and interpersonal violence increased 128% and 138%, respectively, while DALYs from self-harm also rose by 132%.

Figure 10: Shifts in leading causes of DALYs for males, Mexico, 1990-2010



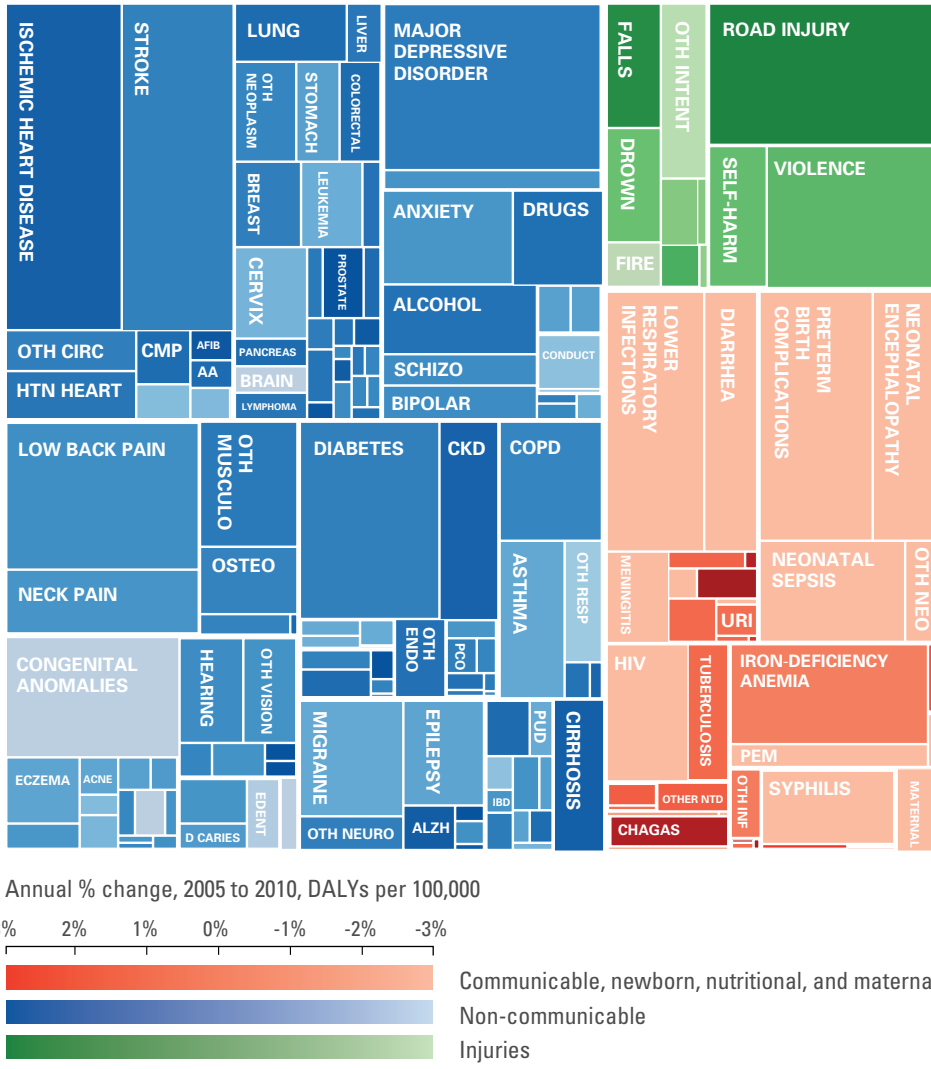
Note: The leading 20 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows indicate causes that have increased by a greater amount than shown on the x-axis.

Figure 11a: Causes of DALYs, both sexes, all ages, Paraguay, 1990



Note: The size of each box in this square pie chart represents the percentage of total DALYs caused by a particular disease or injury. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

Figure 11b: Causes of DALYs, both sexes, all ages, Paraguay, 2010



Note: The size of each box in this square pie chart represents the percentage of total DALYs caused by a particular disease or injury. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

DISABILITY INCREASES IN MIDDLE- AND HIGH-INCOME COUNTRIES

Most countries in the world have succeeded in reducing deaths early in life. To a growing extent, longer lives are redefining "old age" in many countries, and people in all age groups are dying at lower rates than in the past. Little progress has been made in reducing the prevalence of disability, so people are living to an older age but experiencing more ill health. Many people suffer from different forms of disability throughout their lives, such as mental and behavioral health problems starting in their teens and musculoskeletal disorders beginning in middle age. These findings have far-reaching implications for health systems. DALYs, or healthy years lost, are calculated by adding together years lived with disability (YLDs) and years of life lost (YLLs), also known as years lost to premature death.

Between 1990 and 2010, YLDs increased as a percentage of total DALYs in all areas of the world except Eastern Europe, southern sub-Saharan Africa, and the Caribbean. This disability transition has been most dramatic in parts of Latin America, the Middle East, North Africa, and many areas in Asia. The percentage of burden from YLDs also increased in sub-Saharan Africa with the exception of the southern part of the region.

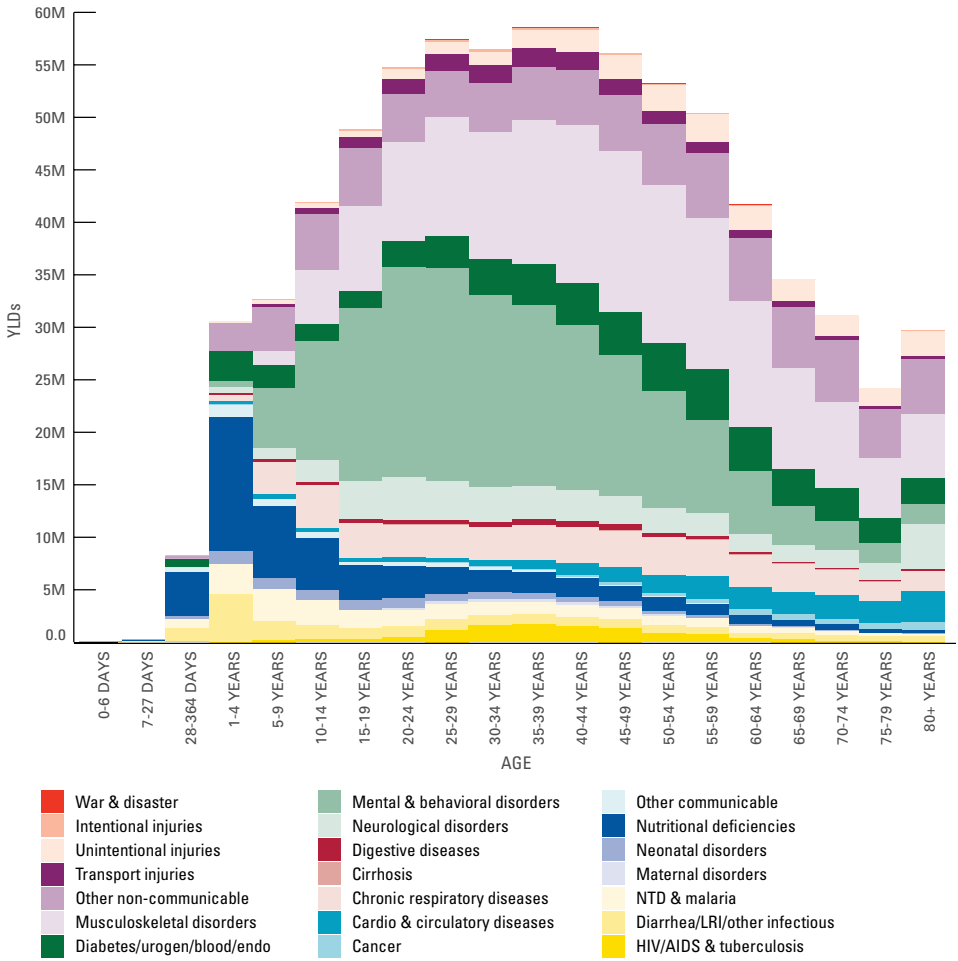
Figure 12 tells a detailed story about the different conditions that cause disability globally. It is important to keep in mind that these estimates reflect both how many individuals suffer from a particular condition as well as the severity of that condition. Mental and behavioral disorders, such as depression, anxiety, and drug use, are the primary drivers of disability worldwide and caused over 40 million years of disability in 20 to 29 year olds. Musculoskeletal conditions, which include low back pain and neck pain, accounted for the next largest number of years lived with disability. People aged 45 to 54 were most impacted by these conditions, as musculoskeletal disorders caused over 30 million years of disability in each of these age groups.

Figure 13 shows disability patterns in Latin America and the Caribbean for 2010. Mental and behavioral and musculoskeletal disorders are the dominant causes of disability in this region, as they are globally. Compared to the world as a whole, however, disability due to nutritional deficiencies in 1 to 4 year olds is lower in Latin America and the Caribbean.

Another way to view the world's health challenges is by comparing how different conditions rank. Figure 14 ranks the leading causes of disability globally and for each of the six World Bank regions. The colors indicate how high a condition ranks in a region. Depression is a major cause of disability across regions and is one of the top three causes of disability in every region. This disorder can cause fatigue, decreased ability to work or attend school, and suicide. Anxiety, a different type of mental disorder, is one of the top 10 causes of disability in all regions, but ranks highest in Latin America and the Caribbean and the Middle East and North Africa. Additionally, two other mental disorders, schizophrenia and bipolar disorder, appear among the top 20 causes of disability in many regions.

Musculoskeletal disorders play a large role in causing disability worldwide. Low back pain causes the most disability in East Asia and the Pacific, Europe and Central Asia, and the Middle East and North Africa. This condition can inhibit people's ability to perform different types of work both inside and outside the home and impair their mobility. In addition to low back pain, neck pain and other musculoskeletal disorders rank in the top 10 causes of disability in most regions. Another musculoskeletal disorder, osteoarthritis, appears in the top 20 causes of disability in every region.

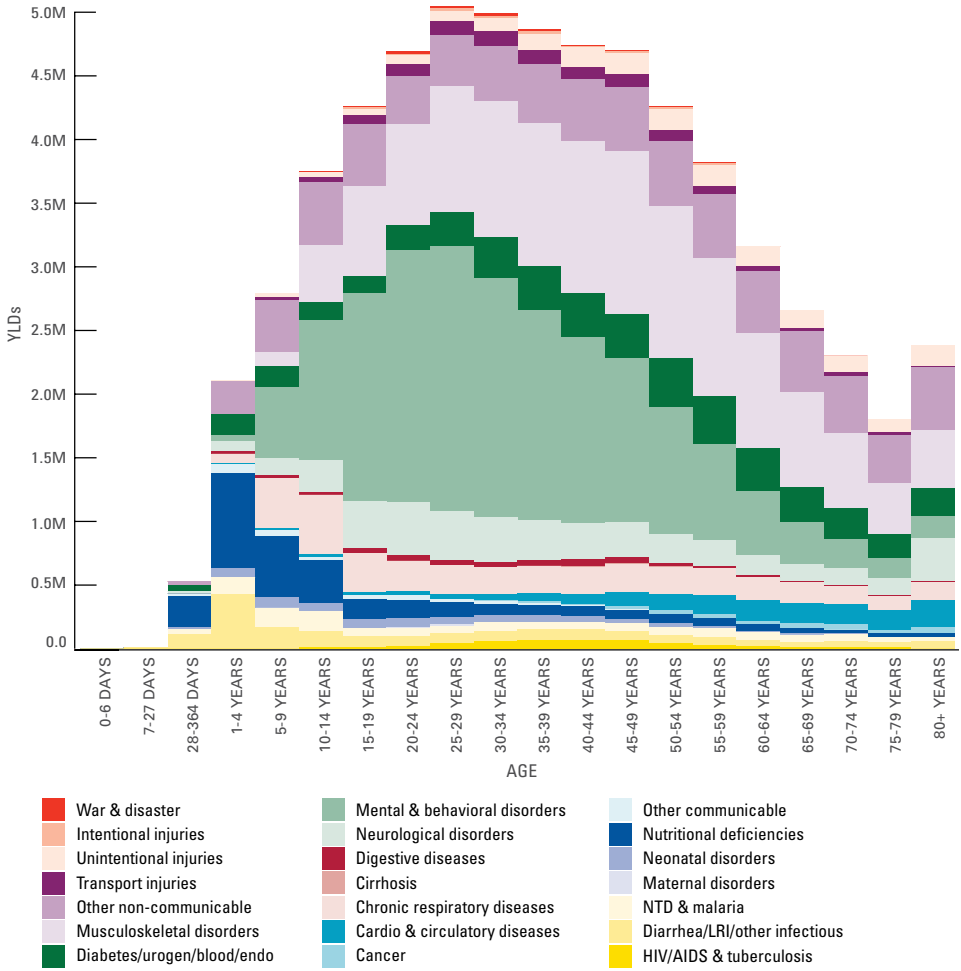
Figure 12: Global disability patterns by broad cause group and age, 2010



Note: The size of the colored portion in each bar represents the number of YLDs attributable to each cause for a given age group. The height of each bar shows total YLDs for a given age group in 2010. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcausepattern.

While mental and musculoskeletal disorders rank high among causes of disability across regions, Figure 14 also reveals substantial regional variation among other causes. Iron-deficiency anemia is the leading cause of disability in sub-Saharan Africa and South Asia but is less important as a cause of disability in the other regions. The substantial burden in these two regions contributed to iron-deficiency anemia's ranking as the third leading cause of disability at the global level. Iron-deficiency anemia can lead to fatigue and lowered ability to fight infection and may decrease cognitive ability.

Figure 13: Disability patterns by broad cause group and age in Latin America and Caribbean, 2010

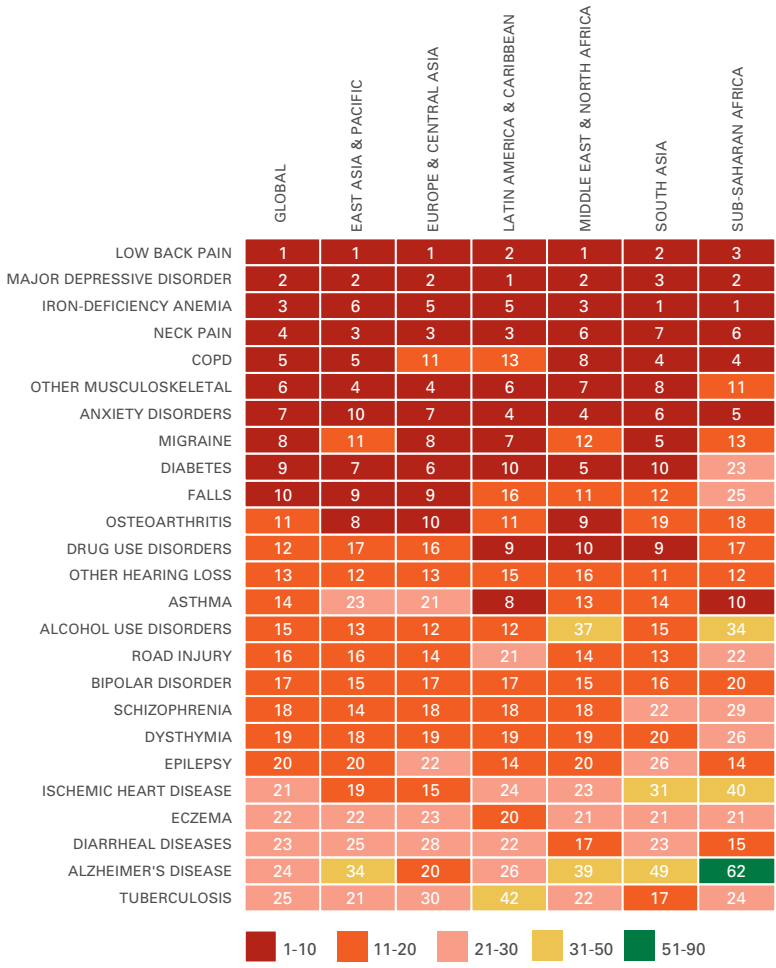


Note: The size of the colored portion in each bar represents the number of YLDs attributable to each cause for a given age group. The height of each bar shows total YLDs for a given age group in 2010. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain.

Chronic obstructive pulmonary disease (COPD), a term used to describe emphysema and other chronic respiratory diseases, is among the top five causes of disability in East Asia and Pacific, South Asia, and sub-Saharan Africa, and is the eighth-leading cause of disability in the Middle East and North Africa.

In Latin America and the Caribbean, many of the leading causes of disability are similar to global rankings, but there are key differences between the region and the rest of the world. Certain causes were less prominent in Latin America and the Caribbean than they were at the global level. Iron-deficiency anemia, for example, was the third-leading cause of disability worldwide but the fifth in Latin America and the Caribbean. While COPD ranked as the fifth-leading cause of disability worldwide,

Figure 14: Rankings of leading causes of disability by region, 2010



Note: In this figure, shading is used to indicate the ranking of each cause of disability in a particular region.

it ranked much lower (13th) in Latin America and the Caribbean. In this region, falls ranked 16th but ranked 10th globally.

Other causes of disability rank higher in Latin America and the Caribbean than at the global level. Asthma was the 14th cause of disability globally, but it ranked eighth in Latin America and the the Caribbean. Drug and alcohol use disorders also ranked higher in this region compared to the world as a whole. Drug use disorders were the 12th-leading cause of disability globally, but ranked ninth in Latin America and the Caribbean. Alcohol use disorders ranked 15th globally, but 12th in the region.

Using GBD tools to identify leading causes of disability, such as mental and behavioral disorders and musculoskeletal disorders, can help guide health system planning and medical education. Decision-makers can use GBD's findings to ensure that health care systems are designed to address the primary drivers of disability in a cost effective way.

