THE GLOBAL BURDEN OF DISEASE: GENERATING EVIDENCE, GUIDING POLICY

SOUTH ASIA 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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IHME GBD

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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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The Global Burden of Disease Study 2010 (GBD 2010) was implemented as a collaboration between seven institutions: the Institute for Health Metrics and Evaluation (IHME) as the coordinating center, the University of Queensland School of Population Health, Harvard School of Public Health, the Johns Hopkins Bloomberg School of Public Health, the University of Tokyo, Imperial College London, and the World Health Organization. This summary draws on seven GBD 2010 papers published in *The Lancet* (2012 Dec 13; 380). GBD 2010 had 488 co-authors from 303 institutions in 50 countries.

IHME and the World Bank oversaw the production of this publication. In particular, we thank IHME's Board for their continued leadership. We are grateful to the report's writer, Nancy Fullman; to Christopher Murray, Michael MacIntyre, Theo Vos, Rafael Lozano, Rouselle Lavado, Rhonda Stewart, and William Heisel at IHME, Anne-Maryse Pierre-Louis of the Human Development Network at the World Bank, and Julie McLaughlin and team at the World Bank for content guidance; to Ryan Barber and Daniel Dicker for data analysis; to Brittany Wurtz and Summer Ohno for program coordination; to Patricia Kiyono for production oversight; to Katherine Leach-Kemon for writing support and production management; to Pamela Bruton for editing; to Rica Asuncion-Reed for editorial support; and to Miriam Alvarado, Ian Bolliger, Roy Burstein, Emily Carnahan, Greg Freedman, Nicole Johns, Katherine Lofgren, and Richard Luning for fact checking. This report would not have been possible without the ongoing contributions of Global Burden of Disease collaborators around the world.

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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 of the GBD approach 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 one 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 South Asia, dramatic progress has been made in reducing the loss of life from many types of communicable diseases and conditions of early childhood, especially in lower-middle-income countries like Bhutan. These diseases still account for the

most health loss in these countries, but their relative burdens are much lower today than 20 years ago. Child mortality rates have plummeted, and death rates among women have generally improved as well. Mortality rates among adult males are more variable, with some age groups showing a reverse pattern of heightened risk for death (e.g., men aged 35 to 39 in Pakistan). Risk factors like childhood underweight and vitamin deficiencies account for far less health loss in South Asia today than in 1990; reductions in these conditions have undoubtedly helped improve overall childhood survival throughout the region. Non-communicable diseases like ischemic heart disease and diabetes are on the rise, especially in some of the lower-middle- and upper-middle-income countries. In the Maldives, the only country in South Asia with a World Bank classification of upper-middle income, non-communicable conditions like ischemic heart disease and stroke now kill more people than maternal, nutritional, and newborn causes of death; these trends mirror those at the global level. The region's lower-middle-income countries show more heterogeneous health trends, with ischemic heart disease accounting for the most deaths in Sri Lanka, while newborn conditions like preterm birth complications still drive the most premature health loss in India. Nonetheless, relative to 1990 – or even just 10 years ago – nearly every country in South Asia has seen improvements in their health outcomes, especially with respect to some of the most lethal diseases of childhood.

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

MAIN FINDINGS FOR SOUTH ASIA

- The South Asia region has made overall progress in reducing mortality and prolonging life since 1970; however, some countries showed elevated rates of death within certain age groups and sex between 1990 and 2010 (e.g., heightened mortality rates among girls aged 10 to 14 in Sri Lanka).
- Over the last 20 years, most countries in the region have succeeded in decreasing premature death and disability from most communicable, newborn, nutritional, and maternal causes, with the exception of HIV/AIDS. In Afghanistan, however, many of these conditions have increased, such as preterm birth complications, meningitis, tuberculosis, and maternal disorders.
- Although their relative burdens have substantially declined, communicable, newborn, nutritional, and maternal causes remained the top drivers of health loss in most South Asian countries, such as in low-income Bangladesh and Nepal and even in lower-middle-income India and Pakistan.
- Between 1990 and 2010, disease burden from many non-communicable causes increased, especially ischemic heart disease, stroke, diabetes, musculoskeletal disorders (including low back pain and neck pain), and major depressive disorders. In Bangladesh and Pakistan, ischemic heart disease increased more than 100% between 1990 and 2010. Although diabetes was not always ranked

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, 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.

in the top five causes of healthy years lost across countries in South Asia, most countries have documented diabetes as their fastest-growing health burden in the last 20 years.

- Many South Asian countries have suffered from increasing levels of health loss as a result of self-harm, especially India and Pakistan. However, in Sri Lanka, premature death and disability from self-harm have declined in the last 20 years, even though it remained the second highest cause of mortality. Poisonings were the fourth highest cause of disease burden in Bhutan. As the lower-income countries in South Asia have become more developed, road injuries have taken a growing toll on human health. In Afghanistan, past and ongoing conflict has driven substantial health loss due to interpersonal violence and war.
- In South Asia, the leading causes of disability were similar to global trends. In 2010, however, chronic respiratory diseases accounted for a greater percentage of health loss in South Asia than globally; this trend was largely driven by India's disease profile and was not experienced by all South Asian countries.
- Dietary risks such as low consumption of fruit, nuts, and seeds and high sodium intake were leading risk factors for premature death and disability in South Asia. In most countries of the region, substantial progress has been made in reducing risks like childhood underweight, suboptimal breastfeeding, and vitamin deficiencies, such that their burdens have been at least halved in the last 20 years. Household air pollution, smoking, and high blood pressure were also top contributors to health loss in many South Asian countries. Among wealthier countries in South Asia, high fasting plasma glucose (high blood sugar) and high body mass index accounted for more health loss. In low-income countries, such as Afghanistan, childhood underweight was a risk factor that drove larger health burdens.

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 quantify 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 that 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 as "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: 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 those 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. Box 3 contains decision-makers' and policy influencers' reflections about the value of using GBD tools and results to inform policy discussions. GBD data visualization tools (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

Box 3: Views on the value of GBD for policymaking

"Today's risk factors will turn out to be tomorrow's events. Policy directions will now have to look at how increasing trends in the major risk factors of non-communicable diseases will have to be tackled even while risk factors related to childhood deaths will continue to receive attention." **Srinath Reddy**, *President of the Public Health Foundation of India*

"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*

"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*

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.

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).

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 GBD estimates to be viewed 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.

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 for the countries in the World Bank's regional definition of "South Asia." Figures reflect World Bank regional classifications. GBD, however, does not produce estimates for territories or countries with fewer than 50,000 people or for countries that have only recently come into existence.

RAPID HEALTH TRANSITIONS: GBD 2010 RESULTS

In most countries in South Asia, years of healthy life lost due to premature death and disability, or DALYs, from non-communicable diseases are increasing, while DALYs from communicable, newborn, nutritional, and maternal causes are decreasing. To help decision-makers establish health service priorities within countries with limited resources, in this section we will explore changes in disease burden around the globe, in South Asia, and in specific countries. In the next section, we will compare how well countries are performing in health relative to other countries in South Asia 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 from 1990 to 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 fell in rank during this period, while solid lines signal causes that rose in rank.

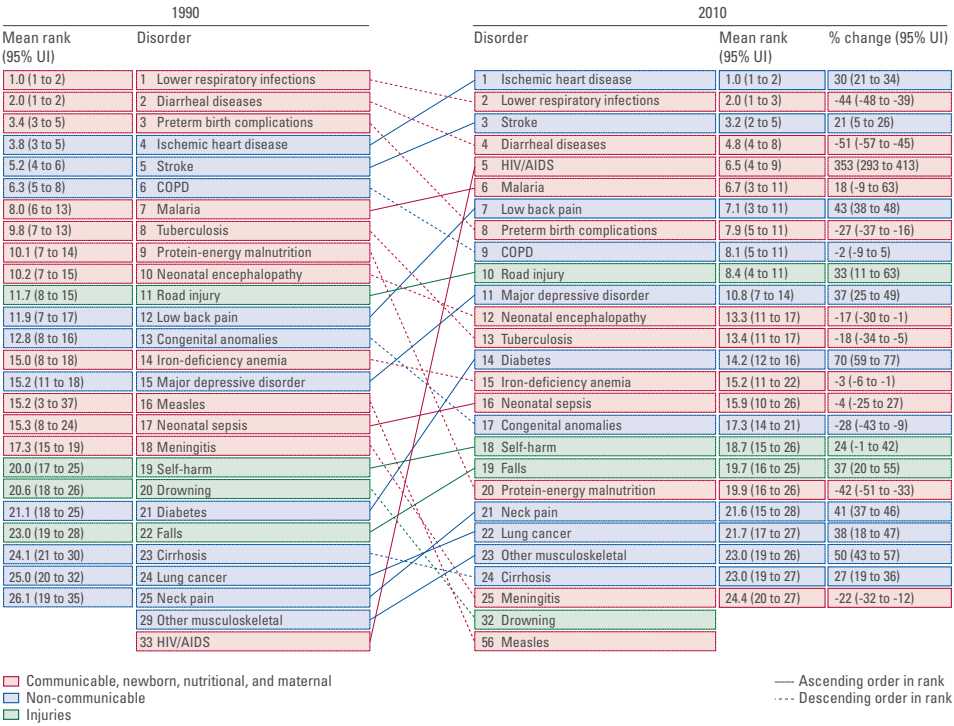
Causes associated with ill health and death in adults, such as ischemic heart disease, stroke, and low back pain, increased in rank between 1990 and 2010, while causes that primarily affect children, such as lower respiratory infections, diarrhea, preterm birth complications, and protein-energy malnutrition, 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 the leading causes of premature death and disability have changed over time in South Asia. Figures showing changes in the leading causes of DALYs by country can be found in the Annex of this report. The region shares three of the top five causes of health loss globally for 2010, with lower respiratory infections, diarrheal diseases, and ischemic heart disease ranking as the first, third, and fourth highest disease burdens, respectively. The disease burdens in the Maldives and Sri Lanka more closely resembled those of high-income countries, such that more non-communicable causes like ischemic heart disease, major depressive disorder, and stroke were among the leading five causes of premature death and disability. At the same time, each country had a fairly distinct leading disease

burden in 2010: for example, self-harm was the second-greatest health burden in Sri Lanka, and iron-deficiency anemia was the third-largest driver of health loss in the Maldives.