THE GLOBAL RISK FACTOR TRANSITION

Data on potentially avoidable causes of health loss, or risk factors, can help policymakers and donors prioritize prevention strategies to achieve maximum health gains. GBD tools estimate the number of deaths, premature deaths, years lived with disability, and DALYs attributable to 67 risk factors worldwide. This study benefited from the availability of new data, such as newly available epidemiologic evidence about the health impacts of different risk factors; population, nutrition, health, and medical examination surveys; and high-resolution satellite data on air pollution.

Figure 15 shows changes in the 15 leading global risk factors for premature death and disability, or DALYs, between 1990 and 2010. Over this period, many risk factors that primarily cause communicable diseases in children declined. Examples of these risk factors are childhood underweight and suboptimal breastfeeding, which dropped by 61% and 57% from 1990 to 2010, respectively. Childhood underweight is commonly used to measure malnutrition, and was formerly the leading risk factor for DALYs in 1990, but ranked eighth in 2010. DALYs attributable to household air pollution, which contributes to lower respiratory tract infections in children, dropped by 37% between 1990 and 2010. Unlike other risk factors that primarily cause DALYs from communicable diseases, progress in reducing premature death and disability from iron deficiency was much lower, declining by just 7% between 1990 and 2010. Slow progress in reducing iron deficiency helps explain why iron-deficiency anemia ranks as the third-leading cause of disability globally.

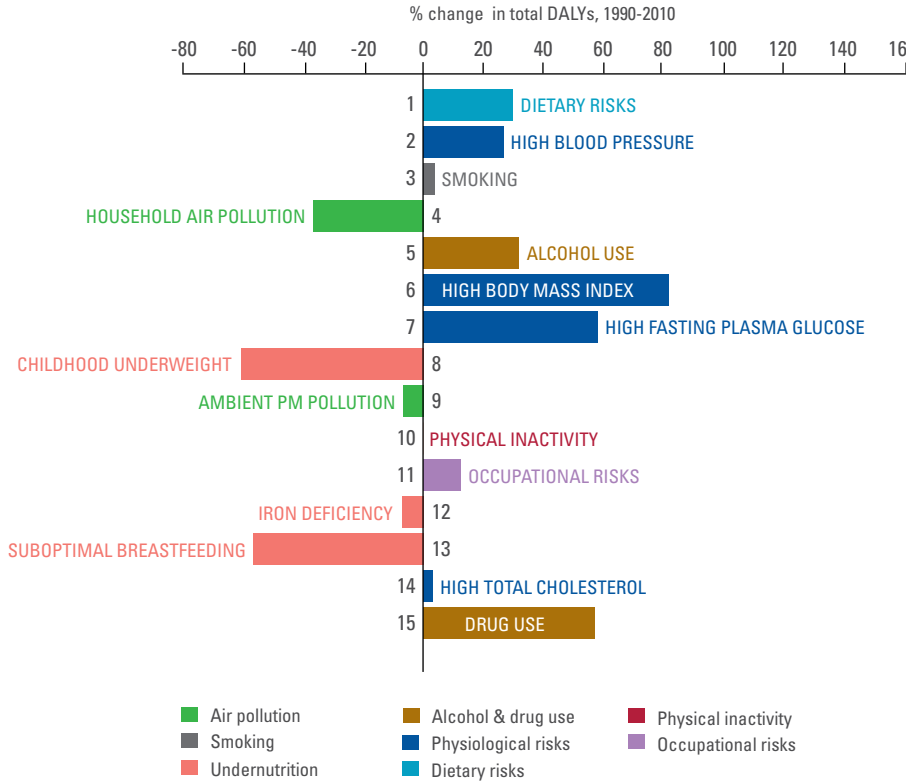
As most risk factors for communicable diseases in children have declined, many risks associated with non-communicable diseases have grown. As the leading global risk factor for premature death and disability, or DALYs, in 2010, dietary risks increased 30% between 1990 and 2010. Dietary risks include components such as high sodium intake and lack of fruit, nuts and seeds, and whole grain intake. GBD found the main diseases linked to dietary risks and physical inactivity are primarily

cardiovascular diseases as well as cancer and diabetes. While many public health messages about diet have stressed the importance of eating less saturated fat, the findings of GBD 2010 indicate that these messages should emphasize a broader range of dietary components.

GBD 2010 used the most recent data available on the effects of different dietary risk factors. It is important to note that these data are constantly evolving as new studies on diet are conducted. Compared to data on the negative health impacts of smoking, which have been well understood for decades, the scientific evidence surrounding dietary risk factors is much newer. Future updates of GBD will incorporate new data on risk factors as they emerge.

The second-leading global risk factor, high blood pressure, increased by 27% as a cause of DALYs between 1990 and 2010. High blood pressure is a major risk factor for cardiovascular and circulatory diseases. DALYs attributable to another risk

Figure 15: Global shifts in rankings of DALYs for top 15 risk factors, 1990-2010

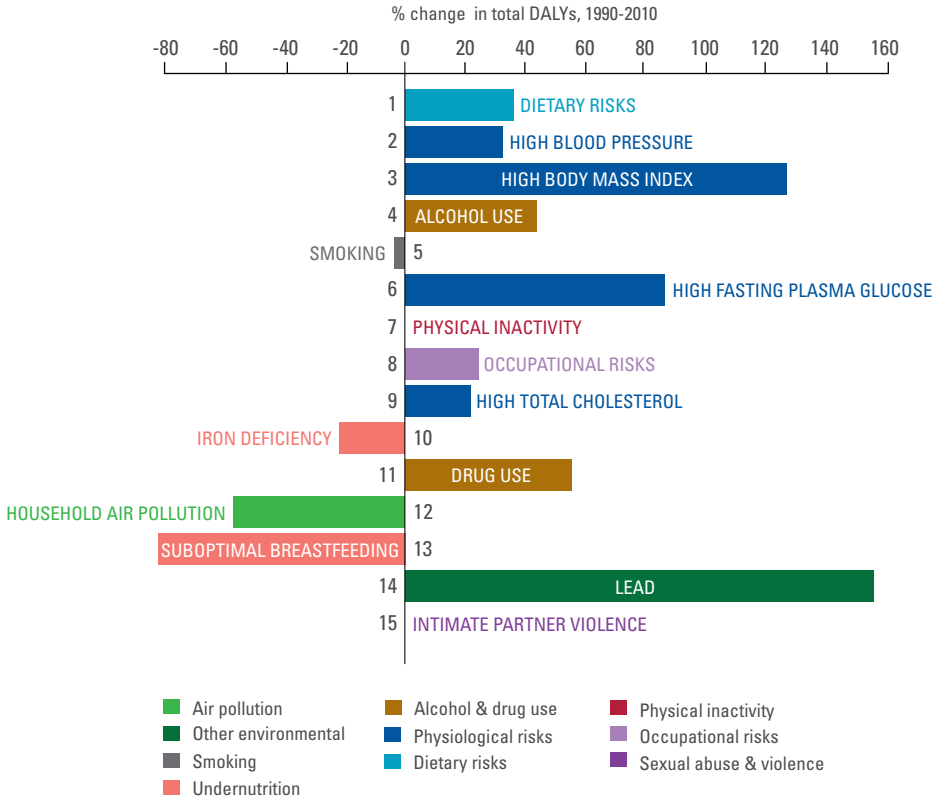


Note: The leading 15 risk factors are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs attributable to different risk factors have increased since 1990. Bars on the left show the percent by which DALYs attributable to different risk factors have decreased. Attributable DALYs were not quantified for physical inactivity for 1990.

factor for non-communicable diseases, tobacco smoking, increased slightly by 3% between 1990 and 2010 and was the third-leading risk factor worldwide. Smoking increases the risk of chronic respiratory diseases, cardiovascular and circulatory diseases, and cancer. DALYs attributable to the use of another substance, alcohol, increased 32% during this period. Alcohol use contributes to cardiovascular and circulatory diseases, cirrhosis, and cancer. In addition to being a contributor to non-communicable diseases, alcohol consumption increases the risk of injuries.

High body mass index (BMI), used as an indicator of overweight and obesity, was another major contributor to DALYs in 2010 and was the sixth-leading risk factor for premature death and disability. It increased by 82% over the period 1990 to 2010. High BMI is a leading risk factor for cardiovascular and circulatory diseases as well as diabetes. It is striking that high BMI was a more important cause of poor health worldwide than childhood underweight in 2010, whereas childhood underweight was a much more prominent risk factor than high BMI in 1990.

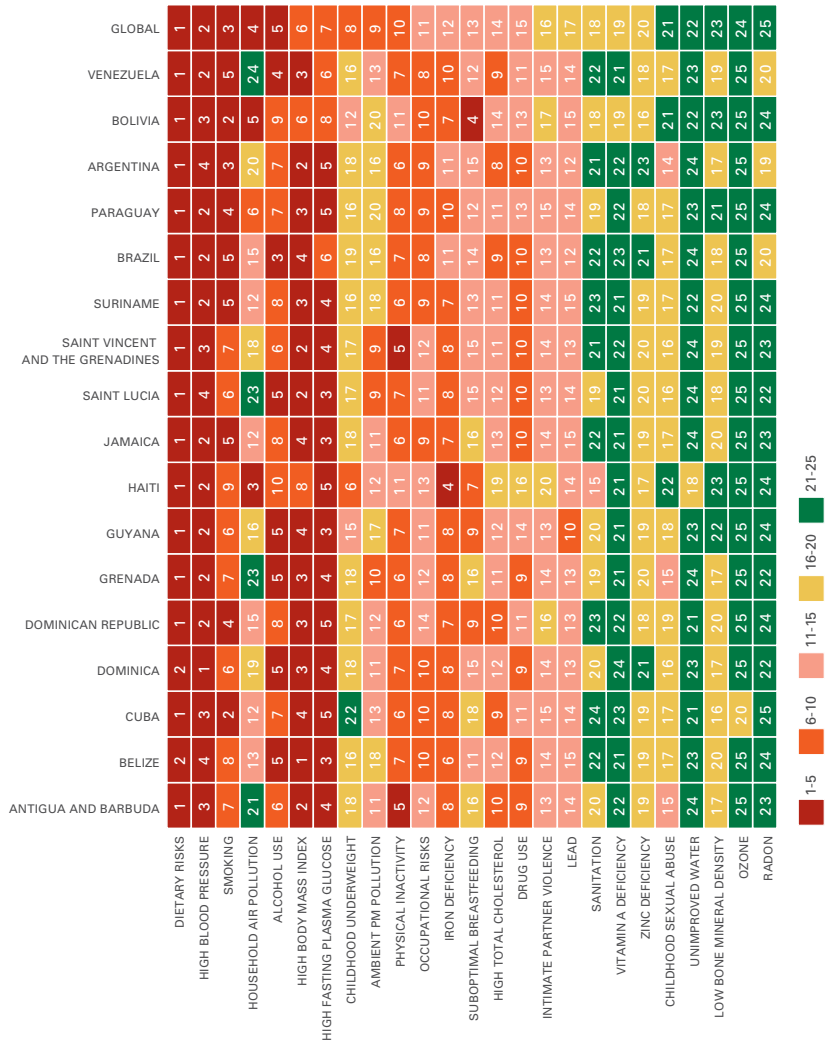
Figure 16: Shifts in rankings of DALYs in Latin America and Caribbean for top 15 risk factors, 1990-2010



Note: The leading 15 risk factors are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs attributable to different risk factors have increased since 1990. Bars on the left show the percent by which DALYs attributable to different risk factors have decreased. Attributable DALYs were not quantified for physical inactivity and intimate partner violence for 1990.

Figure 16 shows changes in leading risk factors for Latin America and the Caribbean, where many risk factors for communicable diseases declined between 1990 and 2010, as they did globally. In comparison to the world overall, DALYs attributable to risk factors for non-communicable diseases such as dietary risks, high blood pressure, high BMI, high fasting plasma glucose, high total cholesterol, and alcohol use increased by greater amounts in Latin America and the Caribbean. For example, high BMI rose by 82% worldwide between 1990 and 2010, but it increased by 127% in Latin America and the Caribbean. High fasting plasma glucose increased 58% at

Figure 17: Rankings of DALYs attributable to leading risk factors across select countries in Latin American and Caribbean, 2010

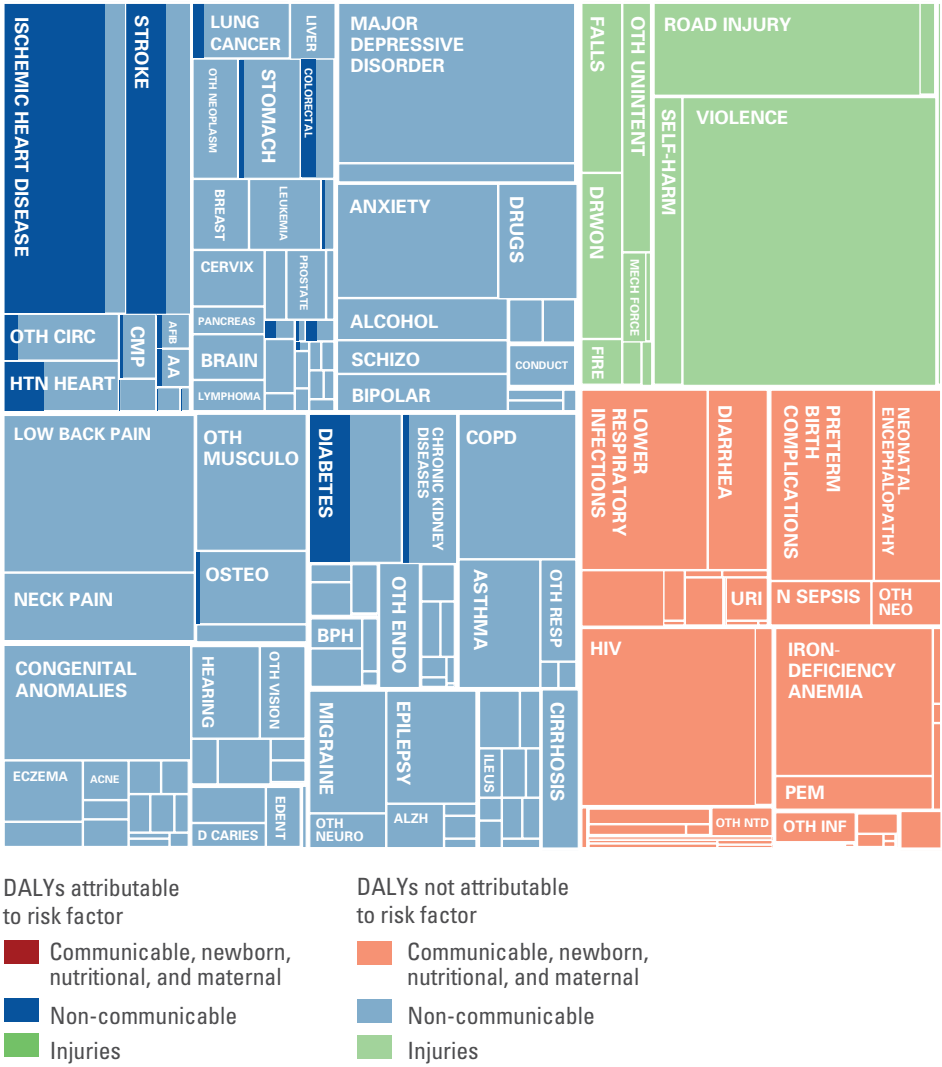


Note: In this figure, shading is used to indicate the ranking of each risk factor in a particular region. Palestine is the GBD equivalent of the West Bank and Gaza in the World Bank classification system. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdheatmap.

the global level but increased by 87% in the region. Alcohol use rose by 35% in the world as a whole and by 50% in the region. In contrast, smoking increased slightly worldwide, but it declined by 4% in Latin America and the Caribbean.

Global and regional rankings of risk factors mask important differences across countries. Figure 17 shows the leading risk factors for DALYs in select Latin American and Caribbean countries in 2010. Risks for non-communicable diseases such as dietary

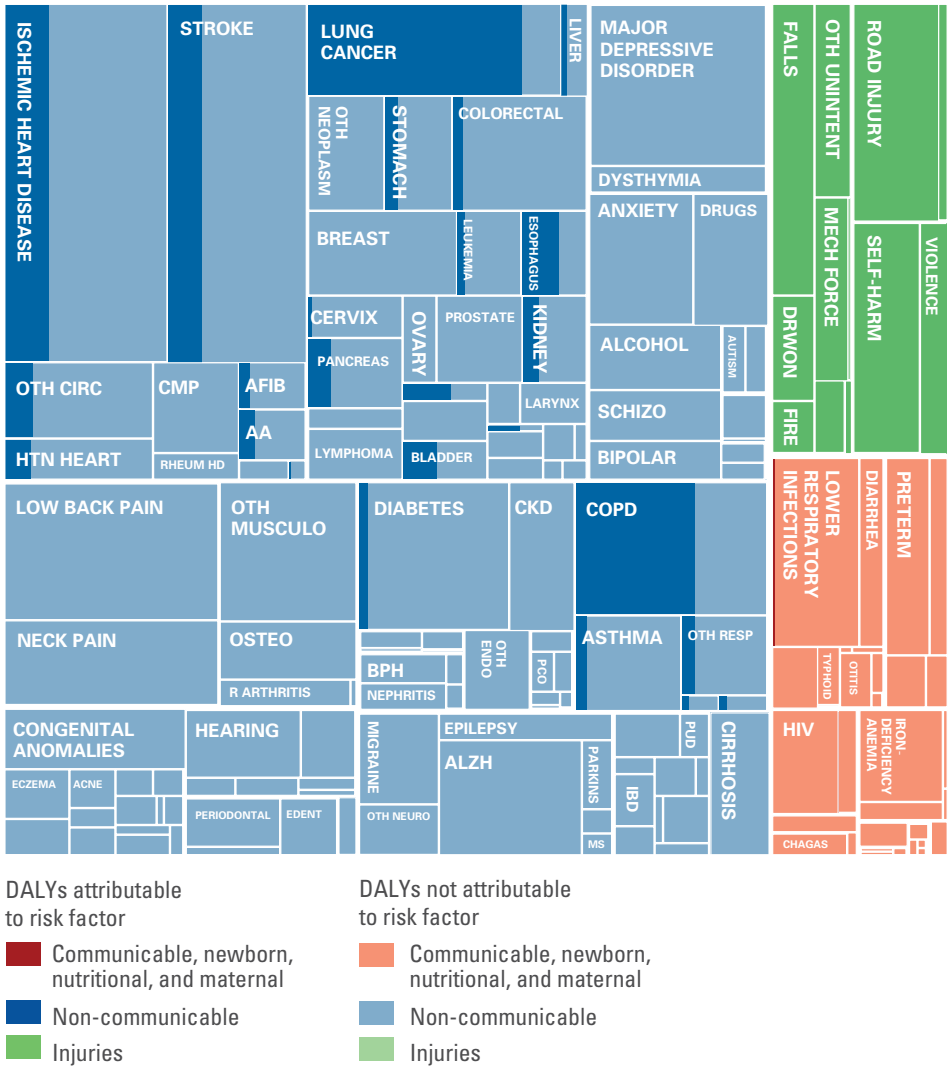
Figure 18: DALYs attributable to dietary risks, both sexes, all ages, Colombia, 2010



Note: The size of each box represents the percentage of total DALYs caused by a particular disease or injury, and the proportion of each cause attributable to the risk factor is shaded. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

risks, high BMI, high blood pressure, and high fasting plasma glucose (an indicator of diabetes) are among the top five risk factors for most countries in this region. In nearly all of these countries, other non-communicable disease risk factors, including physical inactivity, alcohol use, and smoking, are some of the top 10 leading risk factors. Alcohol use ranked particularly high as a risk factor in Brazil and Venezuela, where it was the third- and fourth-leading contributor to DALYs, respectively.

Figure 19: DALYs attributable to tobacco smoking and second-hand smoke, both sexes, all ages, Uruguay, 2010



Note: The size of each box represents the percentage of total DALYs caused by a particular disease or injury, and the proportion of each cause attributable to the risk factor is shaded. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

Bolivia, Cuba, and Argentina stand out as countries where smoking is a particularly large public health problem. Smoking was the second-leading risk factor contributing to DALYs in Bolivia and Cuba in 2010 and was the third-leading risk factor for Argentina. In Bolivia and Haiti, unlike in most countries shown in Figure 17, risk factors for illness in children, such as household air pollution, suboptimal breastfeeding, and iron deficiency, remained among the top risk factors.

In addition to allowing users to explore how different risk factors rank across countries, GBD visualization tools show how many DALYs could potentially be averted by addressing different risk factors. Figure 18 shows the number of DALYs attributable to dietary risks that contribute to different diseases in Colombia. The percentage of DALYs that could be averted by reducing dietary risk factors is shaded in a darker color.

Dietary risks include elements such as low consumption of fruit, nuts and seeds, and whole grains and high salt intake. The figure indicates how improving people's diets could prevent substantial amounts of health loss from ischemic heart disease and stroke, as indicated by the portion of these causes that are shaded in dark blue. Reduction of dietary risks could also reduce DALYs from diabetes and colon and rectal cancers.

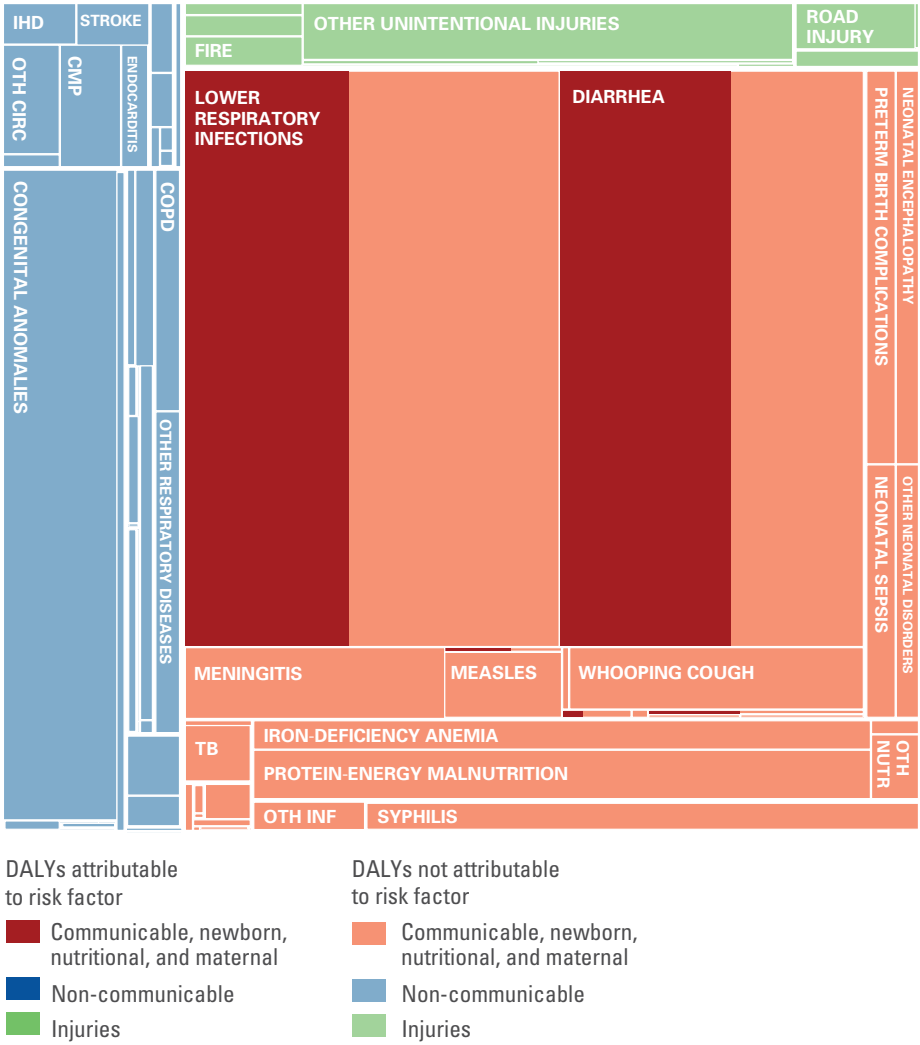
Figure 19 shows how, in Uruguay, many DALYs could be averted by eliminating tobacco smoking, including second-hand smoke.

Most COPD and lung cancer is caused by tobacco smoking and second-hand smoke, as indicated by the dark blue portion of the boxes representing these causes. Substantial numbers of healthy years lost from ischemic heart disease, stroke, and esophageal cancer could be prevented by reducing exposure to these risk factors.

Figure 20 shows the number of DALYs attributable to suboptimal breastfeeding in children aged 1 to 11 months in Bolivia.

This figure can be used to understand the number of years of healthy life that could potentially be gained by ensuring that all Bolivian children in this age group are adequately breastfed. Adequate breastfeeding is defined as exclusive breastfeeding of children for the first six months of life, and continued breastfeeding from the age of 6 months to 2 years. Adequate breastfeeding could prevent nearly 60% of the DALYs attributable to diarrhea, as indicated by the dark shading in the box representing this cause. Adequate breastfeeding would also greatly reduce illness from lower respiratory infections among these children.

Figure 20: DALYs attributable to suboptimal breastfeeding, both sexes, ages 1-11 months, Bolivia, 2010



Note: The size of each box represents the percentage of total DALYs caused by a particular disease or injury, and the proportion of each cause attributable to the risk factor is shaded. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

USING GBD TO ASSESS COUNTRIES' HEALTH PROGRESS

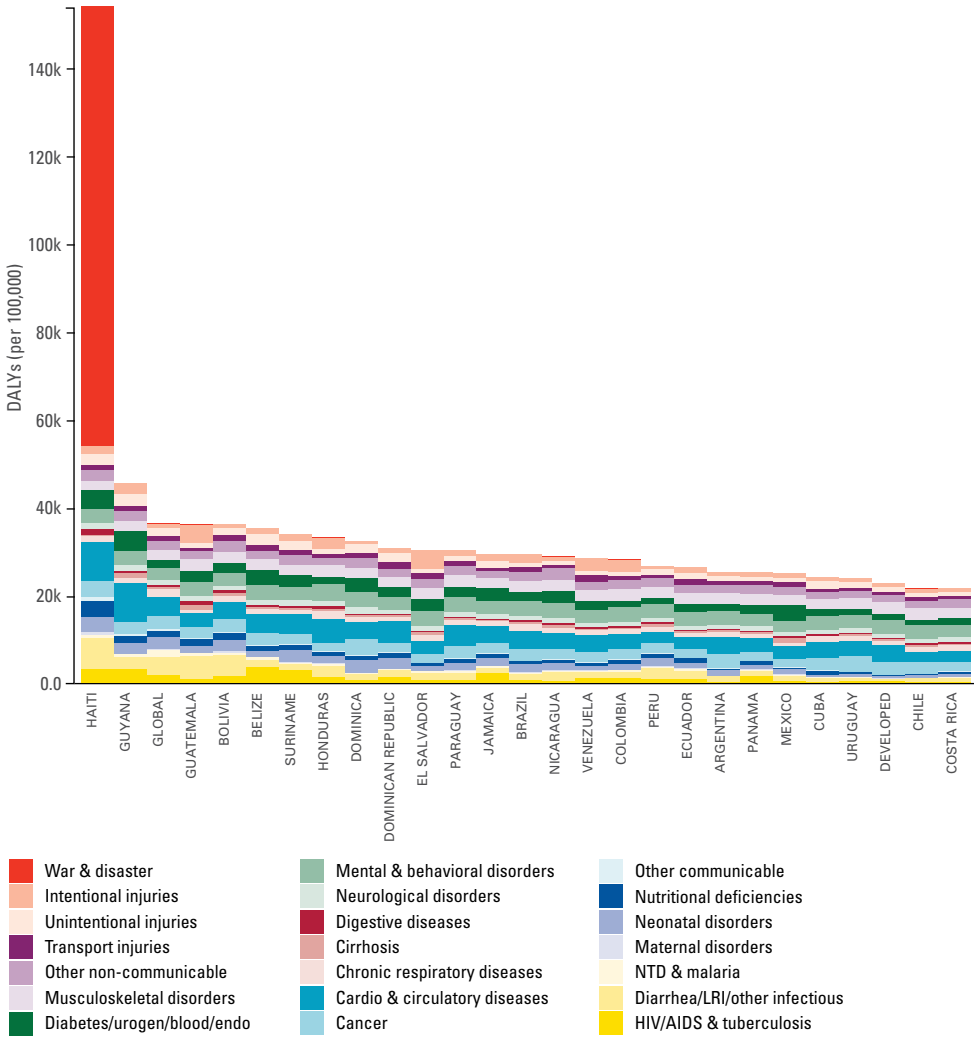
GBD found that factors such as population growth, longer lives, and decreasing mortality are causing increases in years of healthy life lost, or DALYs, from non-communicable diseases in many countries. Although non-communicable diseases are increasing relative to other health problems as a result of these demographic changes, GBD found that many countries are actually showing improvements in health as measured by age-standardized DALY rates.

Differences in population growth and ages across countries can make a country with a younger population appear better in terms of health performance than a country with an older population. Similarly, countries with low population growth will add less disease burden over time than countries with a fast-growing population. Researchers can remove the impact of these factors to isolate what is important for comparisons of health performance using age-standardized rates of DALYs and YLLs.

For example, many countries in Latin America and the Caribbean have made progress in reducing age-standardized rates of DALYs from meningitis, iron-deficiency anemia, and maternal disorders, such as Bolivia, Guatemala, Haiti, and Honduras. Multiple countries in the region generally made progress in reducing age-standardized rates of DALYs from non-communicable diseases including ischemic heart disease and stroke. Conversely, many countries in Latin America and the Caribbean experienced rising age-standardized rates of DALYs due to diabetes, musculoskeletal, and drug use disorders. To explore age-standardized DALY rates of diseases and injuries at the country level between 1990 and 2010, visit IHME's data visualization tools at www.ihmeuw.org/GBDcountryviz.

GBD can be used to compare and contrast disease patterns across countries. Figure 21 shows causes of age-standardized DALYs per 100,000 people. Many countries in Latin America and the Caribbean have rates of DALYs from communicable, maternal, nutritional, and newborn conditions that are much lower than the world as a whole. Low- and low-middle-income countries in the region such as Belize, Bolivia, Guatemala, Guyana, and Haiti have the highest rates for these conditions, while upper-middle-income countries such as Argentina, Chile, Costa Rica, Cuba, and Uruguay have rates of communicable, maternal, nutritional, and newborn conditions comparable to developed countries as a whole. Even without the enormous age-standardized DALY rates due to deaths from forces of nature, Haiti had the highest rates from communicable, maternal, nutritional, and newborn conditions among countries shown in Figure 21. Countries such as Belize, Dominica, Guyana, Haiti, and Mexico have age-standardized DALY rates of diabetes and urogenital, blood, and endocrine disorders that are greater than other countries in the region as well as the global average. Age-standardized DALY rates of intentional injuries in most countries

Figure 21: Age-standardized DALY rates across select countries in Latin American and Caribbean, 2010



Note: The size of the colored portion in each bar represents number of age-standardized DALYs per 100,000 people attributable to each cause. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcausepattern.

in Latin America and the Caribbean exceed global rates, especially in Colombia, El Salvador, Guatemala, Guyana, and Honduras. Many countries in the region are performing better than global rankings on transport injuries, and the rates of DALYs due to transport injuries in some developing countries, including Cuba, Guatemala, Jamaica, Nicaragua, and Uruguay, were lower than those in developed countries.

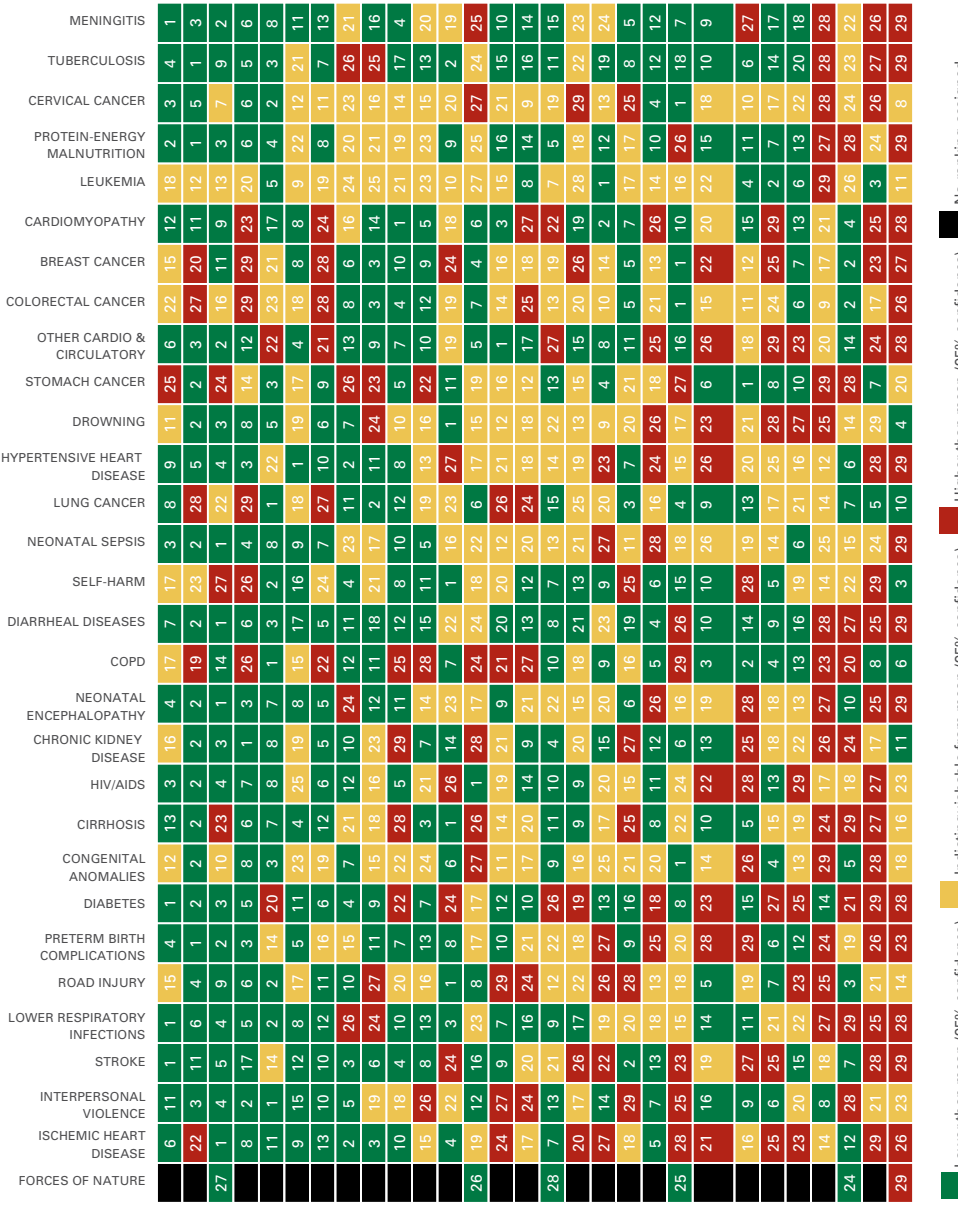
The GBD approach affords countries a unique opportunity to explore their success in improving health outcomes over time. GBD can also be used to better understand how fast a country's health is improving relative to similar countries. This type of progress assessment is called benchmarking. Benchmarking is a tool that can help countries put their health achievements in context and identify areas for improvement. IHME invites countries interested in collaborating on benchmarking exercises to contact us.