Most communicable, newborn, maternal, and nutritional causes of DALYs dropped in rank in South Asia, and most non-communicable causes rose in rank, both of which mirror global trends. At the same time, certain communicable diseases were much more prominent causes of premature death and disability globally than in South Asia, as well as vice versa. HIV/AIDS and malaria ranked as the fifth- and sixth-largest contributors, respectively, to disease burdens worldwide in 2010 but ranked as 17th and 45th, respectively, in South Asia. Globally, the relative malaria burden has increased since 1990 (from seventh to sixth), whereas health loss from

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

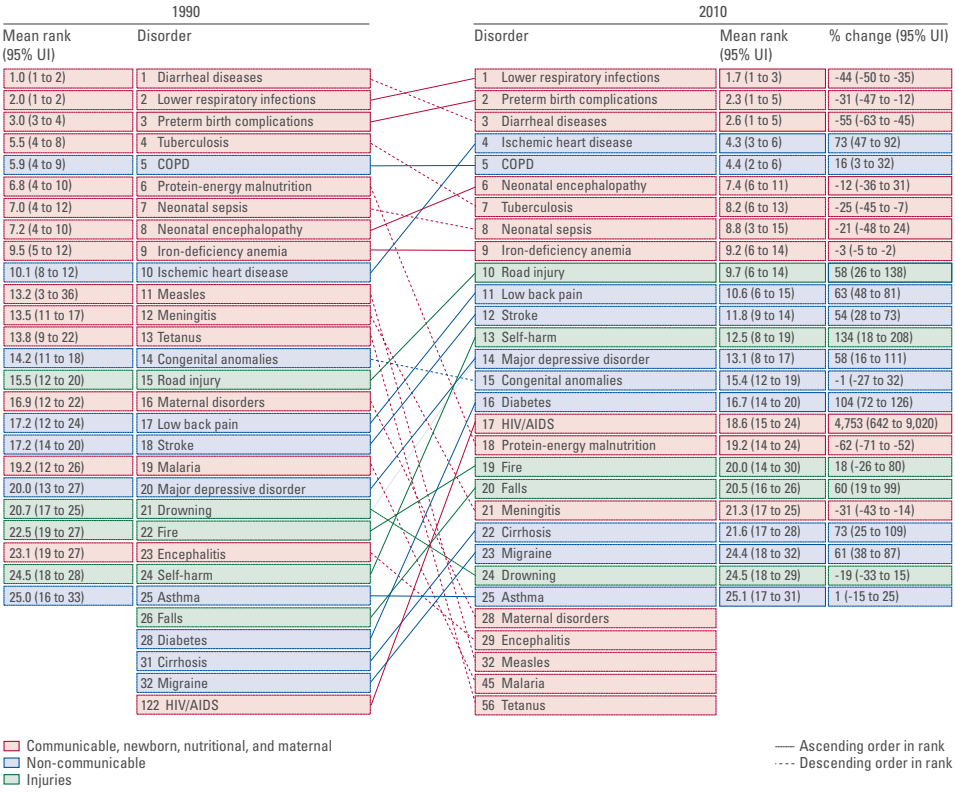


Note: Solid lines indicate a cause that has moved up in rank or stayed the same. Broken lines indicate a cause that has moved down in rank. The causes of DALYs are color coded, with blue for non-communicable diseases, green for injuries, and red for communicable, newborn, nutritional, and maternal causes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

malaria has dramatically plummeted in South Asia, ranking 19th in 1990 and dropping by 66% 20 years later. On the other hand, preterm birth complications ranked second in South Asia but ranked eighth globally in 2010. Increasing health loss from injuries between 1990 and 2010 was documented both globally and for South Asia, but disease burdens from road injury, self-harm, and falls rose much higher in South Asia than they did globally.

Overall, communicable, newborn, maternal, and nutritional health burdens declined similarly globally and in South Asia between 1990 and 2010. Globally, DALYs caused by diarrheal diseases, preterm birth complications, and lower respiratory infections fell by 51%, 27%, and 44%, respectively. For the same conditions in South Asia, declines of 55%, 31%, and 44% were recorded. Similarly, nearly all non-communicable

Figure 2: Disability-adjusted life year ranks, top 25 causes, and percentage change in South Asia, 1990-2010

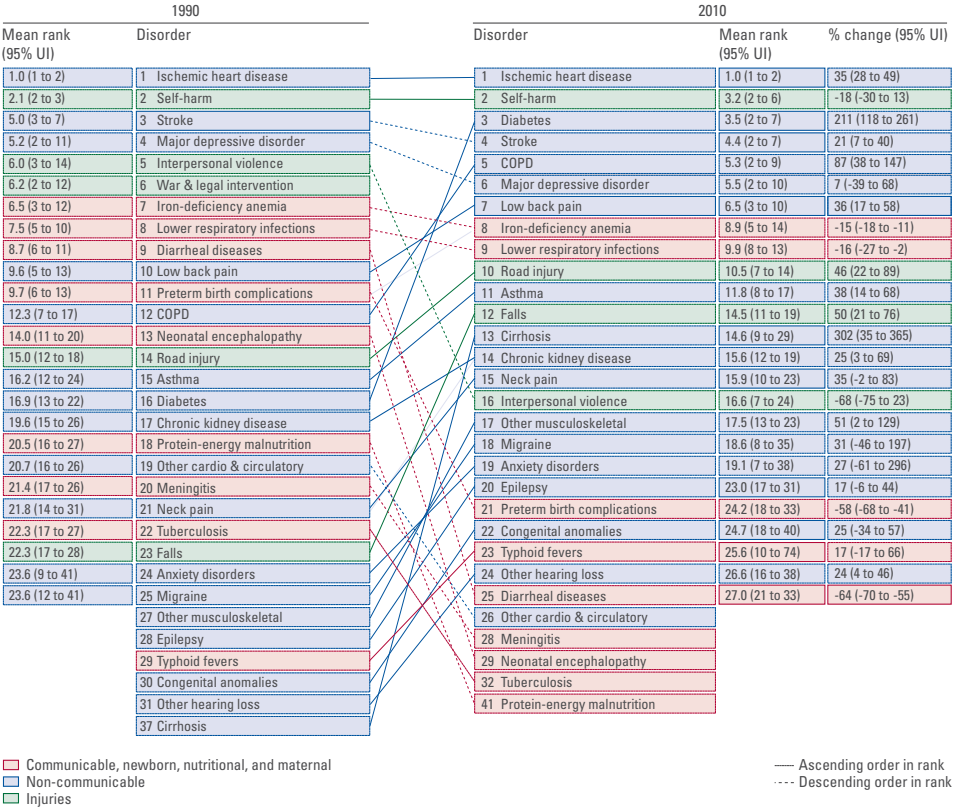


Note: Solid lines indicate a cause that has moved up in rank or stayed the same. Broken lines indicate a cause that has moved down in rank. The causes of DALYs are color coded, with blue for non-communicable diseases, green for injuries, and red for communicable, newborn, nutritional, and maternal causes.

diseases increased globally and in South Asia from 1990 to 2010. Between 1990 and 2010, ischemic heart disease increased by 73% and moved from 10th to fourth place in South Asia. While the global ranking for ischemic heart disease rose from fourth to first between 1990 and 2010, its relative burden increased at a much slower rate (30%) than it did in South Asia. Diabetes rose 70% worldwide, from 21st in 1990 to 14th in 2010. In South Asia, however, the health loss due to diabetes escalated much faster, from 28th in 1990 to 16th in 2010, representing a 104% increase over the 20-year period.

Figure 3 shows changes in the leading causes of premature death and disability in Sri Lanka, which differs from both global and regional trends in many ways. Unlike DALY trends found worldwide and in South Asia, non-communicable diseases have

Figure 3: Disability-adjusted life year ranks, top 25 causes, and percentage change in Sri Lanka, 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. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdarrowdiagram.

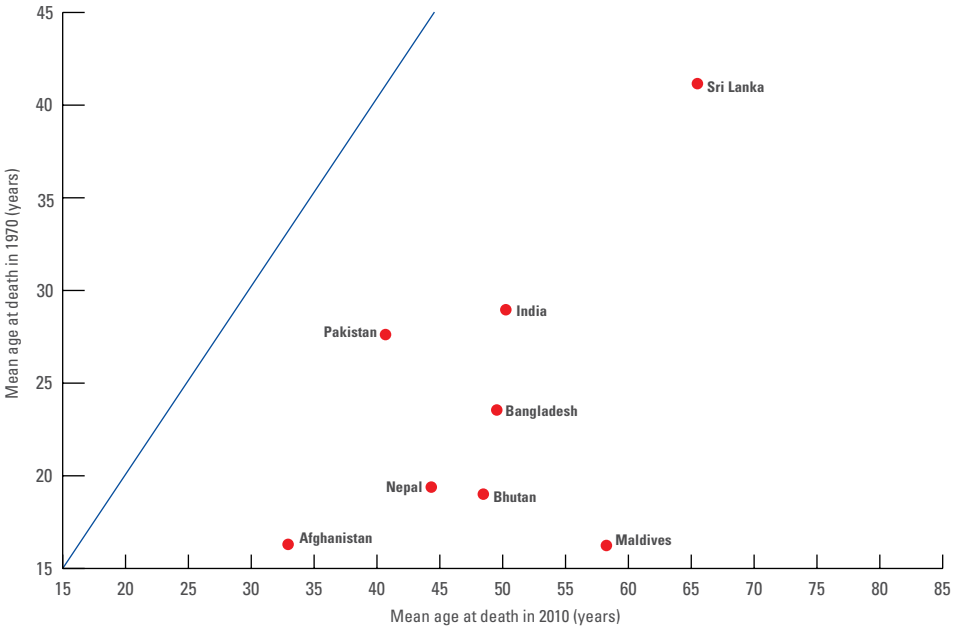
been dominant causes of death in Sri Lanka over the last 20 years, which suggests that Sri Lanka is in a more advanced phase of epidemiologic transition than most of the South Asia region. Epidemiological transition is defined by a progression towards non-communicable diseases replacing communicable, newborn, maternal, and nutritional causes as the leading drivers of disease burden. The relative burdens of these non-communicable diseases have increased substantially from 1990 to 2010 (e.g., a 35% increase in DALYs from ischemic heart disease, the leading cause of health loss in both 1990 and 2010). Like the rest of the South Asia region, Sri Lanka saw substantial reductions in health loss from diarrheal diseases and preterm birth complications between 1990 and 2010 ranking ninth and 11th, respectively, in 1990 and 25th and 21st, respectively, in 2010. In contrast, diarrheal diseases and preterm birth complications both have steadfastly remained among the top three causes in South Asia over the last two decades. The health burdens associated with interpersonal violence and war in Sri Lanka dramatically dropped from 1990 to 2010, reflecting the end of a 26-year-long conflict that began in 1983.

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 Asia, Latin America, 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.

South Asia made much progress in increasing its average age at death between 1970 and 2010 (Figure 4), achieving an average gain of about 25 years in each country. However, substantial variation existed within the region: the Maldives showed the greatest gain (about 42 years), and the more conflict-ravaged countries of Afghanistan and Pakistan showed the least at about 17 and 13 years, respectively. The rest of the countries in South Asia posted gains between 21 years (India) and just under 30 years (Bhutan) between 1970 and 2010.