As an example of a benchmarking exercise, Figure 22 ranks levels of years of life lost in Latin American and Caribbean countries in 2010. The columns are arranged by the top 30 causes of YLLs in the region. The countries are ordered according to levels of premature mortality. For each cause, rankings are coded to reflect each country's level of age-standardized YLLs relative to the others. The best performers for each cause are in green, while the worst performers for each cause appear in red. Yellow shading indicates that the ranking for a particular country does not have a statistically significant difference from the regional average. Black indicates no ranking was assigned due to zero YLLs from a given cause.

Figure 22 can be used to compare the performance of Latin American and Caribbean countries and can help countries identify priority areas for improvement. For example, Cuba performed better than the regional average for most causes of premature death, but performed poorly in areas such as ischemic heart disease, COPD, and lung, colorectal, and breast cancers. Jamaica was the top performer in the region for causes including road injuries, cirrhosis, self-harm, and drowning, but ranked near the bottom for stroke, diabetes, HIV/AIDS, hypertension, and breast cancer. Country comparisons can be used for selecting case studies to understand why performance differs across countries. For example, case studies could potentially reveal why a lower-middle-income country such as El Salvador performed much better for neonatal encephalopathy and tuberculosis than Peru, an upper-middle-income country.

To further illustrate how benchmarking can be implemented at the country level, IHME is currently working with public health experts in the United Kingdom to explore changes in population health over time and to compare its health performance to other countries with similar and higher levels of health spending. Through close collaboration with decision-makers at the National Health Service and Public Health England, the IHME-UK benchmarking project is examining the context in which health progress has occurred, such as the UK's provision of universal health coverage and its implementation of numerous public health interventions.

Figure 22: Causes of leading years of life lost, Latin America and Caribbean countries relative to regional average, 2010



Note: The columns are ordered by the absolute number of YLLs for that particular year. The numbers indicate the rank across countries for each cause in terms of age-standardized YLL rates, with 1 as the best performance and 29 as the worst.

For the UK, GBD estimates of life expectancy and healthy life expectancy (HALE), YLLs, YLDs, and DALYs will provide a detailed and comprehensive picture of changes in health outcomes over time. Comparing GBD estimates across countries will elucidate areas of health where the UK performs both better and worse than its peers. In addition, analysis of potentially modifiable risk factors can shed light on ways that public health policy could address major causes of ill health and premature death. The IHME-UK benchmarking study aims to identify key opportunities to speed up the pace of health improvements in the nation.

The Global Burden of Disease provides detailed data on diseases, injuries, and risk factors that are essential inputs for evidence-based policymaking. This collaborative project shows that the world's health is undergoing rapid change.

CONCLUSION

GBD 2010 identified major trends in global health that can be summarized by the three Ds: demographics, disease, and disability. As most countries have made great strides in reducing child mortality, people are living longer and the population is growing older. These demographic changes are driving up premature deaths and disability, or DALYs, from non-communicable diseases. Health problems are increasingly defined not by what kills us, but what ails us. In 1990, childhood underweight was the leading risk factor for ill health, but high body mass surpassed it in 2010 as a more important cause of premature death and disability. This finding illustrates global shifts away from risk factors for communicable disease in children toward risk factors for non-communicable diseases.

GBD 2010 found that non-communicable diseases and disability caused a greater share of health loss in 2010 compared to 1990 in most regions of the world. At the same time, the study revealed that the leading causes of DALYs in sub-Saharan Africa have changed little over the past 20 years. Still, GBD 2010 provides evidence of encouraging progress in that region, such as reductions in mortality from malaria, HIV/AIDS, and maternal conditions.

In Latin America and the Caribbean, GBD 2010 documented important regional trends that reveal increasing disease burden due to injuries and non-communicable diseases. Injuries from violence in Brazil, Ecuador, and a number of Central Latin American countries are driving these regional trends. Road injuries were another dominant cause of premature death and disability in the region. DALYs due to non-communicable diseases such as depression, musculoskeletal disorders, chronic kidney disease, cirrhosis, and alcohol and drug use disorders also increased in this region between 1990 and 2010.

While disease burden estimates are useful for informing health system planning, an alternative metric known as age-standardized rates must be used to measure health progress in the region. Removing the effects of demographic changes by using age-standardized rates shows that most countries in Latin America and the Caribbean have reduced rates of non-communicable diseases such as ischemic heart disease and stroke between 1990 and 2010, but diabetes, musculoskeletal disorders, drug use disorders, and depression remain problem areas in many countries.

Risk factors such as high sodium intake and lack of fruit, nuts and seeds, and whole grains in the diet, overweight and obesity, high blood pressure, and alcohol use have become important threats to public health in many countries in Latin America and the Caribbean. While many countries have reduced health loss from risk factors related to illness in children, these risk factors persist in countries such as Bolivia and Haiti.

While GBD 2010 provides key information about health trends at global and regional levels, its tools also allow users to view data specific to 187 countries. Similar to the ways in which governments use financial data to monitor economic trends and make necessary adjustments to ensure continued growth, decision-makers can use GBD data to inform health policy. Continual updates of GBD will incorporate the most recent data on disease patterns as well as the latest science about the effects of different risk factors on health.

Future updates of GBD will be enriched by widening the network of collaborators. Expanded collaboration between researchers, staff of ministries of health, and IHME on national and subnational burden of disease studies will ensure that GBD tools are used to understand causes of premature death and disability at the community level. Despite the similarities in epidemiological trends in most regions, GBD illustrates the unique patterns of diseases, injuries, and risk factors that exist in different countries. Local epidemiological assessment is crucial for informing local priorities. The GBD approach to health measurement can help guide the design of public health interventions to ensure they are tailored to countries' specific needs.

IHME is seeking partners interested in conducting in-depth studies of the burden of disease in countries. Through such partnerships, IHME is helping governments and donors gain insights into localized health trends to inform planning and policymaking. IHME is committed to building capacity for GBD analysis in countries around the world and will be conducting a variety of training workshops. Information on these trainings can be found at http://www.healthmetricsandevaluation.org/gbd/training.

GBD data visualization tools can display regional and national data from burden of disease studies. These user-friendly tools are helpful for planning, presentations, and educational purposes. Also, IHME has designed a variety of data visualization tools to compare trends between various raw data sources at the national level. By visualizing all available data, ministry of health officials and researchers can quickly identify unexpected trends in the data that they may wish to flag for further investigation.

Currently, IHME is working to expand GBD to track expenditure for particular diseases and injuries. Also, IHME is estimating utilization of outpatient and inpatient facilities and other health services for specific diseases and injuries. Side-to-side comparisons of these estimates to the number of DALYs from myriad causes will allow decision-makers to evaluate health system priorities. Data on disease-specific expenditure and disease burden are essential for policymakers facing difficult decisions about how to allocate limited resources.

ANNEX

METHODS

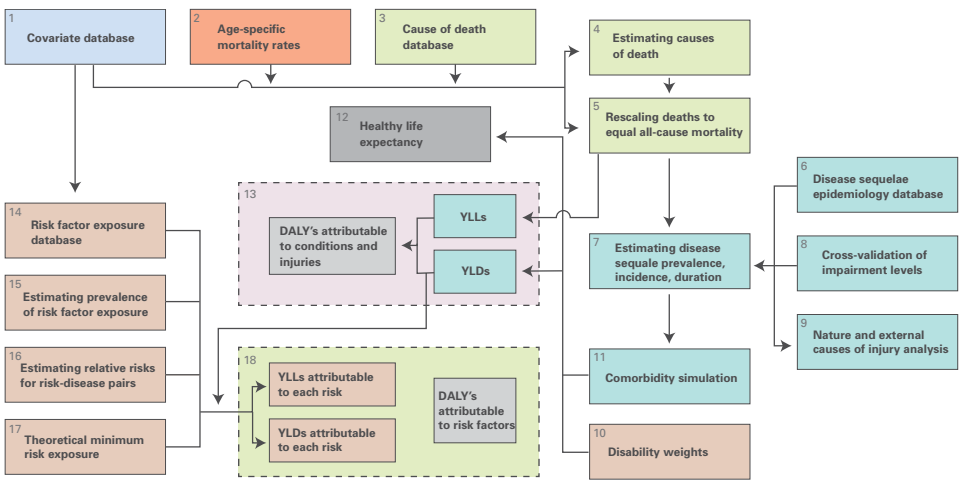
The analytical strategy of GBD

The GBD approach contains 18 distinct components, as outlined in Figure A1. The components of GBD are interconnected. For example, when new data is incorporated into the age-specific mortality rates analysis (component 2), other dependent components must also be updated, such as rescaling deaths for each cause (component 5), healthy life expectancy or HALE (component 12), YLLs (component 13), and estimation of YLLs attributable to each risk factor (component 18). The inner workings of key components are briefly described in this publication, and more detailed descriptions of each component are included in the published articles.

Estimating age- and sex-specific mortality

Researchers identified sources of under-5 and adult mortality data from vital and sample registration systems as well as from surveys that ask mothers about live births and deaths of their children and ask people about siblings and their survival. Researchers processed that data to address biases and estimated the probability of death between ages 0 and 5 and ages 15 and 60 using statistical models. Finally, researchers used these probability estimates as well as a model life table system to estimate age-specific mortality rates by sex between 1970 and 2010.

Figure A1: The 18 components of GBD and their interrelations



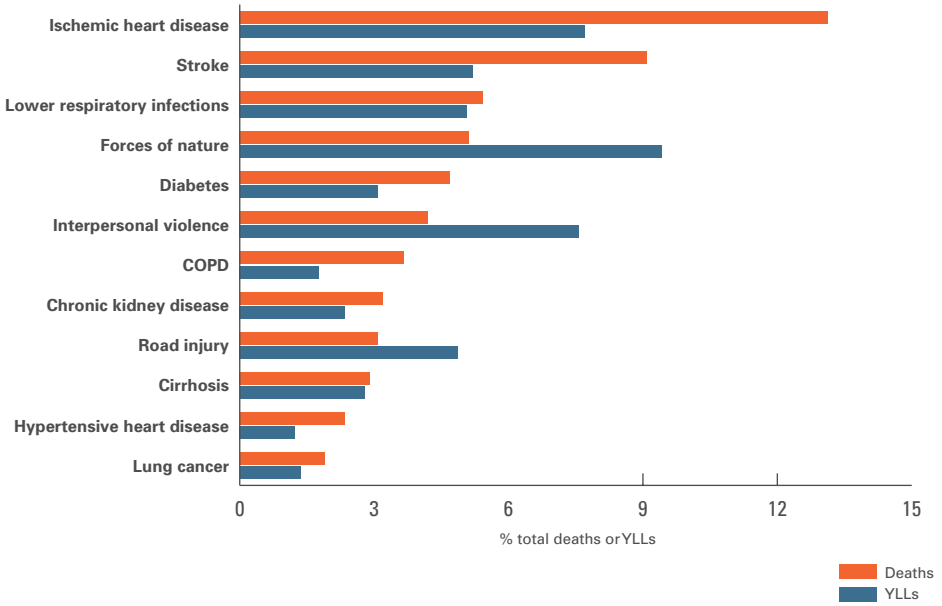
Estimating years lost due to premature death

Researchers compiled all available data on causes of death from 187 countries. Information about causes of death was derived from vital registration systems, mortality surveillance systems, censuses, surveys, hospital records, police records, mortuaries, and verbal autopsies. Verbal autopsies are surveys that collect information from individuals familiar with the deceased about the signs and symptoms the person had prior to death. GBD 2010 researchers closely examined the completeness of the data. For those countries where cause of death data were incomplete, researchers used statistical techniques to compensate for the inherent biases. They also standardized causes of death across different data sources by mapping different versions of the International Classification of Diseases coding system to the GBD cause list.

Next, researchers examined the accuracy of the data, scouring rows and rows of data for "garbage codes." Garbage codes are misclassifications of death in the data, and researchers identified thousands of them. Some garbage codes are instances when we know the cause listed cannot possibly lead to death. Examples found in records include "abdominal rigidity," "senility," and "yellow nail syndrome." To correct these, researchers drew on evidence from medical literature, expert judgment, and statistical techniques to reassign each of these to more probable causes of death.

After addressing data-quality issues, researchers used a variety of statistical models to determine the number of deaths from each cause. This approach, named CODEm

Figure A2: Leading causes of death and premature death in Latin America and Caribbean, 2010



(Cause of Death Ensemble modeling), was designed based on statistical techniques called "ensemble modeling." Ensemble modeling was made famous by the recipients of the Netflix Prize in 2009, BellKor's Pragmatic Chaos, who engineered the best algorithm to predict how much a person would like a film, taking into account their movie preferences.

To ensure that the number of deaths from each cause does not exceed the total number of deaths estimated in a separate GBD demographic analysis, researchers apply a correction technique named CoDCorrect. This technique makes certain that estimates of the number of deaths from each cause do not add up to more than 100% of deaths in a given year.

After producing estimates of the number of deaths from each of the 235 fatal outcomes included in the GBD cause list, researchers then calculated years of life lost to premature death, or YLLs. For every death from a particular cause, researchers estimated the number of years lost based on the highest life expectancy in the deceased's age group. For example, if a 20-year-old male died in a car accident in Brazil in 2010, he has 66 years of life lost, which is the highest remaining life expectancy in 20 year olds, as experienced by 20-year-old females in Japan.

When comparing rankings of the leading causes of death versus YLLs, YLLs place more weight on the causes of death that occur in younger age groups, as shown in Figure A2. For example, road injury represents a greater percentage of total YLLs than total deaths since it is a leading killer of young men. Ischemic heart disease, by contrast, accounts for a smaller percentage of total YLLs than total deaths as it primarily kills older people.

Estimating years lived with disability

Researchers estimated the prevalence of each sequela using different sources of data, including government reports of cases of infectious diseases, data from population-based disease registries for conditions such as cancers and chronic kidney diseases, antenatal clinic data, hospital discharge data, data from outpatient facilities, interview questions, and direct measurements of hearing, vision, and lung function testing from surveys and other sources.

Confronted with the challenge of data gaps in many regions and for numerous types of sequelae, they developed a statistical modeling tool named DisMod-MR (Disease Modeling – Metaregression) to estimate prevalence using available data on incidence, prevalence, remission, duration, and extra risk of mortality due to the disease.

Researchers estimated disability weights using data collected from almost 14,000 respondents via household surveys in Bangladesh, Indonesia, Peru, Tanzania, and the United States. Disability weights measure the severity of different sequelae that result from disease and injury. Data were also used from an Internet survey of more than 16,000 people. GBD researchers presented different lay definitions of sequelae

grouped into 220 unique health states to survey respondents, and respondents were then asked to rate the severity of the different health states. The results were similar across all surveys despite cultural and socioeconomic differences. Respondents consistently placed health states such as mild hearing loss and long-term treated fractures at the low end of the severity scale, while they ranked acute schizophrenia and severe multiple sclerosis as very severe.

Finally, years lived with disability, or YLDs, are calculated as prevalence of a sequela multiplied by the disability weight for that sequela. The number of years lived with disability for a specific disease or injury are calculated as the sum of the YLDs from each sequela arising from that cause.

Estimating disability-adjusted life years

DALYs are calculated by adding together YLLs and YLDs. Figure A3 compares the 10 leading diseases and injuries calculated as percentages of both deaths and DALYs in Latin America and the Caribbean. This figure also shows the top 10 risk factors attributable to deaths and DALYs worldwide. It illustrates how a decision-maker looking only at the top 10 causes of death would fail to see the importance of low back pain, for example, which was a leading cause of DALYs in 2010. DALYs are a powerful tool for priority setting as they measure disease burden from non-fatal as well as fatal conditions. Yet another reason why top causes of DALYs differ from leading causes of death is that DALYs give more weight to death in younger ages, as illustrated by the case of preterm birth complications. In contrast, stroke causes a much larger percentage of total deaths than DALYs as it primarily impacts older people.

Estimating DALYs attributable to risk factors

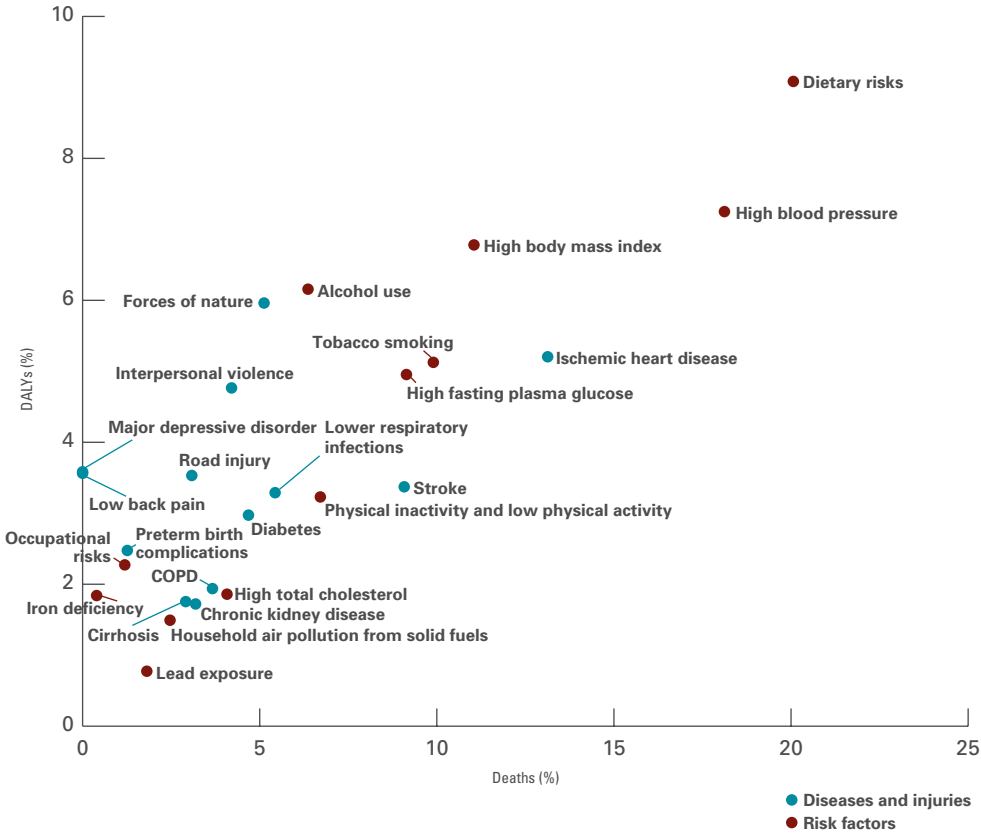
To estimate the number of healthy years lost, or DALYs, attributable to potentially avoidable risk factors, researchers collected detailed data on exposure to different risk factors. The study used data from sources such as satellite data on air pollution, breastfeeding data from population surveys, and blood and bone lead levels from medical examination surveys and epidemiological surveys. Researchers then collected data on the effects of risk factors on disease outcomes through systematic reviews of epidemiological studies.

All risk factors analyzed met common criteria in four areas:

1. The likely importance of a risk factor for policymaking or disease burden.
2. Availability of sufficient data to estimate exposure to a particular risk factor.
3. Rigorous scientific evidence that specific risk factors cause certain diseases and injuries.
4. Scientific findings about the effects of different risk factors that are relevant for the general population.

To calculate the number of DALYs attributable to different risk factors, researchers compared the disease burden in a group exposed to a risk factor to the disease burden in a group that had zero exposure to that risk factor. When subjects with zero exposure were impossible to find, as in the case of high blood pressure, for example, researchers established a level of minimum exposure that leads to the best health outcomes.

Figure A3: The 10 leading diseases and injuries and 10 leading risk factors based on percentage of deaths and DALYs in Latin America and Caribbean, 2010



Note: This figure compares the percent of DALYs and deaths attributable to different diseases and injuries (shown in blue) as well as risk factors (shown in red). Certain causes, such as low back pain, cause a substantial numbers of DALYs, but do not cause death. DALYs are an important tool for decision-makers because they capture years of health loss from both fatal and non-fatal causes.

Table A1: Age-standardized death rates, years of life lost, and years lived with disability, and life expectancy at birth and healthy life expectancy at birth for 1990 and 2010 for both sexes combined

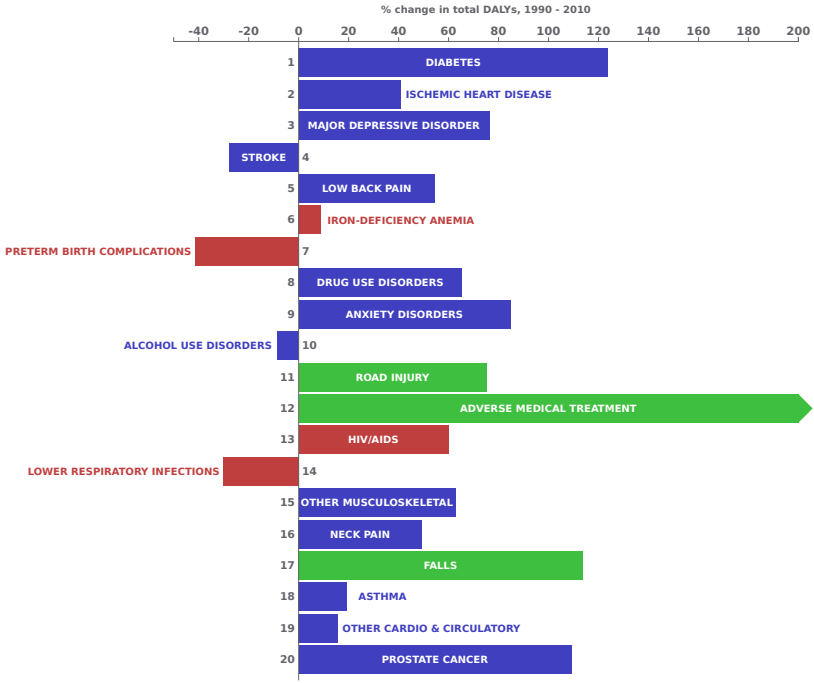
Country	**Age-standardized death rate** (per 100,000)				**Age-standardized YLL rate** (per 100,000)			
	1990		2010		1990		2010	
	Rate	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*
Antigua and Barbuda	728 (688-755)	8 (6-11)	593 (553-626)	9 (6-12)	19,168 (17,688-20,207)	8 (4-10)	13,919 (12,685-14,906)	5 (4-8)
Argentina	731 (725-736)	9 (8-10)	597 (593-602)	8 (8-10)	19,400 (19,003-19,767)	9 (7-10)	14,343 (14,163-14,574)	7 (5-8)
Belize	765 (744-788)	15 (12-16)	805 (755-840)	26 (24-26)	20,556 (19,736-21,501)	11 (10-11)	21,887 (20,335-22,992)	25 (24-25)
Bolivia	1,136 (1,087-1,188)	27 (27-27)	751 (685-816)	22 (20-25)	41,077 (38,858-43,587)	28 (28-28)	23,965 (21,599-26,251)	26 (26-27)
Brazil	854 (846-863)	20 (19-22)	670 (665-674)	17 (15-19)	26,370 (25,718-27,152)	20 (18-24)	17,580 (17,240-17,932)	15 (13-18)
Chile	760 (752-767)	13 (12-16)	490 (482-500)	2 (2-2)	18,210 (17,880-18,511)	4 (4-6)	11,136 (10,920-11,448)	3 (2-3)
Colombia	760 (744-777)	12 (12-16)	617 (596-650)	12 (9-13)	23,157 (22,513-23,791)	14 (13-15)	16,372 (15,704-17,370)	11 (11-14)
Costa Rica	556 (547-561)	1 (1-1)	462 (458-468)	1 (1-1)	13,705 (13,321-14,011)	1 (1-1)	10,447 (10,266-10,723)	1 (1-1)
Cuba	635 (628-639)	3 (2-3)	543 (539-550)	4 (4-6)	15,919 (15,589-16,144)	2 (2-2)	11,088 (10,949-11,312)	2 (2-3)
Dominica	831 (791-862)	19 (17-20)	669 (633-698)	16 (13-19)	24,475 (22,878-25,789)	16 (14-17)	19,240 (17,857-20,438)	20 (18-21)
Dominican Republic	765 (744-784)	16 (12-16)	683 (647-707)	18 (15-19)	23,701 (22,900-24,580)	15 (14-16)	18,385 (17,220-19,211)	18 (16-20)
Ecuador	700 (690-710)	6 (5-7)	522 (503-537)	3 (3-4)	22,420 (21,787-23,068)	12 (12-13)	14,956 (14,197-15,576)	9 (7-10)
El Salvador	809 (796-821)	18 (17-19)	661 (648-673)	15 (14-17)	26,931 (25,998-27,888)	23 (19-25)	18,474 (17,953-19,050)	19 (16-21)
Grenada	904 (864-931)	24 (22-25)	850 (801-881)	27 (26-27)	25,983 (24,460-27,214)	19 (17-23)	21,313 (20,003-22,093)	24 (22-25)
Guatemala	1,061 (1,045-1,081)	26 (26-26)	787 (768-800)	25 (23-26)	36,242 (35,061-37,857)	27 (26-27)	24,337 (23,537-25,018)	27 (26-27)
Guyana	1,199 (1,168-1,226)	28 (28-28)	1,124 (1,029-1,204)	28 (28-28)	35,469 (34,461-36,558)	26 (26-27)	31,305 (28,306-34,444)	28 (28-28)
Haiti	1,717 (1,662-1,780)	29 (29-29)	3,321 (2,404-5,352)	29 (29-29)	61,823 (59,254-64,644)	29 (29-29)	137,295 (92,238-242,719)	29 (29-29)
Honduras	869 (824-905)	21 (20-22)	784 (674-886)	24 (20-27)	26,454 (25,019-27,652)	21 (18-24)	20,507 (17,522-23,158)	21 (18-25)
Jamaica	676 (655-692)	4 (4-5)	610 (546-675)	11 (6-16)	18,618 (17,687-19,484)	6 (4-8)	16,417 (14,769-18,115)	12 (9-16)
Mexico	740 (732-749)	11 (10-12)	604 (599-609)	10 (9-12)	22,775 (22,171-23,502)	13 (12-15)	15,658 (15,365-15,976)	10 (9-11)
Nicaragua	762 (740-787)	14 (12-16)	652 (627-674)	14 (13-16)	25,101 (24,193-26,213)	17 (16-21)	16,911 (16,141-17,602)	13 (11-15)
Panama	634 (612-653)	2 (2-3)	545 (517-572)	5 (4-6)	16,812 (16,180-17,495)	3 (3-3)	14,027 (13,274-14,832)	6 (5-8)
Paraguay	682 (662-704)	5 (4-6)	725 (680-755)	21 (19-22)	18,868 (18,201-19,603)	7 (5-9)	18,059 (16,871-18,867)	17 (14-19)
Peru	803 (772-830)	17 (17-19)	551 (525-586)	6 (4-7)	27,953 (26,604-29,275)	25 (23-25)	14,679 (13,854-15,802)	8 (5-10)
Saint Lucia	891 (855-917)	23 (21-24)	722 (674-765)	20 (18-24)	25,875 (24,517-27,048)	18 (17-22)	17,785 (16,657-18,882)	16 (13-19)
Saint Vincent and the Grenadines	890 (851-918)	22 (21-24)	753 (715-781)	23 (21-24)	26,567 (25,188-27,741)	22 (18-24)	20,602 (19,344-21,589)	22 (21-24)
Suriname	922 (891-945)	25 (24-25)	693 (657-723)	19 (17-20)	27,022 (25,994-28,010)	24 (20-25)	20,892 (19,769-21,856)	23 (21-25)
Uruguay	731 (722-737)	10 (8-10)	585 (576-597)	7 (7-9)	18,332 (17,966-18,632)	5 (4-7)	13,126 (12,874-13,473)	4 (4-5)
Venezuela	716 (710-723)	7 (7-8)	630 (609-650)	13 (11-14)	19,688 (19,256-20,199)	10 (8-10)	17,271 (16,542-17,901)	14 (12-16)

Age-standardized YLD rate (per 100,000)				**Life expectancy at birth**				**Health-adjusted life expectancy at birth**			
1990		2010		1990		2010		1990		2010	
Rate	*Rank*	*Rate*	*Rank*	*LE*	*Rank*	*LE*	*Rank*	*HALE*	*Rank*	*HALE*	*Rank*
12,425 (10,114-14,947)	15 (5-26)	13,535 (11,001-16,340)	26 (17-28)	73.1 (72.2-73.9)	6 (4-10)	76.5 (75.3-77.8)	7 (4-11)	62.7 (60.4-64.7)	10 (4-12)	64.3 (61.6-66.8)	12 (9-18)
11,154 (9,280-13,517)	4 (2-13)	10,843 (8,885-13,183)	4 (2-14)	72.5 (72.5-72.6)	10 (8-11)	76.0 (75.9-76.0)	9 (7-10)	63.1 (61.2-64.7)	7 (3-11)	66.1 (64.0-67.9)	7 (4-10)
12,951 (10,597-15,751)	22 (9-28)	13,377 (10,984-16,145)	25 (17-28)	72.0 (71.4-72.7)	11 (9-13)	71.2 (70.2-72.3)	24 (22-27)	61.2 (58.9-63.2)	13 (11-16)	60.2 (57.9-62.5)	27 (22-27)
13,140 (10,762-15,753)	25 (12-28)	12,020 (9,912-14,691)	15 (7-23)	62.3 (61.2-63.3)	28 (28-28)	70.7 (68.9-72.6)	26 (21-27)	53.2 (51.2-55.0)	28 (28-28)	60.8 (58.2-63.1)	25 (19-27)
12,016 (9,914-14,293)	8 (6-17)	11,637 (9,670-13,849)	9 (6-17)	69.1 (68.9-69.3)	19 (19-23)	74.1 (73.9-74.3)	16 (14-19)	59.6 (57.8-61.3)	18 (16-20)	64.0 (62.0-65.7)	13 (12-16)
11,185 (9,275-13,408)	3 (2-10)	10,407 (8,562-12,391)	2 (2-8)	72.9 (72.8-73.0)	8 (6-8)	78.5 (78.3-78.8)	2 (2-2)	63.4 (61.5-65.1)	5 (3-10)	68.6 (66.7-70.4)	2 (1-2)
12,110 (10,117-14,453)	10 (5-21)	11,643 (9,671-13,882)	10 (6-17)	71.1 (70.6-71.4)	14 (13-16)	75.0 (74.1-75.9)	12 (9-16)	61.1 (59.2-62.8)	14 (12-16)	64.7 (62.6-66.6)	11 (9-15)
11,672 (9,509-14,109)	6 (2-20)	10,948 (8,973-13,312)	5 (2-15)	76.6 (76.5-76.9)	1 (1-1)	79.4 (79.3-79.6)	1 (1-1)	66.0 (63.7-68.0)	1 (1-1)	68.9 (66.5-70.7)	1 (1-2)
11,765 (9,701-14,144)	7 (3-17)	12,791 (10,606-15,454)	19 (14-26)	74.8 (74.8-74.9)	2 (2-3)	77.9 (77.8-78.0)	3 (3-4)	64.6 (62.5-66.4)	2 (2-3)	66.1 (63.7-68.1)	8 (4-10)
12,486 (10,211-15,200)	17 (6-27)	13,022 (10,598-15,773)	22 (14-27)	70.3 (69.5-71.1)	16 (14-18)	73.8 (72.6-74.9)	17 (12-21)	60.2 (57.9-62.1)	16 (13-20)	62.4 (60.0-64.6)	19 (16-23)
12,154 (10,079-14,515)	11 (5-23)	12,232 (10,027-14,893)	17 (9-23)	70.8 (70.3-71.3)	15 (14-17)	73.7 (72.8-74.7)	19 (12-21)	60.8 (58.8-62.6)	15 (12-17)	63.1 (60.7-65.1)	17 (13-20)
12,265 (10,092-14,749)	13 (6-24)	11,404 (9,398-13,802)	8 (4-16)	72.0 (71.7-72.2)	12 (11-12)	77.0 (76.3-77.8)	4 (4-8)	61.6 (59.5-63.4)	12 (11-15)	66.4 (64.2-68.4)	6 (3-9)
12,585 (10,404-15,075)	18 (6-27)	11,781 (9,628-14,217)	13 (5-22)	69.6 (69.4-69.8)	18 (17-19)	74.2 (73.8-74.6)	15 (13-18)	59.4 (57.3-61.2)	19 (16-24)	63.9 (61.7-65.7)	15 (11-18)
13,149 (10,849-15,692)	24 (11-28)	13,076 (10,621-15,932)	24 (15-27)	68.9 (68.1-69.6)	23 (18-25)	71.0 (70.1-71.8)	25 (23-27)	58.7 (56.8-60.7)	20 (17-25)	60.5 (58.1-62.6)	26 (21-27)
12,800 (10,661-15,434)	20 (11-27)	11,705 (9,739-13,977)	12 (6-18)	64.5 (64.3-64.6)	26 (26-27)	70.5 (70.1-70.9)	27 (25-27)	55.2 (53.3-56.8)	26 (26-27)	61.0 (59.1-62.5)	24 (20-27)
13,663 (11,198-16,537)	28 (18-29)	14,024 (11,510-17,112)	27 (21-28)	64.1 (63.4-64.8)	27 (26-27)	66.0 (64.1-67.9)	28 (28-28)	54.6 (52.5-56.6)	27 (26-27)	55.9 (53.3-58.3)	28 (28-28)
15,059 (12,201-18,249)	29 (27-29)	16,428 (13,131-19,964)	29 (29-29)	54.1 (53.2-55.0)	29 (29-29)	38.0 (26.0-45.9)	29 (29-29)	45.7 (43.9-47.4)	29 (29-29)	32.4 (22.4-38.8)	29 (29-29)
12,940 (10,740-15,593)	23 (10-28)	12,485 (10,455-14,904)	18 (11-26)	68.9 (68.1-69.6)	21 (18-25)	71.9 (69.2-74.4)	23 (14-27)	58.7 (56.7-60.5)	21 (18-25)	61.6 (58.8-64.3)	22 (15-27)
12,075 (9,895-14,594)	9 (3-23)	12,909 (10,470-15,647)	20 (13-27)	73.6 (72.9-74.3)	4 (3-7)	75.4 (72.8-77.7)	11 (4-21)	63.2 (61.1-65.2)	6 (3-11)	63.8 (60.8-66.6)	16 (9-21)
10,092 (8,414-12,094)	1 (1-1)	9,364 (7,762-11,245)	1 (1-1)	71.5 (71.2-71.9)	13 (12-14)	75.5 (75.2-75.7)	10 (9-12)	62.9 (61.1-64.4)	8 (5-11)	66.9 (65.2-68.4)	3 (3-6)
12,459 (10,173-15,019)	16 (5-27)	11,835 (9,676-14,369)	14 (5-22)	70.3 (69.8-70.8)	17 (15-17)	74.4 (73.7-75.0)	14 (12-18)	60.0 (57.9-61.9)	17 (14-21)	64.0 (61.6-65.9)	14 (10-18)
12,186 (10,066-14,758)	12 (4-25)	11,151 (9,167-13,447)	7 (2-16)	74.5 (73.9-75.1)	3 (2-4)	76.7 (75.8-77.6)	5 (4-9)	63.8 (61.6-65.7)	3 (2-9)	66.5 (64.1-68.4)	5 (3-9)
12,337 (10,187-14,701)	14 (6-26)	12,006 (9,966-14,443)	16 (8-22)	73.2 (72.8-73.6)	5 (4-8)	73.2 (72.4-74.1)	20 (17-22)	62.6 (60.5-64.5)	11 (6-12)	62.9 (60.7-64.7)	18 (15-21)
12,854 (10,540-15,507)	21 (10-28)	11,692 (9,610-13,997)	11 (5-21)	68.9 (68.3-69.4)	22 (19-25)	76.4 (75.4-77.4)	8 (4-11)	58.6 (56.5-60.5)	24 (19-25)	65.7 (63.5-67.8)	9 (4-12)
13,328 (10,973-16,233)	27 (14-28)	14,233 (11,621-17,595)	28 (23-28)	68.9 (68.2-69.6)	20 (18-25)	73.7 (72.1-75.5)	18 (11-22)	58.7 (56.4-60.5)	23 (18-25)	61.6 (58.6-64.3)	21 (17-27)
13,233 (10,716-16,044)	26 (10-28)	13,056 (10,686-15,847)	23 (15-27)	68.7 (67.9-69.6)	24 (19-25)	72.0 (71.1-73.0)	22 (20-25)	58.5 (56.4-60.6)	25 (18-25)	61.2 (58.8-63.2)	23 (20-27)
12,827 (10,347-15,593)	19 (8-28)	12,945 (10,510-15,516)	21 (14-27)	68.5 (67.7-69.3)	25 (20-25)	72.6 (71.3-74.0)	21 (16-24)	58.6 (56.5-60.6)	22 (18-25)	61.6 (59.2-64.1)	20 (18-26)
11,007 (9,132-13,189)	2 (2-8)	10,540 (8,708-12,586)	3 (2-7)	73.0 (72.9-73.2)	7 (5-8)	76.5 (76.2-76.9)	6 (5-9)	63.6 (61.7-65.2)	4 (3-8)	66.8 (65.0-68.5)	4 (3-7)
11,583 (9,621-14,158)	5 (2-18)	10,994 (9,072-13,268)	6 (2-15)	72.6 (72.5-72.6)	9 (8-10)	74.5 (73.7-75.3)	13 (11-18)	62.8 (60.6-64.5)	9 (5-11)	64.9 (62.9-66.6)	10 (8-15)