Figure 4: Average age of death for countries in South Asia, 1970 compared with 2010

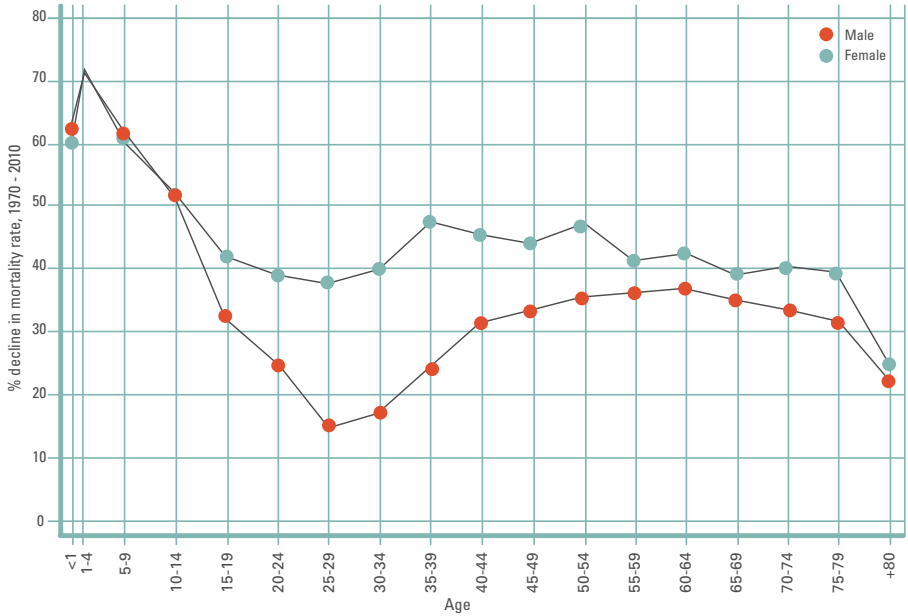


Note: Countries falling on the right side of the 45-degree-angle line had a greater average age of death in 2010 than in 1970.

Yet another way to understand changes in global demographic trends is to explore reductions in mortality rates by sex and age group. Figure 5 shows how global death rates 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, as well as alcohol and tobacco use, among men.

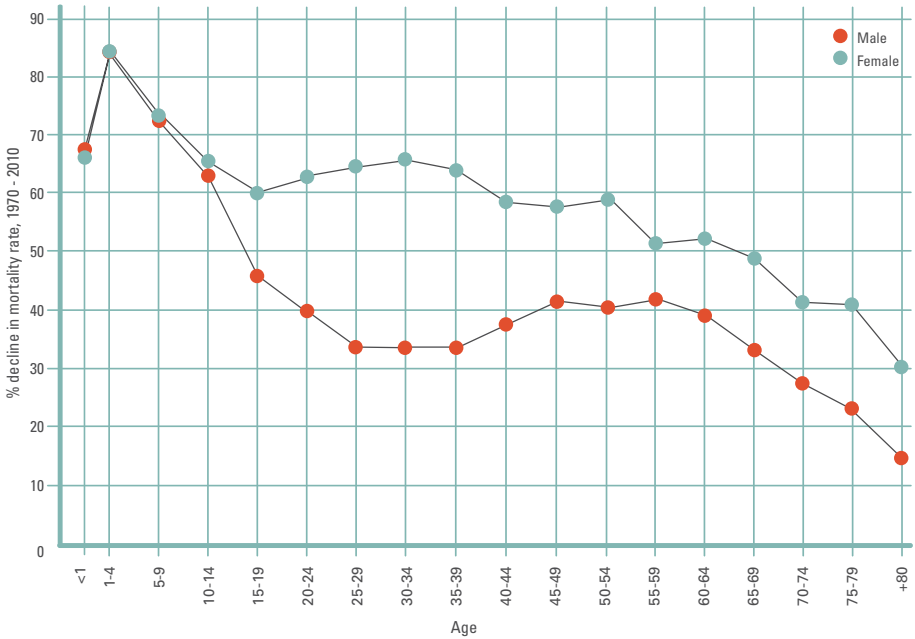
Figure 6 showcases the same age-specific mortality trends in South Asia from 1970 to 2010. Similar to global trends, the largest improvements in mortality rates was seen among both males and females between the ages of 0 and 9, with death rates declining over 60% since 1970. The most pronounced decreases were among children aged 1 to 4 years old, posting a decline of over 80% since 1970. Akin to the gender divide seen at the global level, beyond the age of 15, female death rates improved far more than male death rates in South Asia. The greatest absolute difference was seen between the ages of 25 to 39.

Figure 5: 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 6: Decline in age-specific mortality rate in South Asia, 1970-2010



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

LEADING CAUSES OF DEATH ARE SHIFTING TO NON-COMMUNICABLE DISEASES

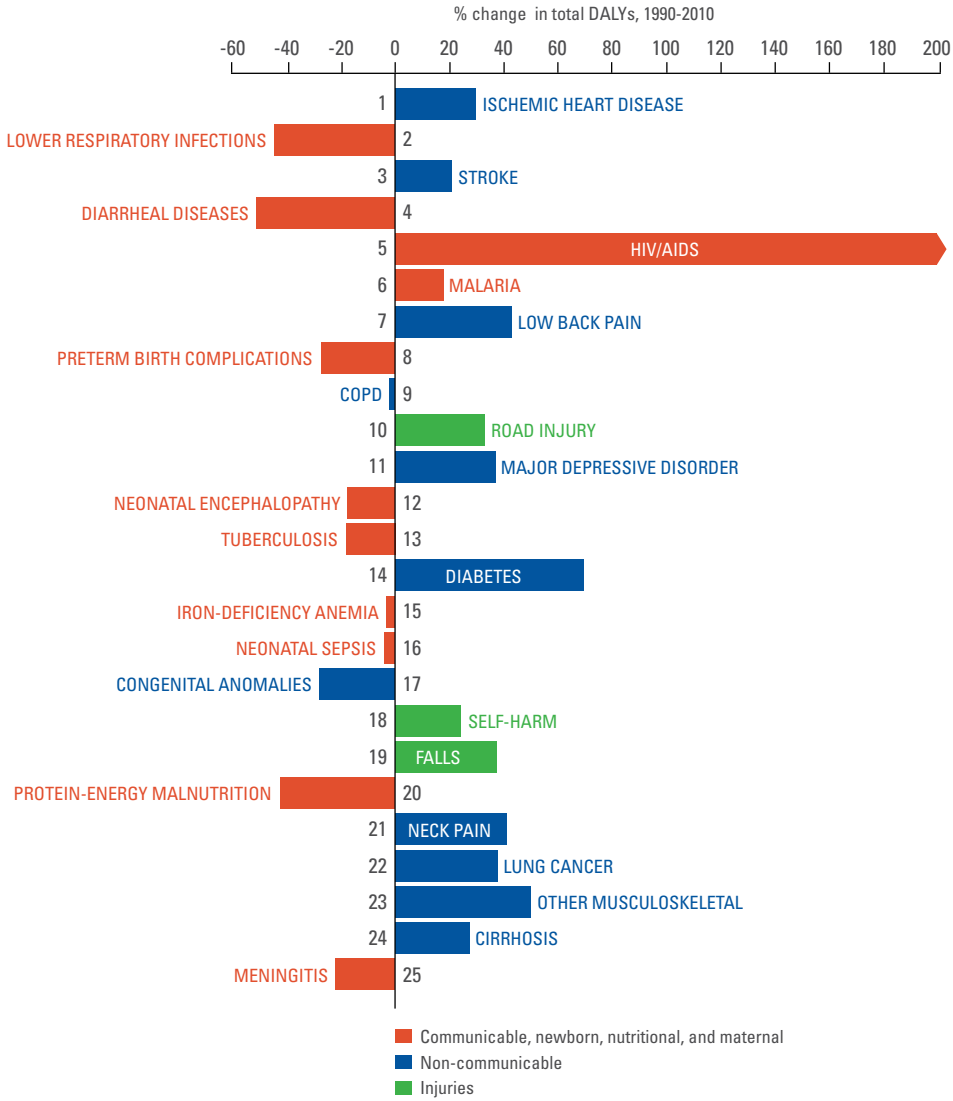
In part because many people are living longer lives and the population is growing older, the leading causes of death have changed. Worldwide, the number of people dying from non-communicable diseases, such as ischemic heart disease and diabetes, has grown 30% since 1990. To a lesser extent, overall population 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 7 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 7 shows that among non-communicable diseases, diabetes and low back pain and other musculoskeletal disorders increased the most between 1990 and 2010.

Changes in the 25 leading causes of DALYs in South Asia, from 1990 to 2010, are depicted in Figure 8. In the region, substantial progress has been made for many communicable and childhood conditions, as highlighted by the drastic declines in protein-energy malnutrition (62%), diarrhea (55%), and lower respiratory infections (44%). Nonetheless, HIV/AIDS skyrocketed by 4,753%, which demonstrates that improvements in communicable diseases are not always uniform. After the growing relative HIV/AIDS burden in South Asia, self-harm, diabetes, cirrhosis, and ischemic heart disease were the next four drivers of increased health loss in 2010, compared with 1990 (with increases of 134%, 104%, 73%, and 73%, respectively).