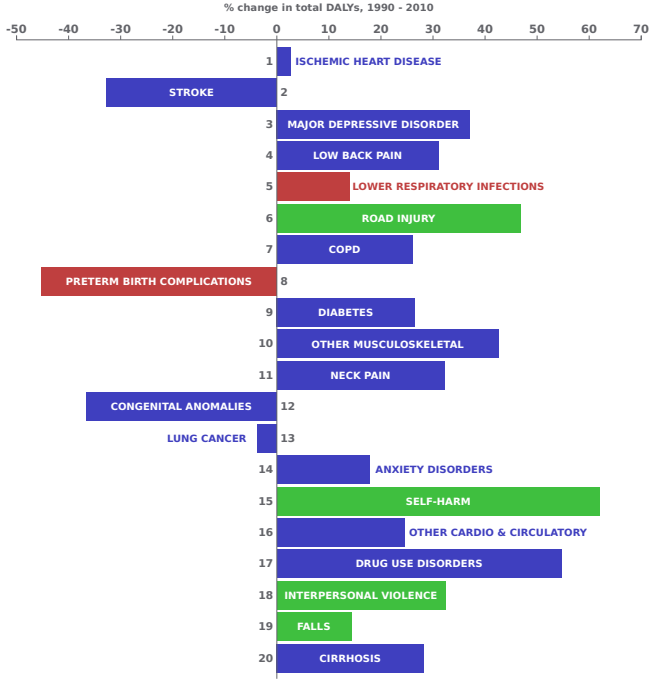
CHANGES IN LEADING CAUSES OF DALYS BETWEEN 1990 AND 2010 FOR COUNTRIES IN LATIN AMERICA AND CARIBBEAN

In the following figures, pointed arrows indicate causes that have increased by a greater amount than shown on the x-axis. For more country data, explore IHME's data visualization tools online: www.ihmeuw.org/GBDcountryviz.

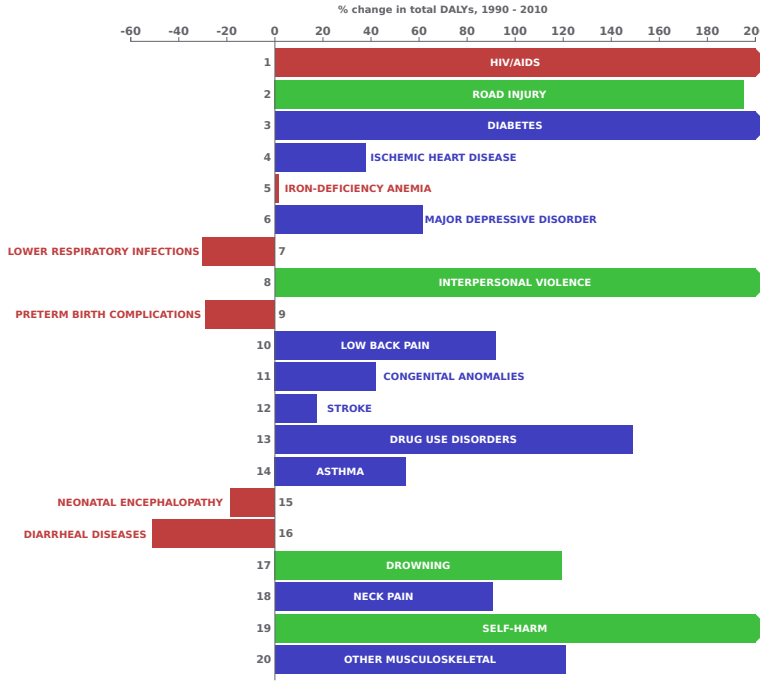
Shifts in leading causes of DALYs in Antigua and Barbuda, 1990-2010



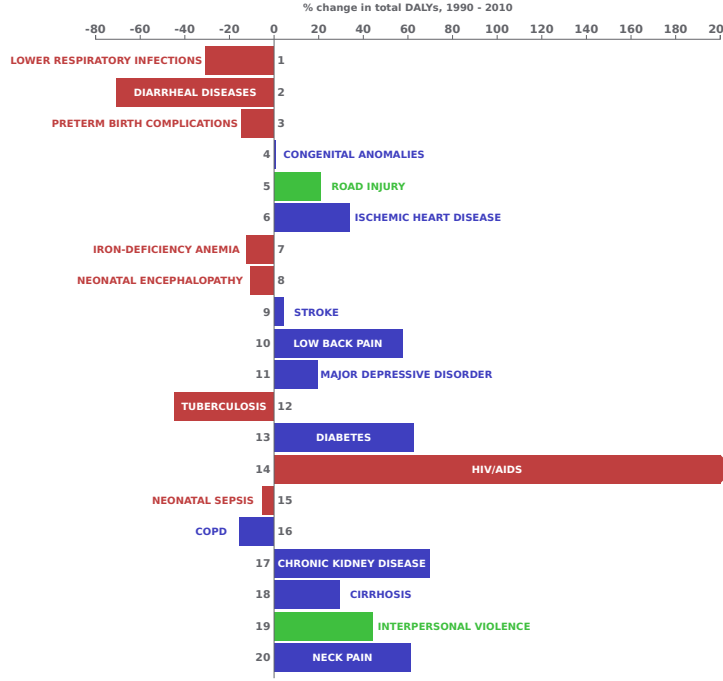
Shifts in leading causes of DALYs in Argentina, 1990-2010



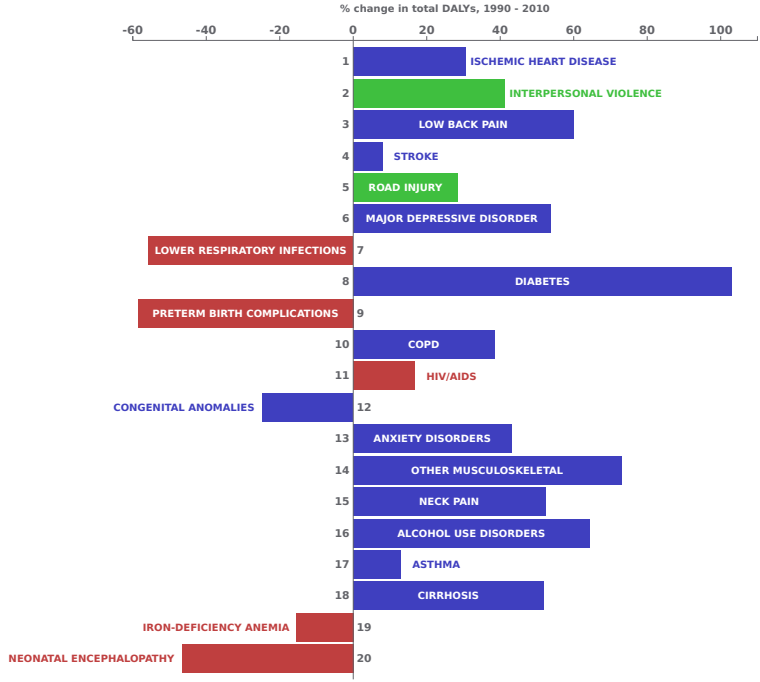
Shifts in leading causes of DALYs in Belize, 1990-2010



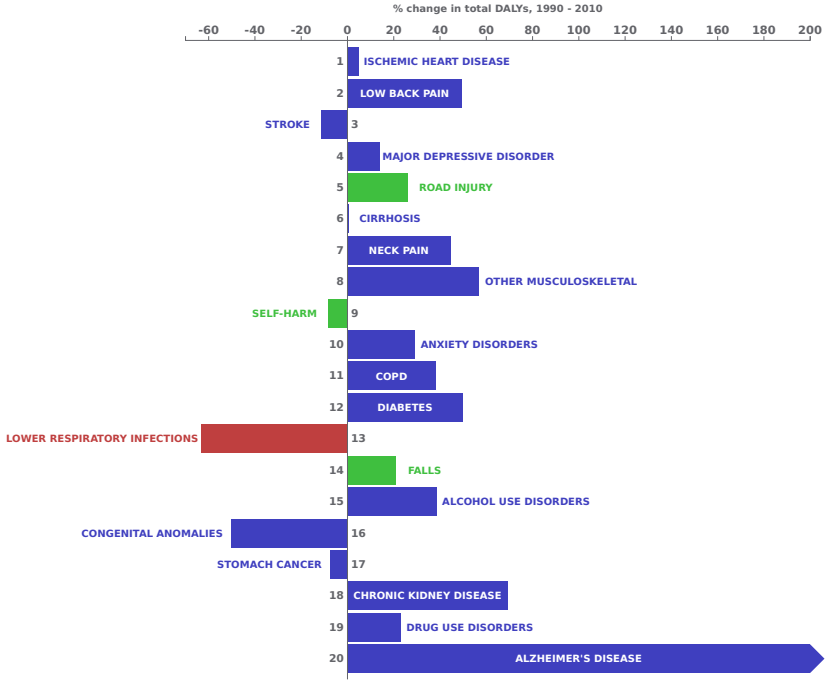
Shifts in leading causes of DALYs in Bolivia, 1990-2010



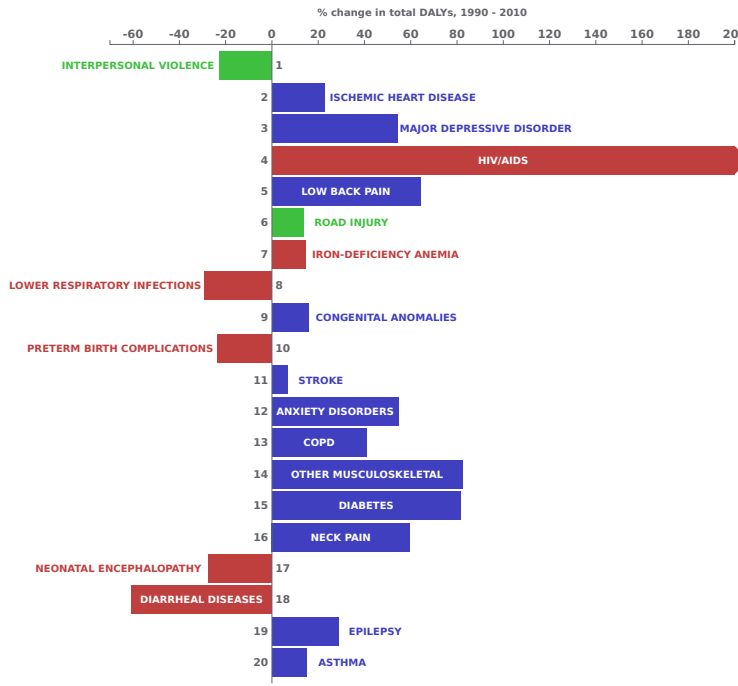
Shifts in leading causes of DALYs in Brazil, 1990-2010



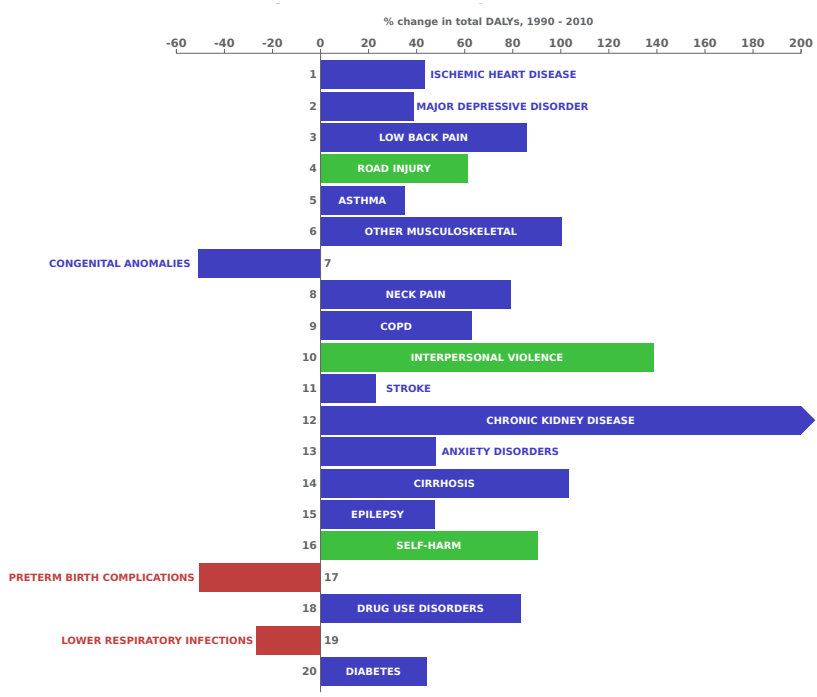
Shifts in leading causes of DALYs in Chile, 1990-2010



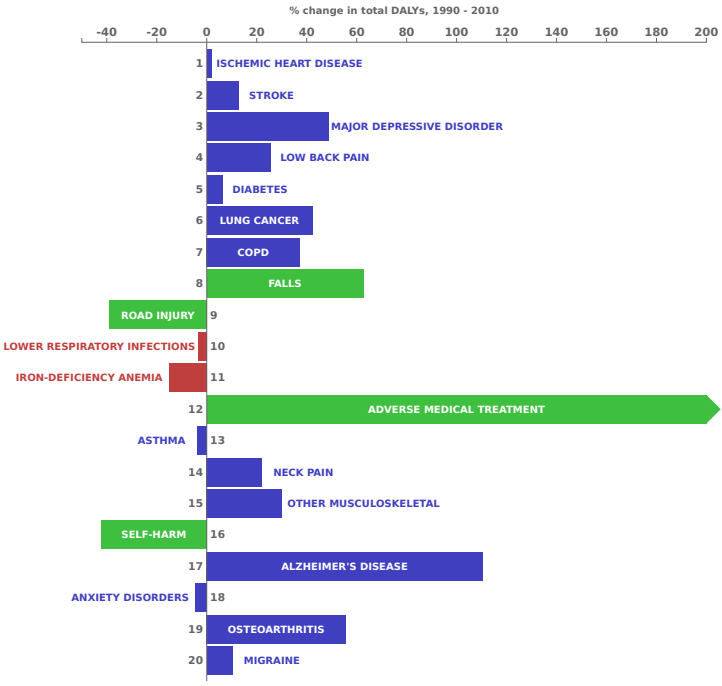
Shifts in leading causes of DALYs in Colombia, 1990-2010



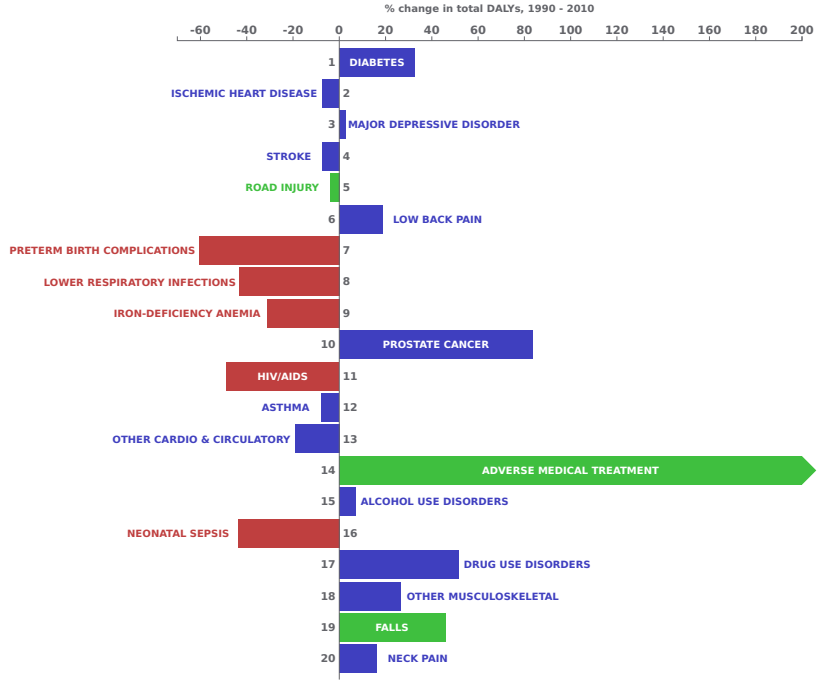
Shifts in leading causes of DALYs in Costa Rica, 1990-2010