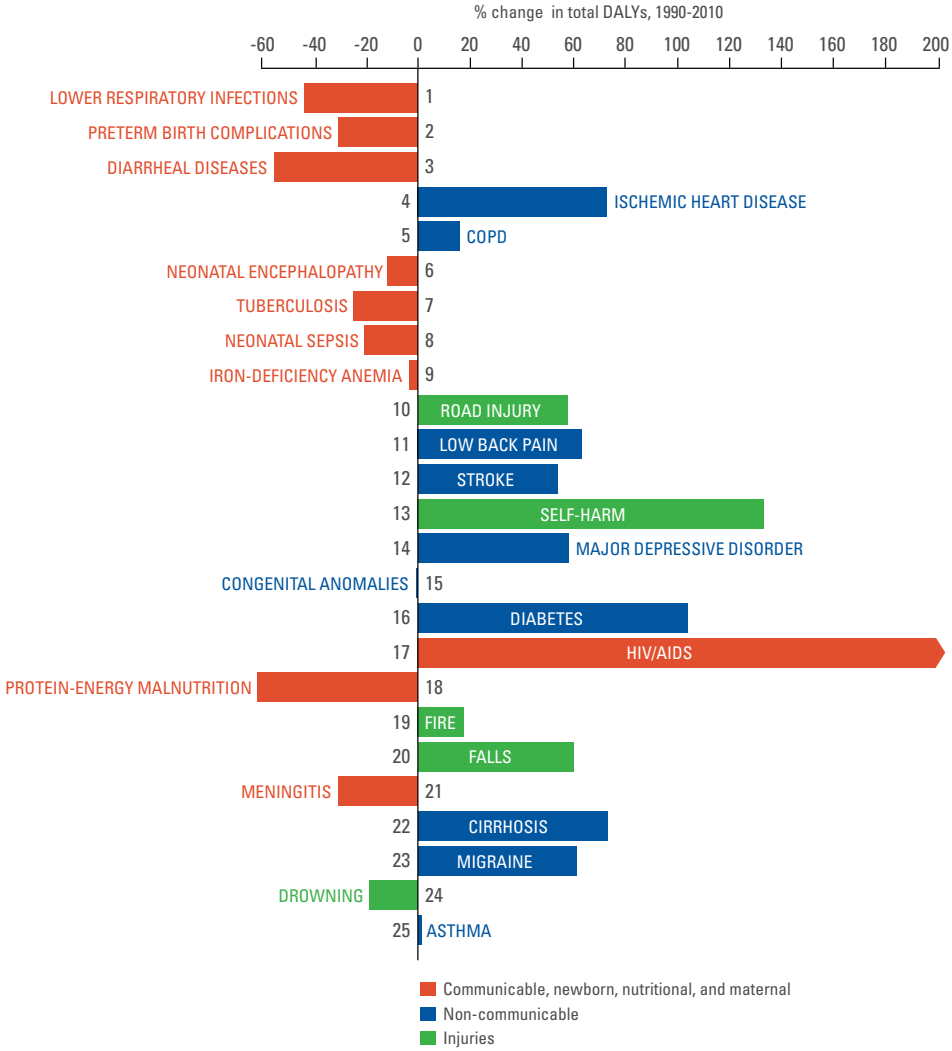
In many countries around the world, non-communicable diseases account for the majority of DALYs. Figure 9 shows the percentage of healthy years lost from this disease group by country in 2010. In most countries outside sub-Saharan Africa, non-communicable diseases caused 50% or more of all DALYs. In Australia, Japan, and richer countries in Western Europe and North America, the percentage was greater than 80%. In South Asia, Afghanistan documented the lowest DALY burden from non-communicable diseases (38%). The Maldives and Sri Lanka posted much higher relative burdens from non-communicable diseases: 70% and 69% of all DALYs, respectively. India, a country where 45% of DALYs are caused by non-communicable diseases, epitomizes the definition of "double burden of disease," where communicable causes of premature death and disability co-exist alongside growing burdens from non-communicable causes.

Figure 7: Global shifts in leading causes of DALYs, 1990-2010



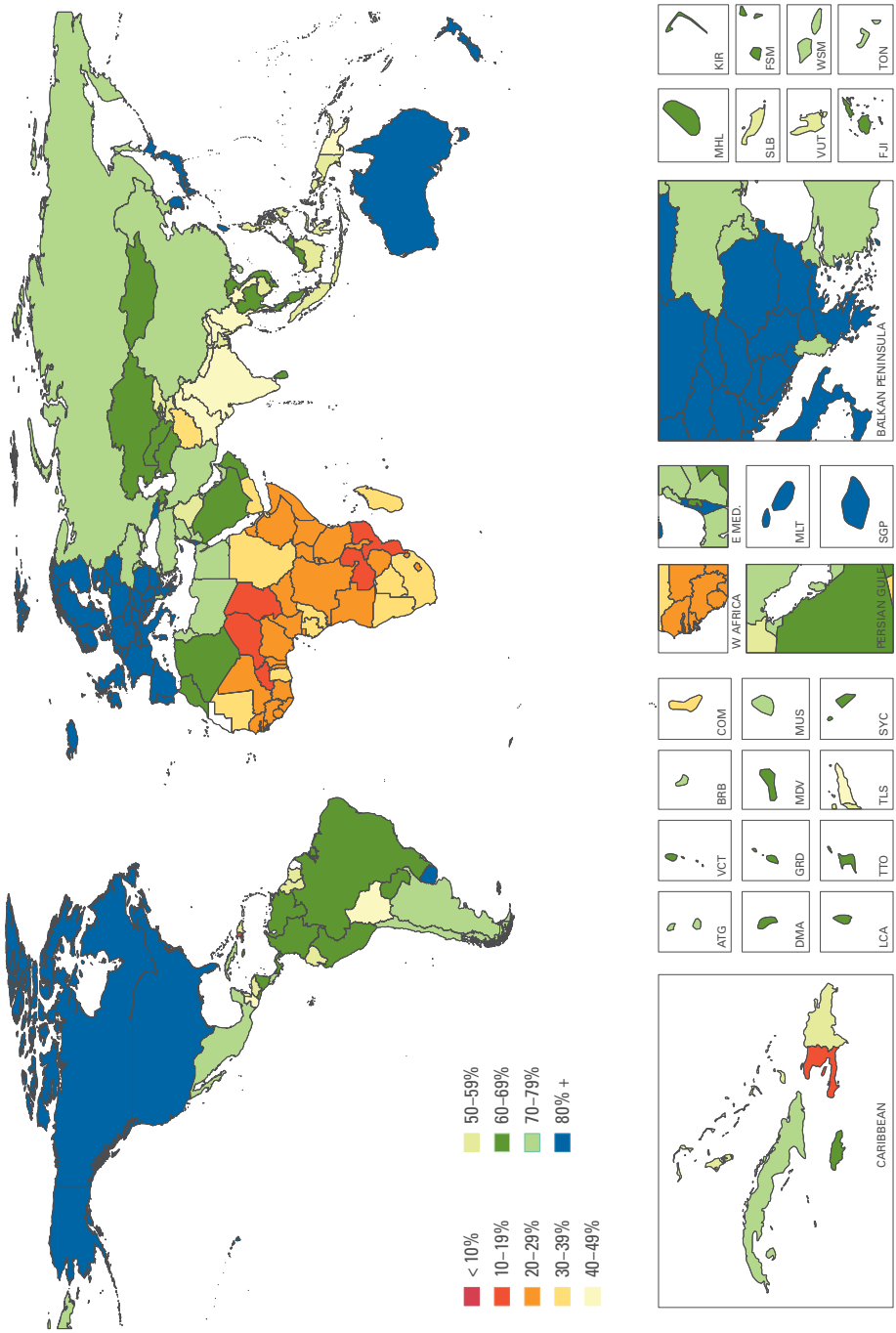
Note: The leading 25 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows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

Figure 8: Shifts in leading causes of DALYs in South Asia, 1990-2010



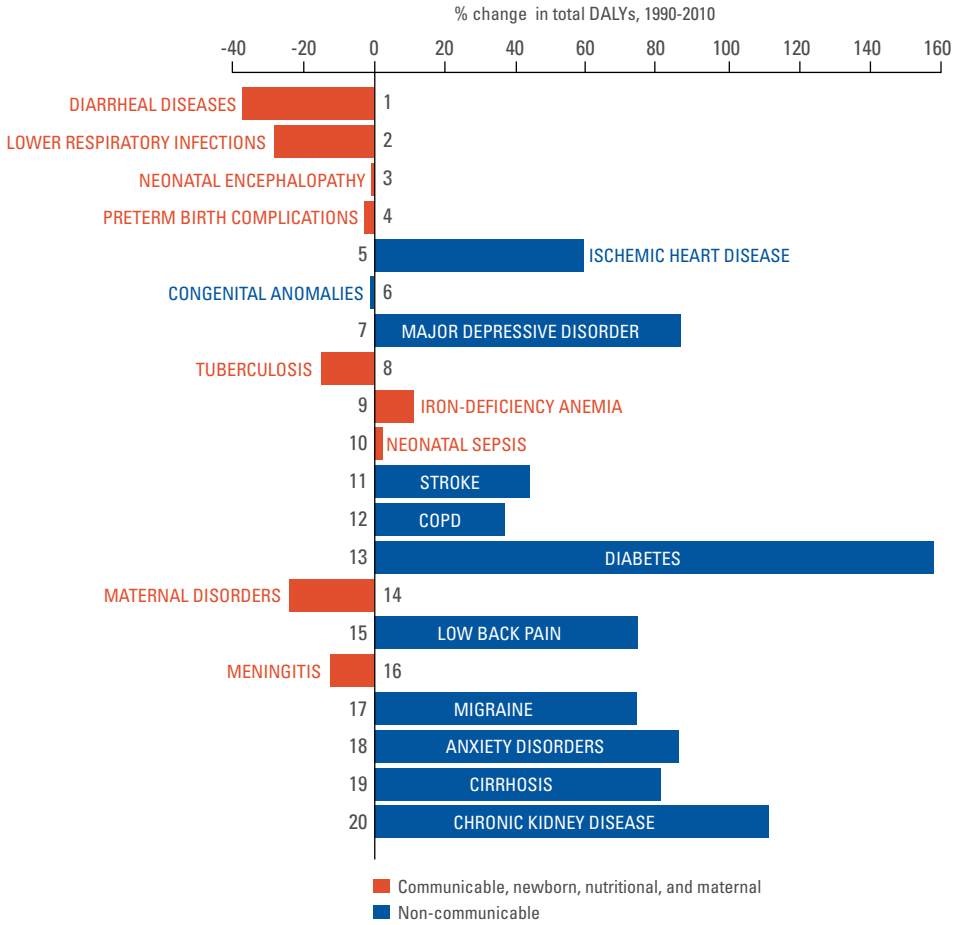
Note: The leading 25 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows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

Figure 9: Percent of global DALYs due to non-communicable diseases, 2010



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 10 displays the changes in the top 20 causes of DALYs in Pakistani females between 1990 and 2010. The causes are organized by ranking from top to bottom. Most non-communicable diseases rose over time, while the majority of communicable, newborn, nutritional, and maternal conditions fell during this period. Among communicable, nutritional, newborn, and maternal conditions, diarrheal diseases and lower respiratory infections experienced the most dramatic declines, falling by 37% and 28%, respectively. Among the top 20 causes in 2010, diabetes increased the most (159%), followed by chronic kidney disease (112%) and depression (87%).