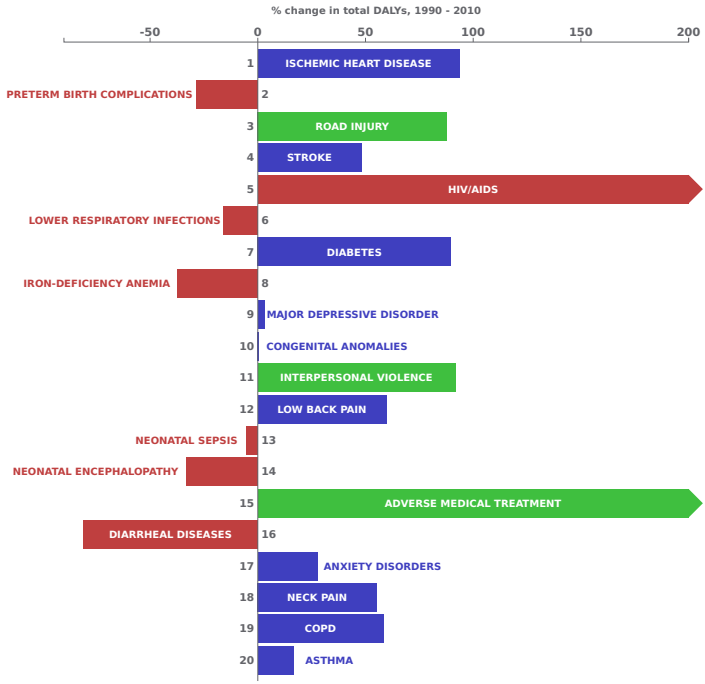
Shifts in leading causes of DALYs in Cuba, 1990-2010



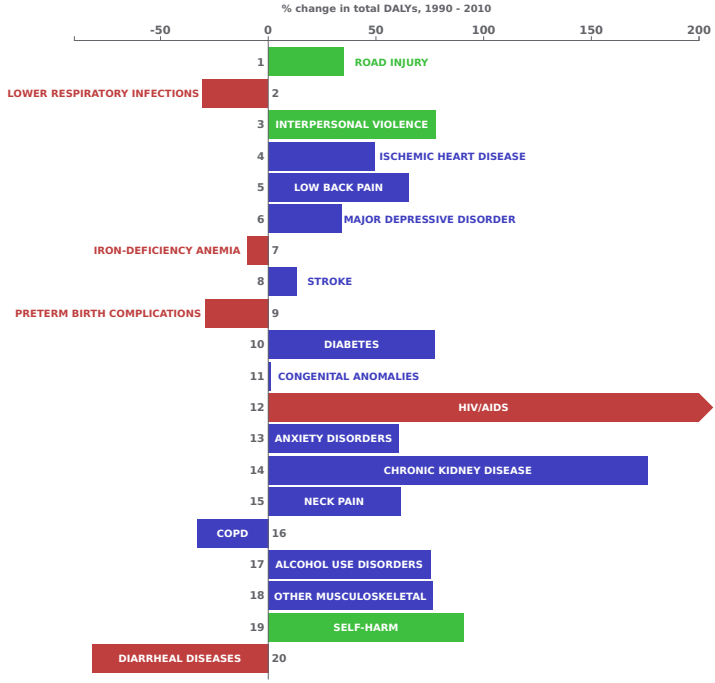
Shifts in leading causes of DALYs in Dominica, 1990-2010



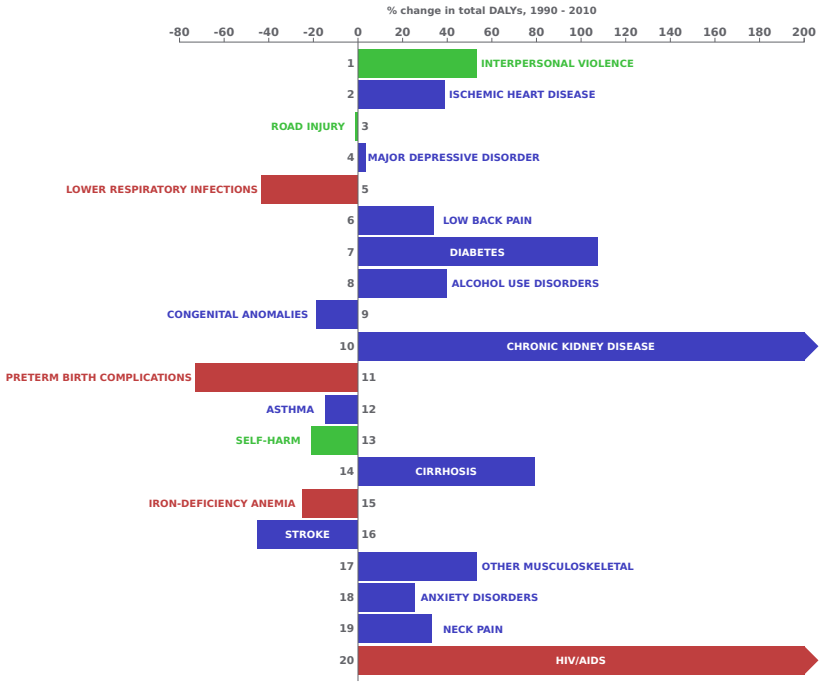
Shifts in leading causes of DALYs in Dominican Republic, 1990-2010



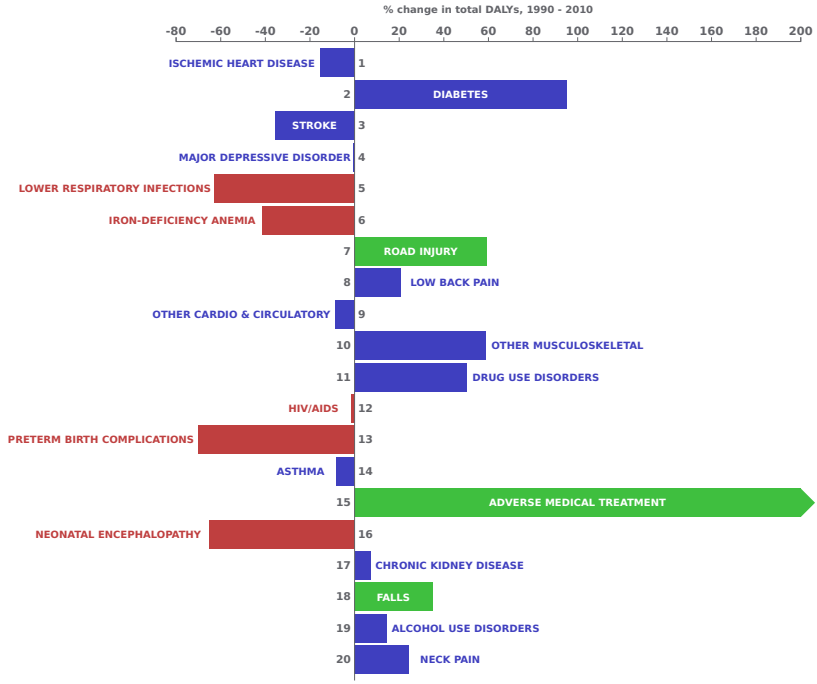
Shifts in leading causes of DALYs in Ecuador, 1990-2010



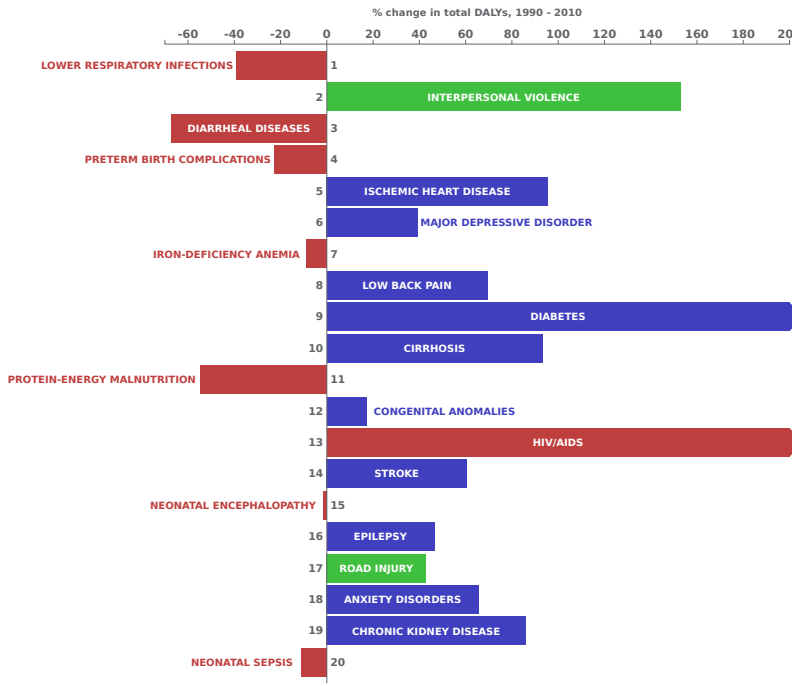
Shifts in leading causes of DALYs in El Salvador, 1990-2010



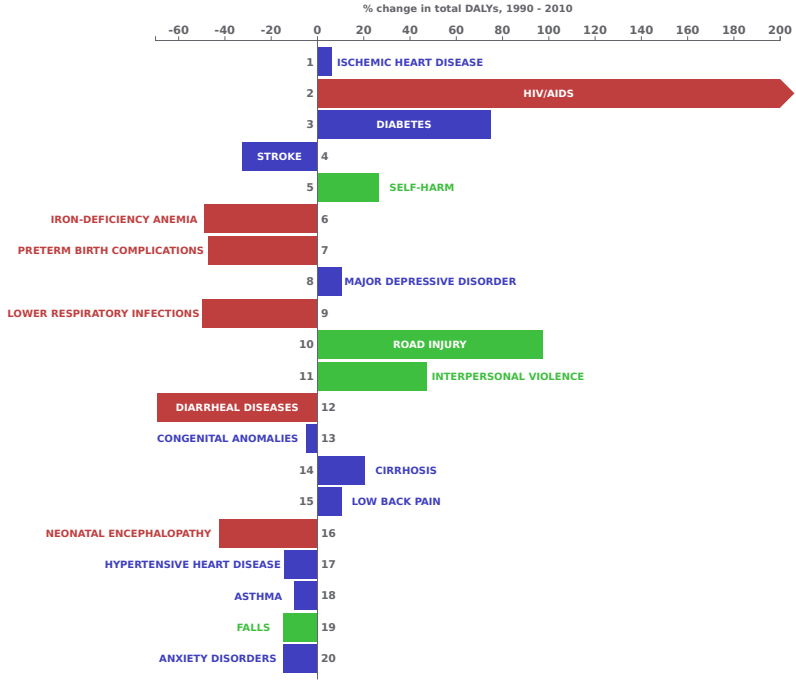
Shifts in leading causes of DALYs in Grenada, 1990-2010



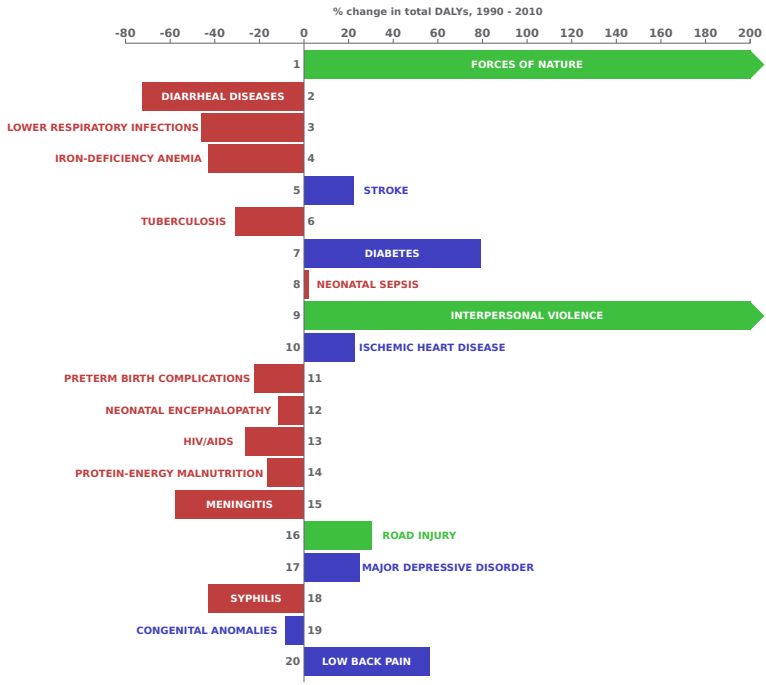
Shifts in leading causes of DALYs in Guatemala, 1990-2010



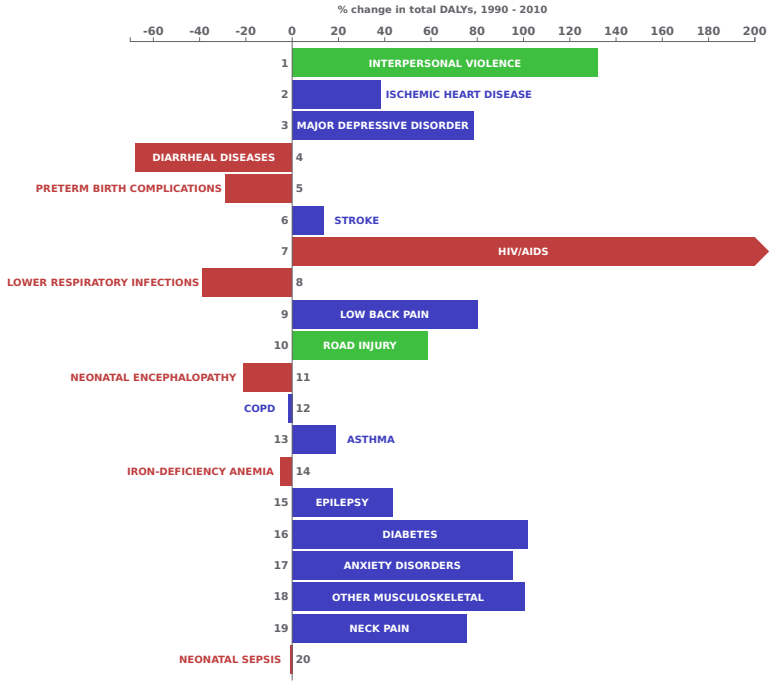
Shifts in leading causes of DALYs in Guyana, 1990-2010



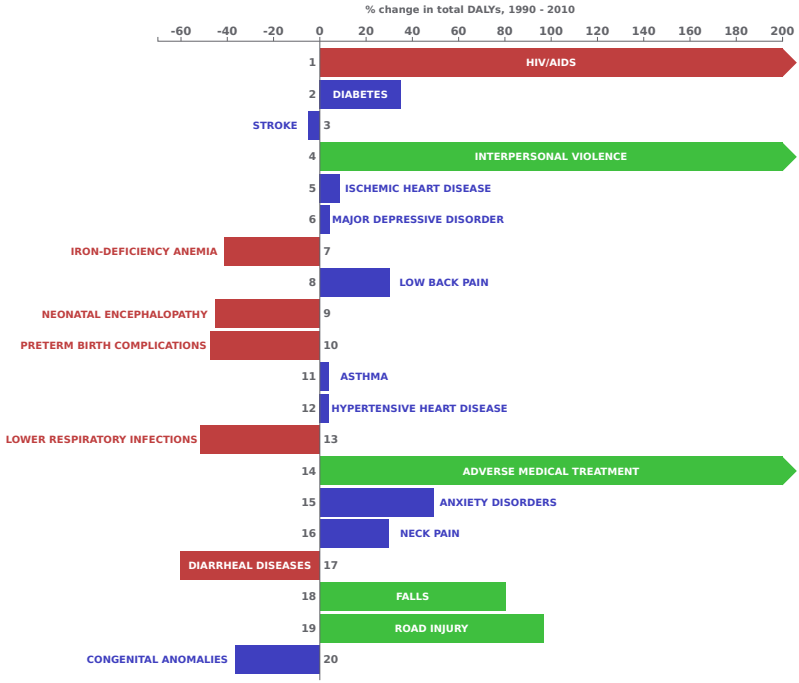
Shifts in leading causes of DALYs in Haiti, 1990-2010