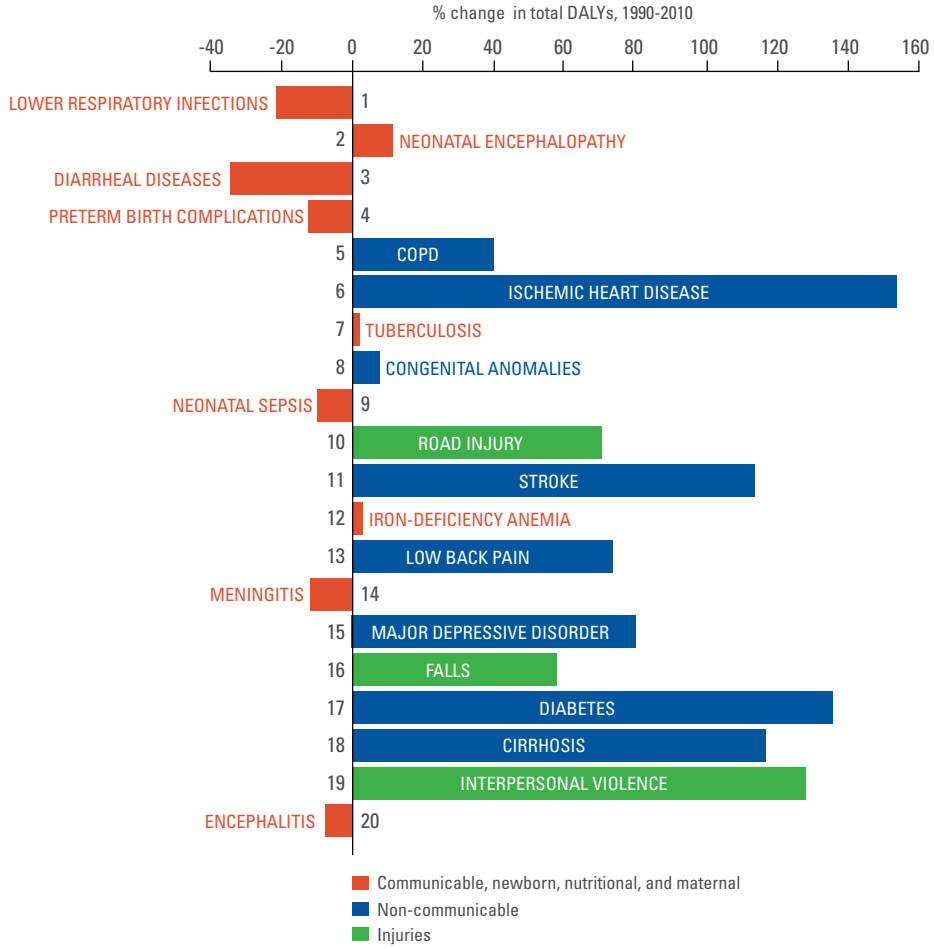
Figure 10: Shifts in leading causes of DALYs for females, Pakistan, 1990-2010



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.

Figure 11 shows declines in DALYs among Pakistani males from communicable, nutritional, and newborn conditions coupled with increases in non-communicable diseases between 1990 and 2010. The greatest improvements were seen for diarrheal diseases and lower respiratory infections, with declines of 35% and 22%, respectively, from 1990 to 2010. Out of all the non-communicable diseases shown in this figure, ischemic heart disease increased the most over the period (155%). Diabetes increased by 136%, cirrhosis by 118%, and stroke by 114%. In addition to displaying the rising prominence of non-communicable diseases, this figure shows that injuries are important causes of healthy life lost in males in Pakistan. DALYs caused by road injuries increased by 71%, falls by 58%, and interpersonal violence by 129%.

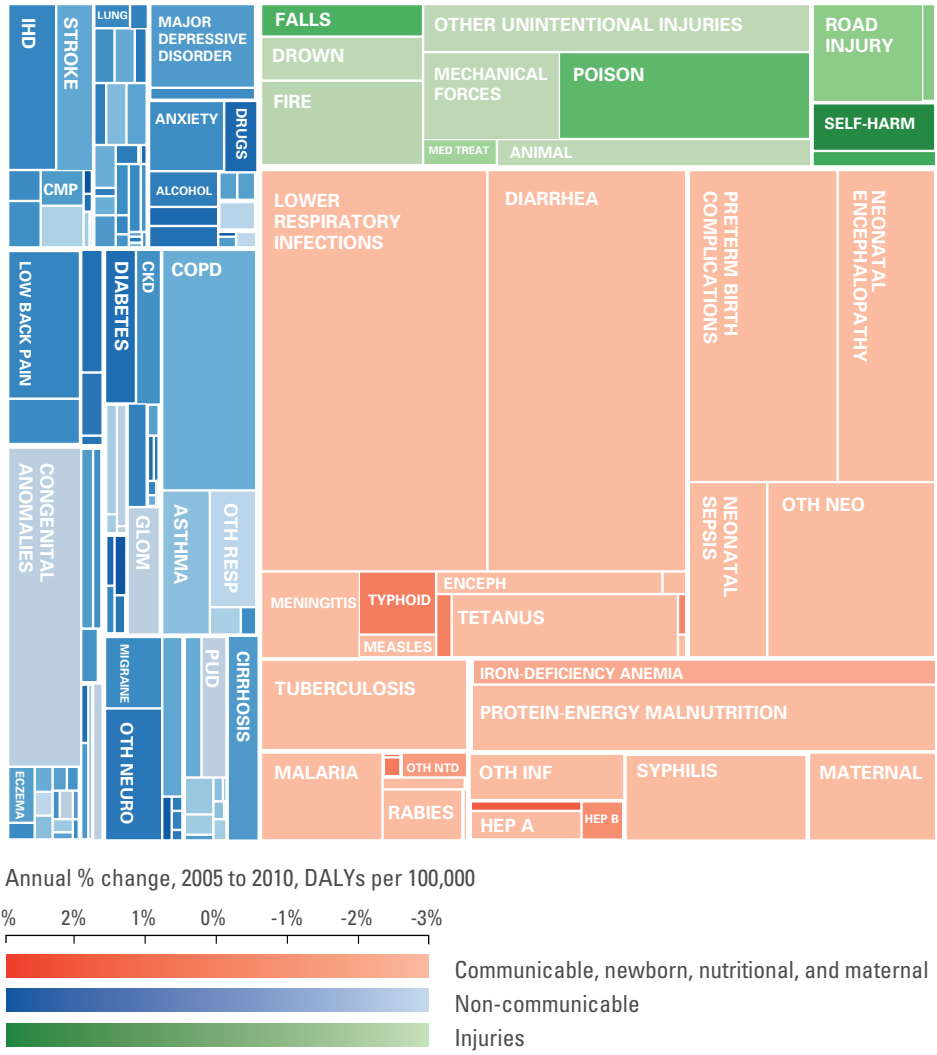
Figure 11: Shifts in leading causes of DALYs for males, Pakistan, 1990-2010



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.

Another visualization tool, GBD Compare, displays proportional changes in disease patterns over time using a treemap diagram, which is essentially a square pie chart. Causes of DALYs are shown in boxes. The size of each box represents the percentage of total DALYs due to a specific cause. Figures 12a and 12b show how DALYs changed in Bhutan between 1990 and 2010. In 1990, non-communicable diseases accounted for 27% of DALYs in both sexes, while communicable, nutritional, maternal, and newborn causes accounted for 58%. By 2010, these two groups of causes

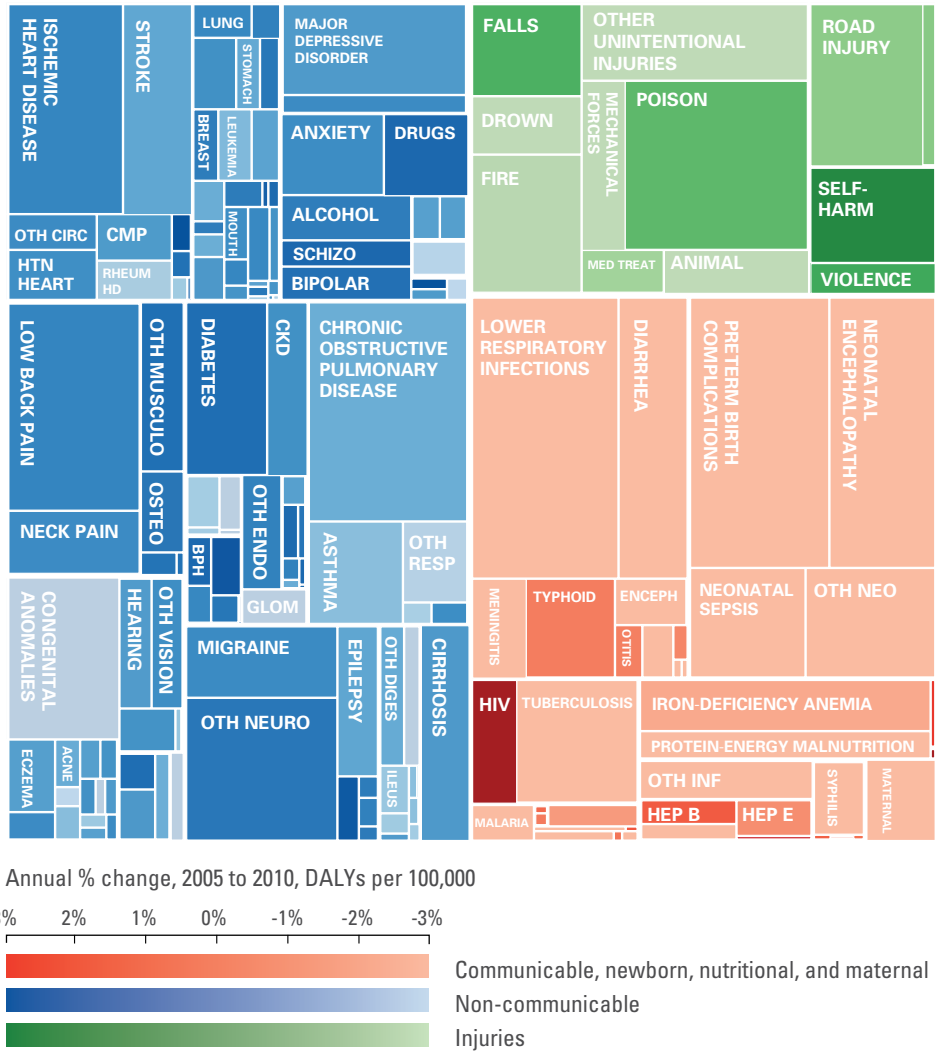
Figure 12a: Causes of DALYs, both sexes, all ages, Bhutan, 1990



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.

represented 50% and 33% of total disease burden, respectively. This near reversal of disease burden types exemplifies the progress made against communicable conditions in Bhutan over the last two decades, but it also highlights the upcoming challenges posed by more chronic diseases. Premature death and disability from many communicable, nutritional, maternal, and newborn causes decreased during this period. The greatest declines were documented for measles (100%), tetanus (93%), and whooping cough (92%). DALYs from many non-communicable causes

Figure 12b: Causes of DALYs, both sexes, all ages, Bhutan, 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.

rose considerably from 1990 to 2010. Large escalations occurred in causes of burden such as ischemic heart disease (76%), diabetes (74%), low back pain (50%), and neck pain (50%).

In 2010, chronic obstructive pulmonary disease (COPD), a term used to describe emphysema and other chronic respiratory diseases, caused nearly 11,300 DALYs, the largest number from any non-communicable cause in Bhutan. In addition to non-communicable disease burden, health loss from injuries such as self-harm increased by 22%, while DALYs from poisonings declined by 13%.

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. Simply living longer does not mean that people are healthier. 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.

Healthy years lost, or DALYs, 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.

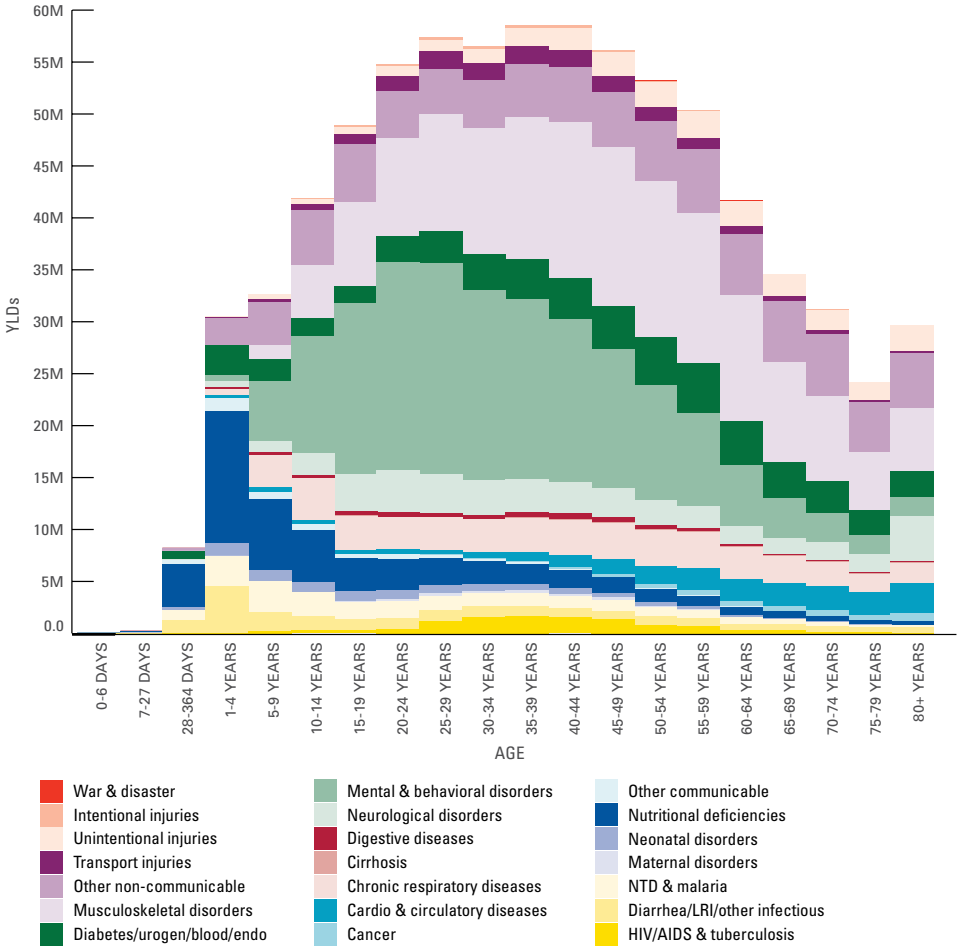
Figure 13 tells a more detailed story about the different conditions that cause disability globally. It is important to keep in mind that these estimates reflect both how many individuals suffer from a particular condition and the severity of that condition. Mental and behavioral disorders, such as depression, anxiety, and drug use, were the primary drivers of disability worldwide and caused over 40 million YLDs in 20- to 29-year-olds. Musculoskeletal conditions, which include low back pain and neck pain, accounted for the next-largest number of YLDs. People aged 45 to 54 were most impacted by these conditions, as musculoskeletal disorders caused over 30 million YLDs in this age group.

Figure 14 also shows trends in disability by age group in 2010, but for the South Asia region. Similar to what is seen worldwide, the predominant sources of disability between the ages of 0 to 9 years were nutritional deficiencies, and between the ages of 10 and 44 years, mental and behavioral disorders predominated. Beyond the

age of 45, musculoskeletal disorders and other non-communicable diseases (largely sense organ diseases) became the largest drivers of disability in South Asia.

Another way to view the world's health challenges is by comparing how different conditions rank. Figure 15 ranks the leading causes of disability globally and in each of the six World Bank regions in 2010, using color coding and numbering to indicate how high a condition ranks in a region. Low back pain caused the most disability in East Asia and Pacific, Europe and Central Asia, and in the Middle East and North Africa and ranks second in South Asia and Latin America and the Caribbean. This

Figure 13: Global disability patterns by broad cause group and age, 2010

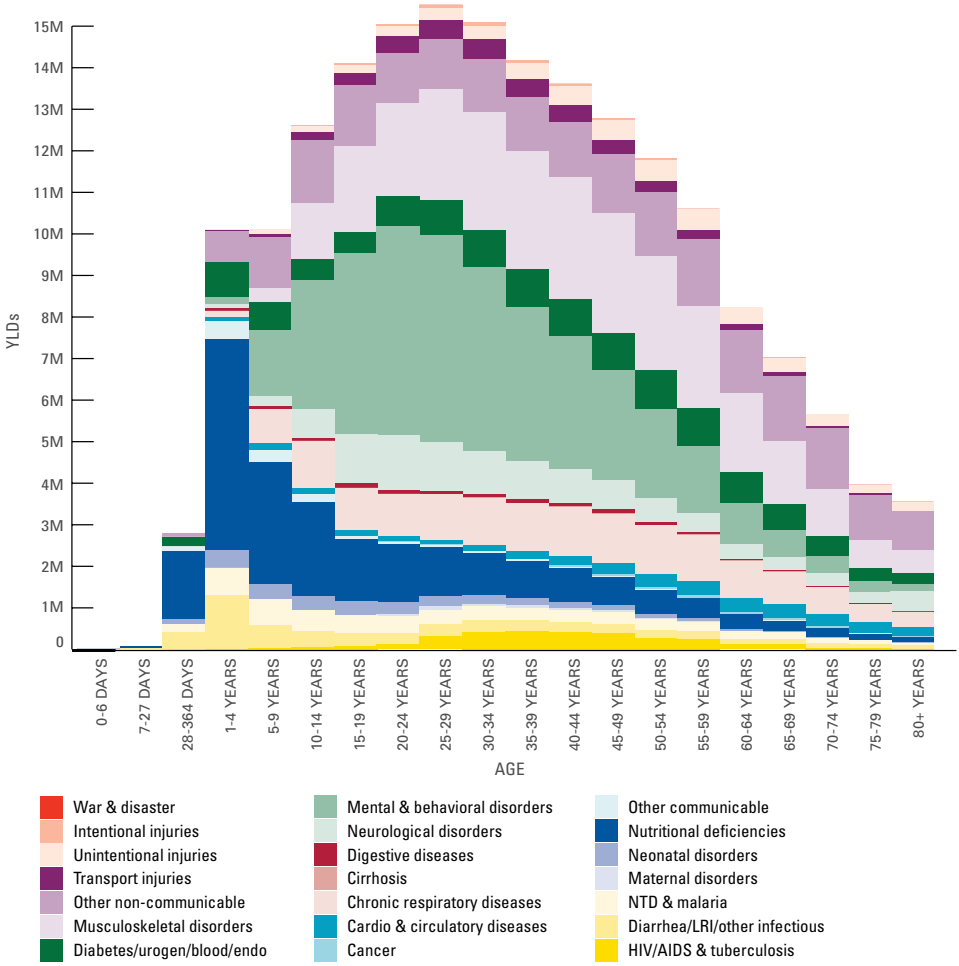


Note: The size of the colored portion in each bar represents the number of YLDs attributable to each cause for a given age group. The height of each bar shows total YLDs for a given age group in 2010. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain.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

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 ranked in the top 10 causes of disability in most regions. Another musculoskeletal disorder, osteoarthritis, ranked among the top 20 causes of disability in every region.

Depression was a major cause of disability across regions and was 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. Other types of mental disorder caused

Figure 14: Disability patterns by broad cause group and age in South Asia, 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.

considerable disability around the world. Anxiety was one of the top 10 causes of disability across all regions, and bipolar disorder appeared among the top 20 causes of disability in all regions.

While mental and musculoskeletal disorders ranked high among causes of disability across regions, Figure 15 also reveals substantial regional variation among other causes. Iron-deficiency anemia was the leading cause of disability in sub-Saharan Africa and South Asia but was 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 15: Rankings of leading causes of disability by region, 2010

	GLOBAL	EAST ASIA & PACIFIC	EUROPE & CENTRAL ASIA	LATIN AMERICA & CARIBBEAN	MIDDLE EAST & NORTH AFRICA	SOUTH ASIA	SUB-SAHARAN AFRICA
LOW BACK PAIN	1	1	1	2	1	2	3
MAJOR DEPRESSIVE DISORDER	2	2	2	1	2	3	2
IRON-DEFICIENCY ANEMIA	3	6	5	5	3	1	1
NECK PAIN	4	3	3	3	6	7	6
COPD	5	5	11	13	8	4	4
OTHER MUSCULOSKELETAL	6	4	4	6	7	8	11
ANXIETY DISORDERS	7	10	7	4	4	6	5
MIGRAINE	8	11	8	7	12	5	13
DIABETES	9	7	6	10	5	10	23
FALLS	10	9	9	16	11	12	25
OSTEOARTHRITIS	11	8	10	11	9	19	18
DRUG USE DISORDERS	12	17	16	9	10	9	17
OTHER HEARING LOSS	13	12	13	15	16	11	12
ASTHMA	14	23	21	8	13	14	10
ALCOHOL USE DISORDERS	15	13	12	12	37	15	34
ROAD INJURY	16	16	14	21	14	13	22
BIPOLAR DISORDER	17	15	17	17	15	16	20
SCHIZOPHRENIA	18	14	18	18	18	22	29
DYSTHYMIA	19	18	19	19	19	20	26
EPILEPSY	20	20	22	14	20	26	14
ISCHEMIC HEART DISEASE	21	19	15	24	23	31	40
ECZEMA	22	22	23	20	21	21	21
DIARRHEAL DISEASES	23	25	28	22	17	23	15
ALZHEIMER'S DISEASE	24	34	20	26	39	49	62
TUBERCULOSIS	25	21	30	42	22	17	24

1-10 | 11-20 | 21-30 | 31-50 | 51-90

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

COPD was among the top five causes of disability in East Asia and Pacific, South Asia, and sub-Saharan Africa and was the eighth leading cause of disability in the Middle East and North Africa. COPD ranked lower in Europe and Central Asia (11th) and Latin America and the Caribbean (13th).