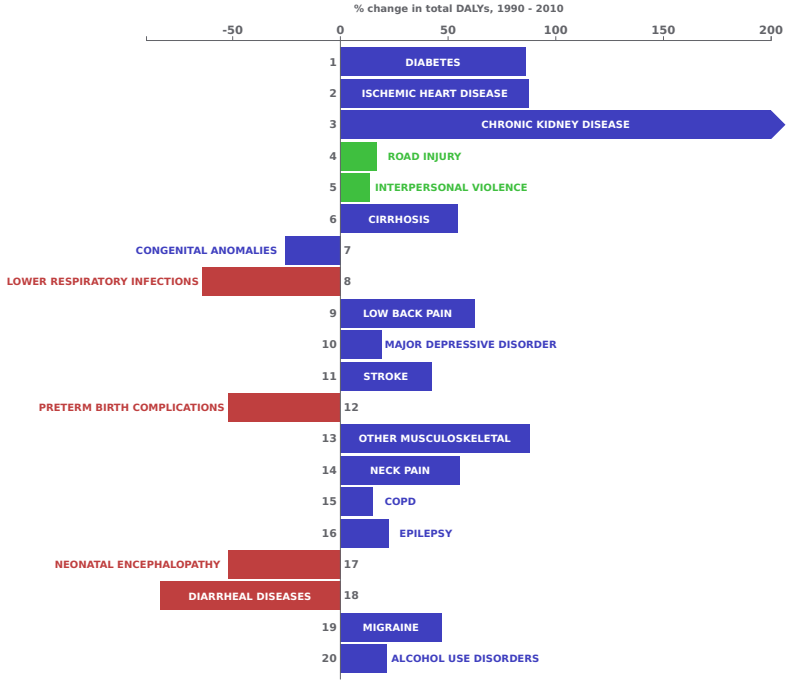
Shifts in leading causes of DALYs in Honduras, 1990-2010



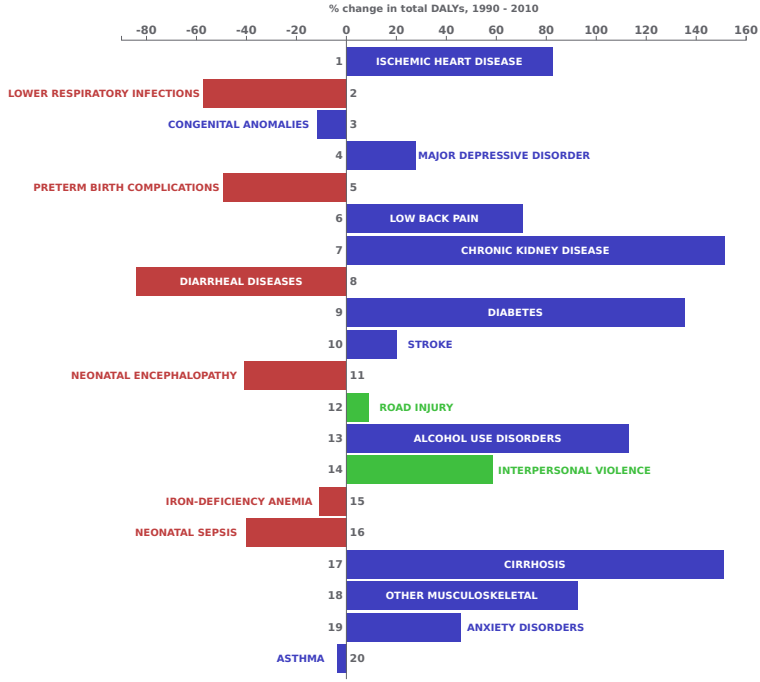
Shifts in leading causes of DALYs in Jamaica, 1990-2010



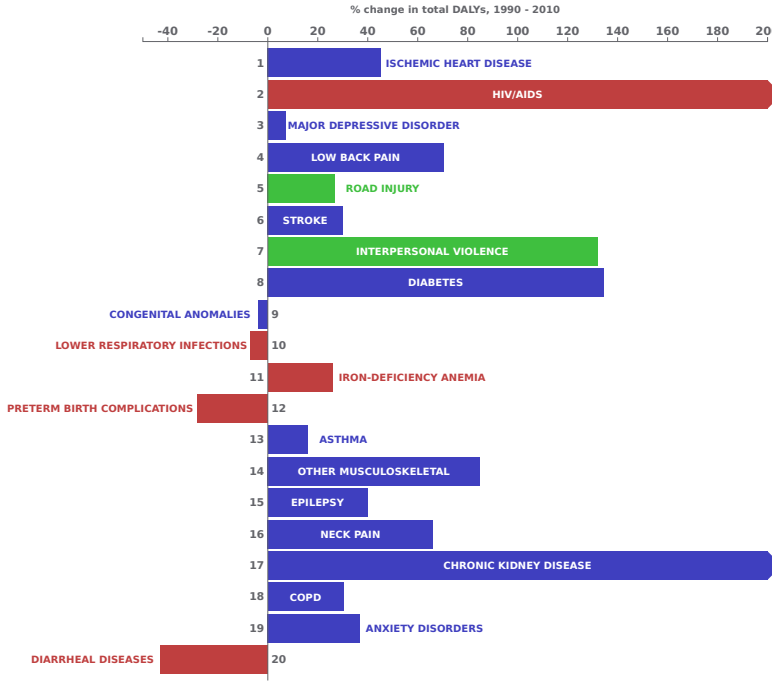
Shifts in leading causes of DALYs in Mexico, 1990-2010



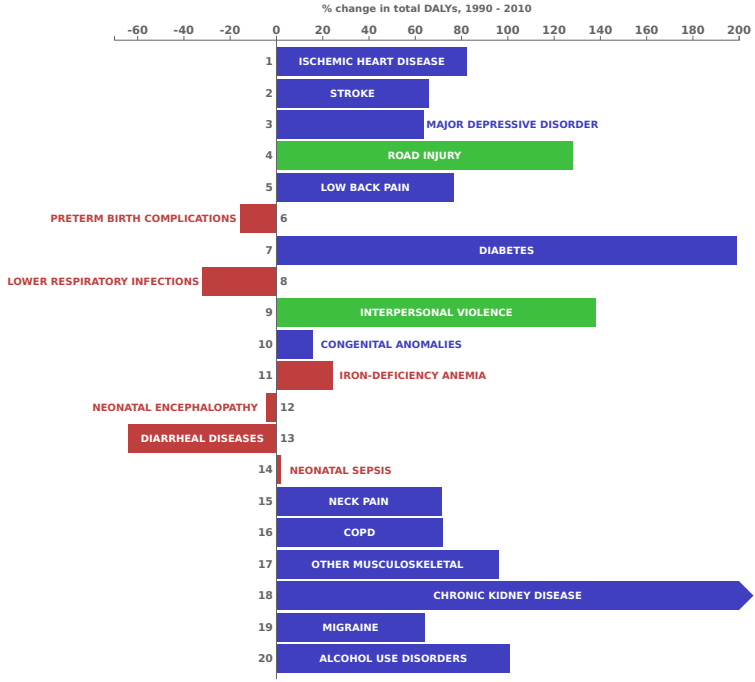
Shifts in leading causes of DALYs in Nicaragua, 1990-2010



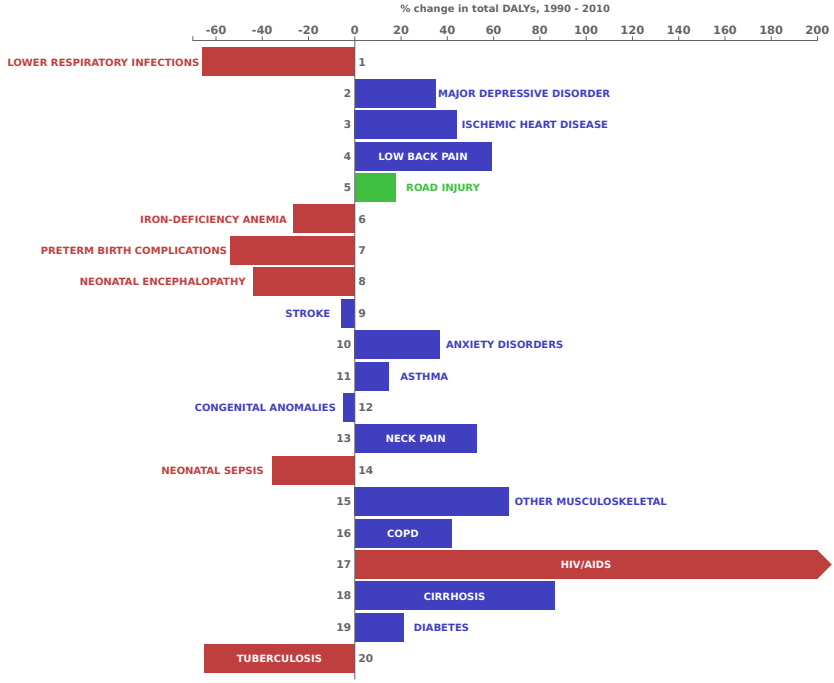
Shifts in leading causes of DALYs in Panama, 1990-2010



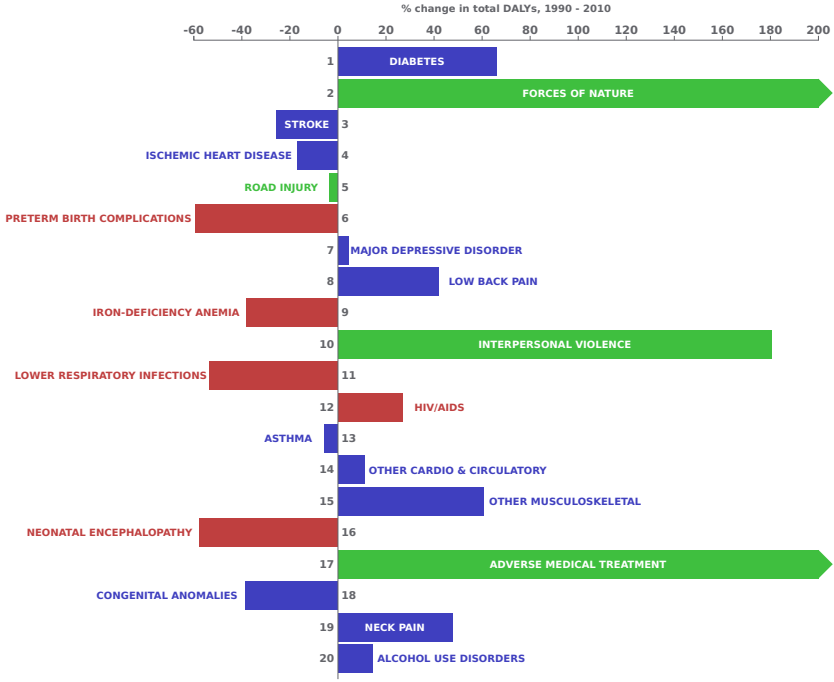
Shifts in leading causes of DALYs in Paraguay, 1990-2010



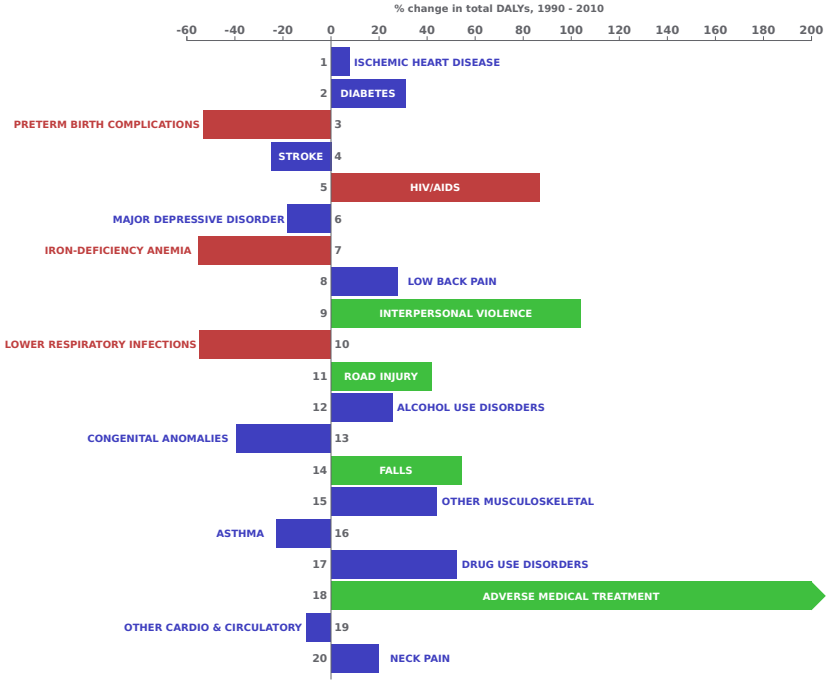
Shifts in leading causes of DALYs in Peru, 1990-2010



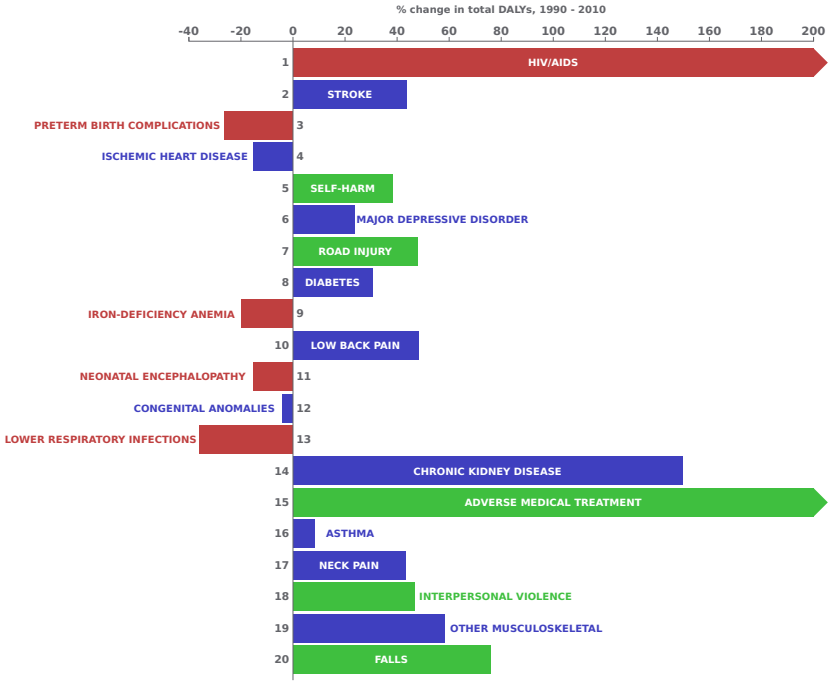
Shifts in leading causes of DALYs in Saint Lucia, 1990-2010



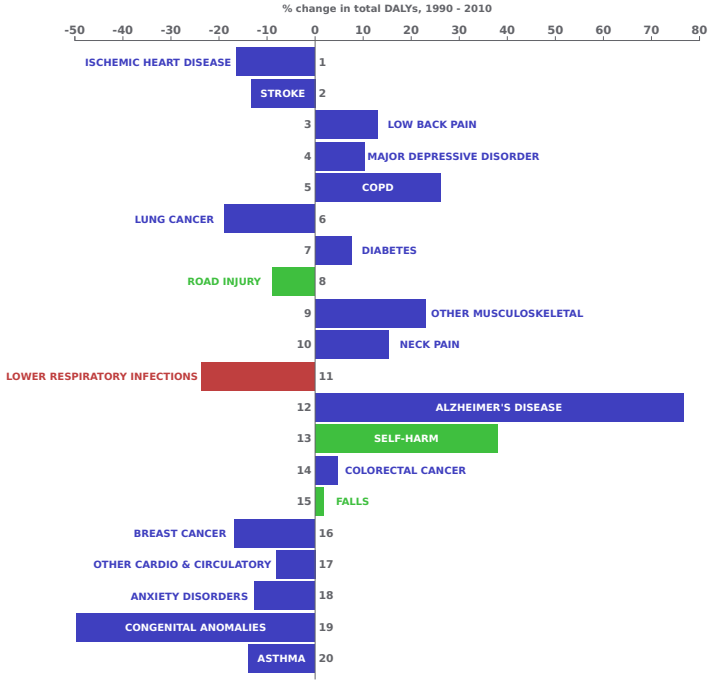
Shifts in leading causes of DALYs in Saint Vincent and the Grenadines, 1990-2010



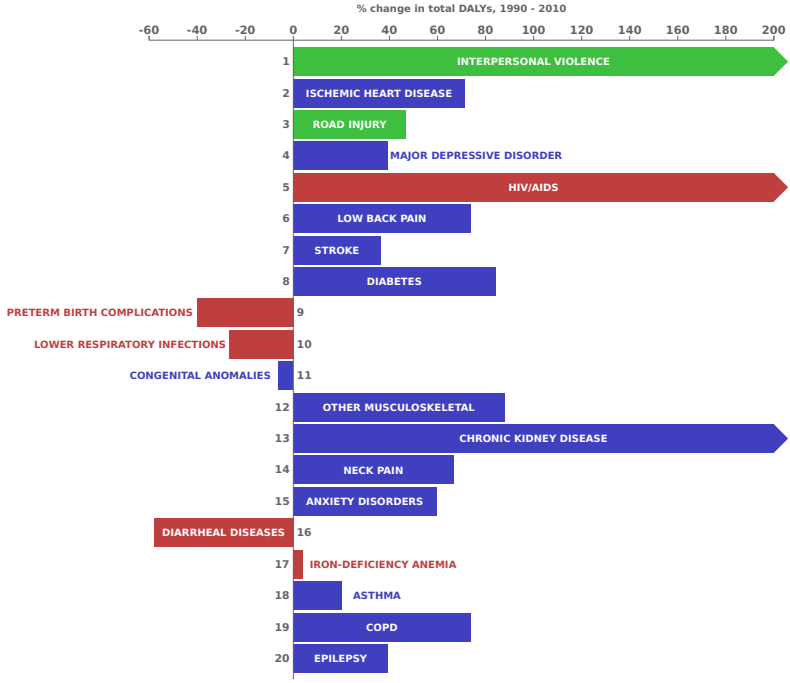
Shifts in leading causes of DALYs in Suriname, 1990-2010



Shifts in leading causes of DALYs in Uruguay, 1990-2010



Shifts in leading causes of DALYs in Venezuela, 1990-2010



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