The leading causes of disability in South Asia during this period were similar to the leading causes globally. Nine of the top 10 causes globally appeared in the top 10 causes in South Asia (albeit with different relative burden ranks). Drug use disorders ranked ninth among the top 10 causes of disability in South Asia, while these disorders ranked 12th globally. Migraine ranked higher across South Asian countries (fifth) than globally (eighth). Greater heterogeneity is revealed when individual countries within the South Asia region are examined. In Bangladesh, osteoarthritis was the 10th highest contributor to health loss, whereas the condition ranked lower both globally (11th) and within the South Asia region (19th). Unlike any of the other countries in its region, Afghanistan posted tuberculosis as its fifth highest cause of disability, whereas this disease ranked much lower globally (25th) and in other countries in the region. In Bhutan, tuberculosis was the 10th leading cause of disability, the 12th in Nepal, 16th in Pakistan, 19th in India, 20th in Bangladesh, 31st in the Maldives, and 36th in Sri Lanka. As the largest country in South Asia, India largely drives regional trends; however, when the country's top 25 causes of disability are compared with those worldwide, lymphatic filariasis was on India's list (25th) but failed to make the global top 50 (53rd) in 2010. Country-level disability rankings can be viewed on IHME's website: http://ihmeuw.org/gbdheatmap.

Using GBD tools to identify leading causes of disability 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

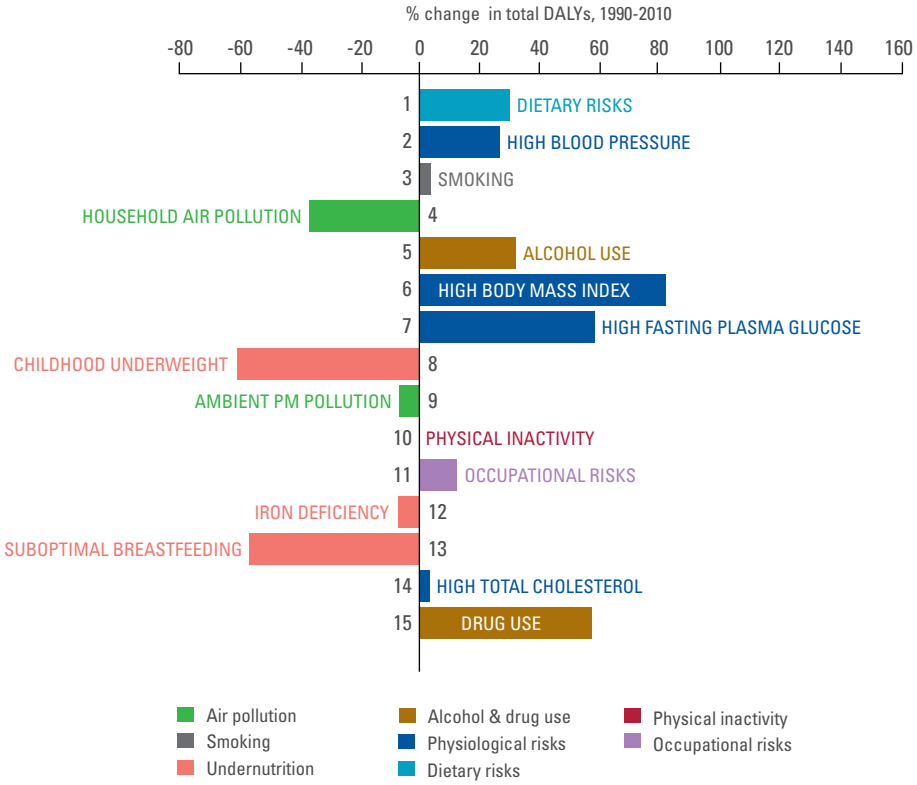
Data on potentially modifiable causes of health loss, or risk factors, can help policymakers and donors prioritize prevention strategies to achieve maximum health gains. GBD tools estimate the number of deaths, premature deaths, YLDs, and DALYs attributable to 67 risk factors worldwide. This study benefited from the availability of new data, such as 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 16 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 it 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 DALYs 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 ranked 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 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 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, GBD 2010's findings indicate that these messages should emphasize a broader range of dietary components.

Figure 16: 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 increased since 1990. Bars on the left show the percent by which DALYs attributable to different risk factors decreased. Attributable DALYs were not quantified for physical inactivity for 1990.

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 with data on the negative health impacts of tobacco 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 factor for non-communicable diseases, tobacco smoking, increased slightly, by 3%, between 1990 and 2010. Smoking increases the risk of chronic respiratory diseases, cardiovascular and circulatory diseases, and cancer. DALYs attributable to another substance, alcohol use 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 increases the risk of injuries.

High body mass index (BMI) was another major contributor to DALYs in 2010 and was the sixth leading risk factor. High BMI is typically used as an indicator of overweight and obesity. It increased by a dramatic 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.

Based on trends in South Asia, Figure 17 shows changes in the 15 leading regional risk factors for DALYs between 1990 and 2010. Akin to worldwide trends, substantial improvements in childhood underweight, suboptimal breastfeeding, and iron deficiency were documented in South Asia from 1990 to 2010. As risk factors for DALYs, high fasting plasma glucose and high BMI escalated much faster in South Asia than globally, increasing by more than 100% each.

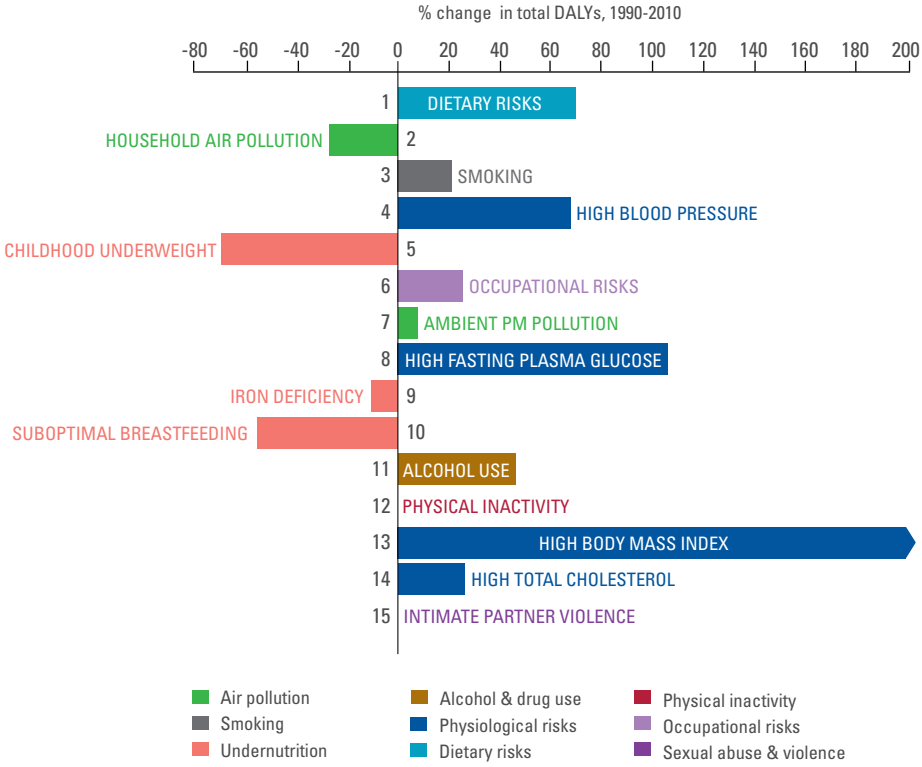
Global and regional rankings of risk factors mask important differences across countries. Figure 18 shows the leading risk factors for DALYs in the countries in the South Asia region in 2010.

Dietary risks ranked as the leading risk factor in four countries (Bhutan, India, the Maldives, and Sri Lanka) and was the third-largest risk factor in the remaining countries (Afghanistan, Bangladesh, Nepal, and Pakistan). Smoking was the third-largest risk factor contributing to DALYs regionally and was among the top three risk factors for Bangladesh, India, and Nepal. Household air pollution was ranked among the top three risk factors for all countries except the Maldives, which is the only country in the South Asia region with high BMI as a top-five risk factor. As seen in Figure 18, the Maldives featured a composition of risk factors that contributed to the country's correspondingly higher disease burdens from non-communicable diseases, mirroring global trends. The lower-income countries in South Asia, like Nepal

and Pakistan, reported more ill health from household air pollution and childhood underweight; these trends are more akin to risk factor patterns found in sub-Saharan Africa than in the rest of South Asia.

In addition to allowing users to explore how different risk factors rank across countries, decision-makers can use GBD visualization tools to understand how many DALYs could potentially be averted by addressing different risk factors. Figure 19 shows the number of DALYs attributable to household air pollution that contributed to different diseases in India. The percentage of DALYs that could be averted by reducing this risk factor is shown in dark shading.

Figure 17: Shifts in rankings of DALYs for top 15 risk factors in South Asia, 1990-2010



Note: The top 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 increased since 1990. Bars on the left show the percent by which DALYs attributable to different risk factors decreased. Attributable DALYs were not quantified for physical inactivity and intimate partner violence for 1990.

Household air pollution results from burning solid fuels. Figure 19 depicts how reducing this exposure is likely to substantially reduce DALYs from ischemic heart disease, lower respiratory infections, and COPD, as indicated by the portions of these causes that are shaded in dark blue or dark red. Reduction of household air pollution could also reduce DALYs from cataracts and stroke in India.

Figure 20 shows how, in Nepal, many DALYs could be averted by reducing occupational risks, which include toxins (e.g., carcinogens, asthmagens, particulate matter), noise, and physical injury associated with occupation-based exposures.

In Nepal, over 50% of low back pain was attributable to occupational risks, as highlighted by the dark-blue portion of the box. Of the non-communicable conditions associated with occupational risk in Nepal, hearing loss, COPD, asthma, and lung

Figure 18: Rankings of DALYs attributable to leading risk factors, South Asia, 2010

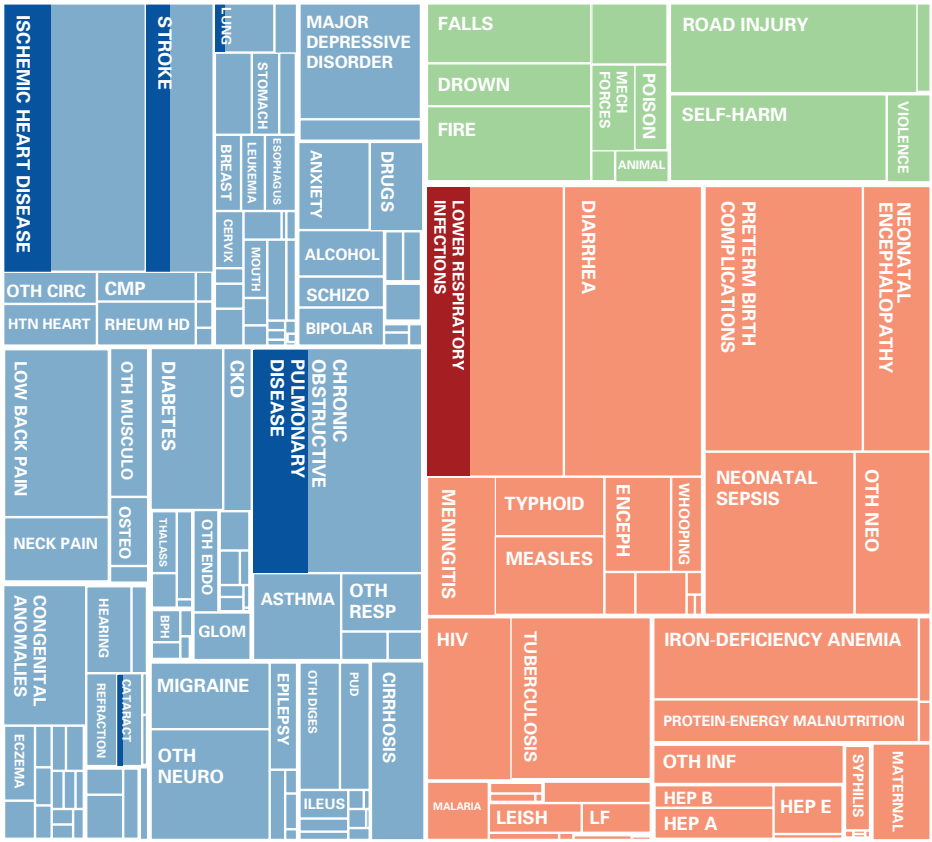
	AFGHANISTAN	BANGLADESH	BHUTAN	INDIA	MALDIVES	NEPAL	PAKISTAN	SRI LANKA	GLOBAL
DIETARY RISKS	3	3	1	1	1	3	3	1	1
HIGH BLOOD PRESSURE	5	5	2	4	2	6	6	2	2
SMOKING	6	1	7	3	5	2	5	5	3
HOUSEHOLD AIR POLLUTION	1	2	3	2	15	1	1	3	4
ALCOHOL USE	18	15	6	10	10	10	19	11	5
HIGH BODY MASS INDEX	12	14	11	13	3	16	12	7	6
HIGH FASTING PLASMA GLUCOSE	8	8	5	8	7	11	8	4	7
CHILDHOOD UNDERWEIGHT	2	7	13	5	14	4	4	16	8
AMBIENT PM POLLUTION	7	9	12	7	13	7	7	12	9
PHYSICAL INACTIVITY	9	11	10	11	9	13	11	6	10
OCCUPATIONAL RISKS	11	4	4	6	6	5	10	9	11
IRON DEFICIENCY	10	6	9	9	4	8	9	8	12
SUBOPTIMAL BREASTFEEDING	4	10	8	12	17	9	2	19	13
HIGH TOTAL CHOLESTEROL	17	19	15	14	11	20	15	10	14
DRUG USE	21	12	14	17	8	12	14	13	15
INTIMATE PARTNER VIOLENCE	15	13	16	15	12	15	17	14	16
LEAD	16	17	17	18	16	24	16	15	17
SANITATION	14	16	19	16	22	14	13	24	18
VITAMIN A DEFICIENCY	20	21	23	20	21	18	18	22	19
ZINC DEFICIENCY	19	18	20	21	20	17	20	20	20
CHILDHOOD SEXUAL ABUSE	22	20	18	19	18	19	21	17	21
UNIMPROVED WATER	13	24	24	23	24	21	22	21	22
LOW BONE MINERAL DENSITY	23	22	21	24	19	23	23	18	23
OZONE	24	23	22	22	23	22	24	23	24
RADON	25	25	25	25	25	25	25	25	25

1-5 6-10 11-15 16-20 21-25

Note: In this figure, shading is used to indicate the ranking of each risk factor in a particular country or region. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdheatmap.

cancer rounded out the top five, with occupational risk attributions of 32%, 18%, 15%, and 8%, respectively. Considerable health loss from injuries was attributable to occupational exposures in Nepal, as designated by the dark-green portions of the boxes representing injury subcategories. Of the top injuries associated with employment, 16% of injuries due to mechanical forces, 15% of poisonings, 12% of total road injuries, 11% of animal-contact-based injuries, and 9% of drowning were attributable to heightened occupational risks in the country.

Figure 19: DALYs attributable to household air pollution, both sexes, all ages, India, 2010



DALYs attributable to risk factor

- Communicable, newborn, nutritional, and maternal
- Non-communicable
- Injuries

DALYs not attributable to risk factor

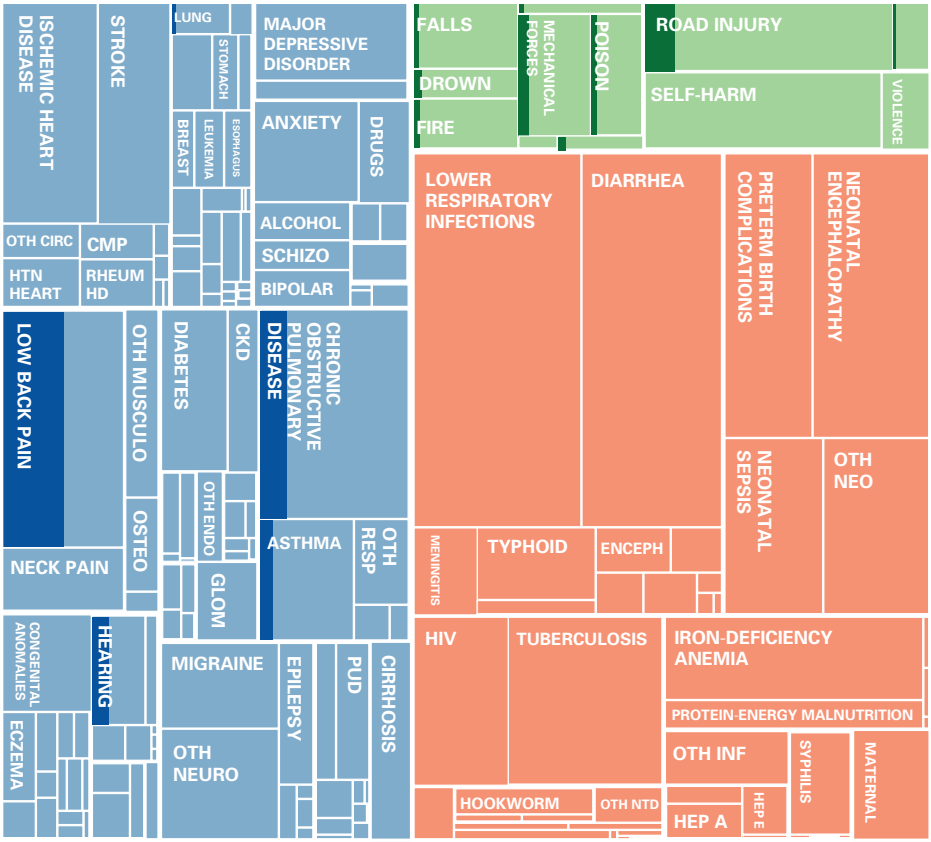
- Communicable, newborn, nutritional, and maternal
- Non-communicable
- Injuries

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.

Figure 21 shows the number of DALYs attributable to suboptimal breastfeeding for children aged 1 to 11 months in Afghanistan. This is the fourth highest risk factor for health loss in Afghanistan.

Figure 21 can be used to determine the number of years of healthy life that could potentially be gained by ensuring that all Afghan children in this age group are adequately breastfed. Adequate breastfeeding is defined as exclusive breastfeeding of

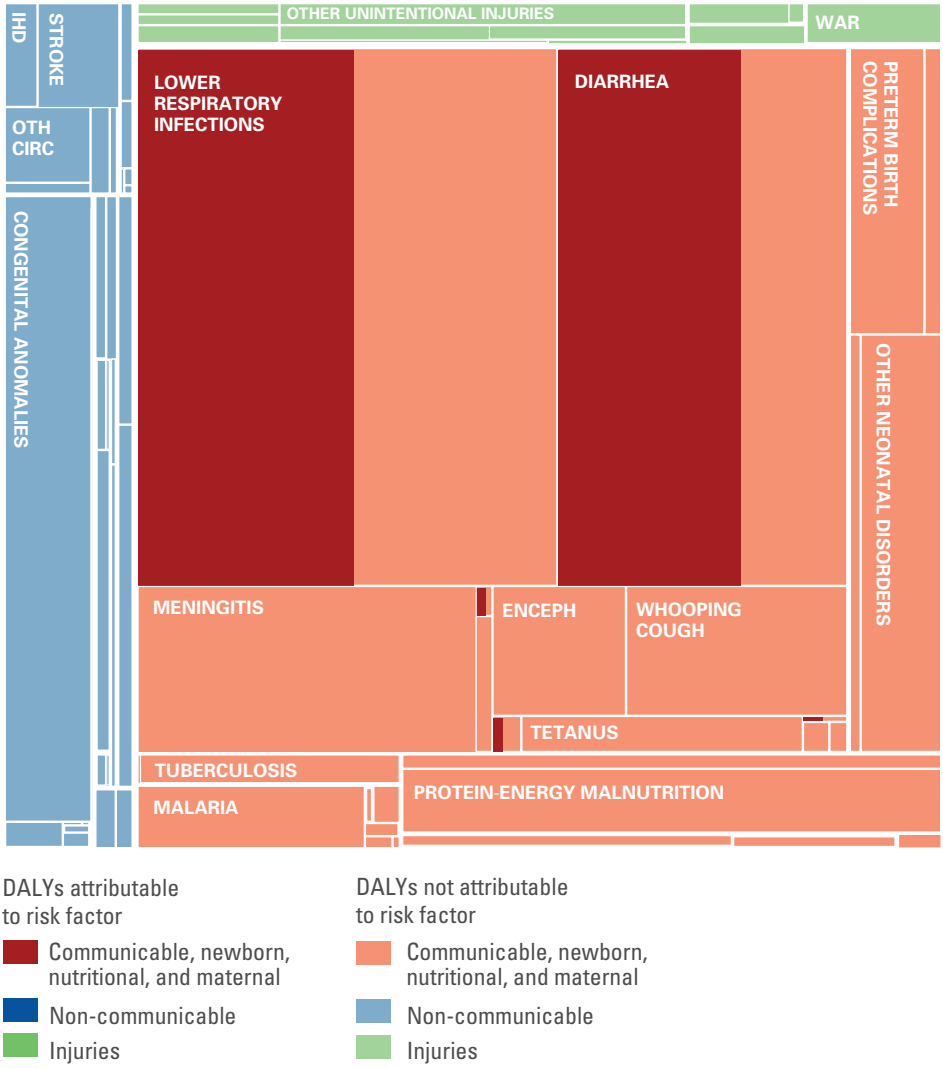
Figure 20: DALYs attributable to occupational risks, both sexes, all ages, Nepal, 2010



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.

children for the first six months of life and continued breastfeeding after 6 months of age until age 2. Over 63% of the DALYs attributable to diarrhea could potentially be prevented in this age group, 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 (i.e., over 50% of DALYs).

Figure 21: DALYs attributable to suboptimal breastfeeding, both sexes, ages 1-11 months, Afghanistan, 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

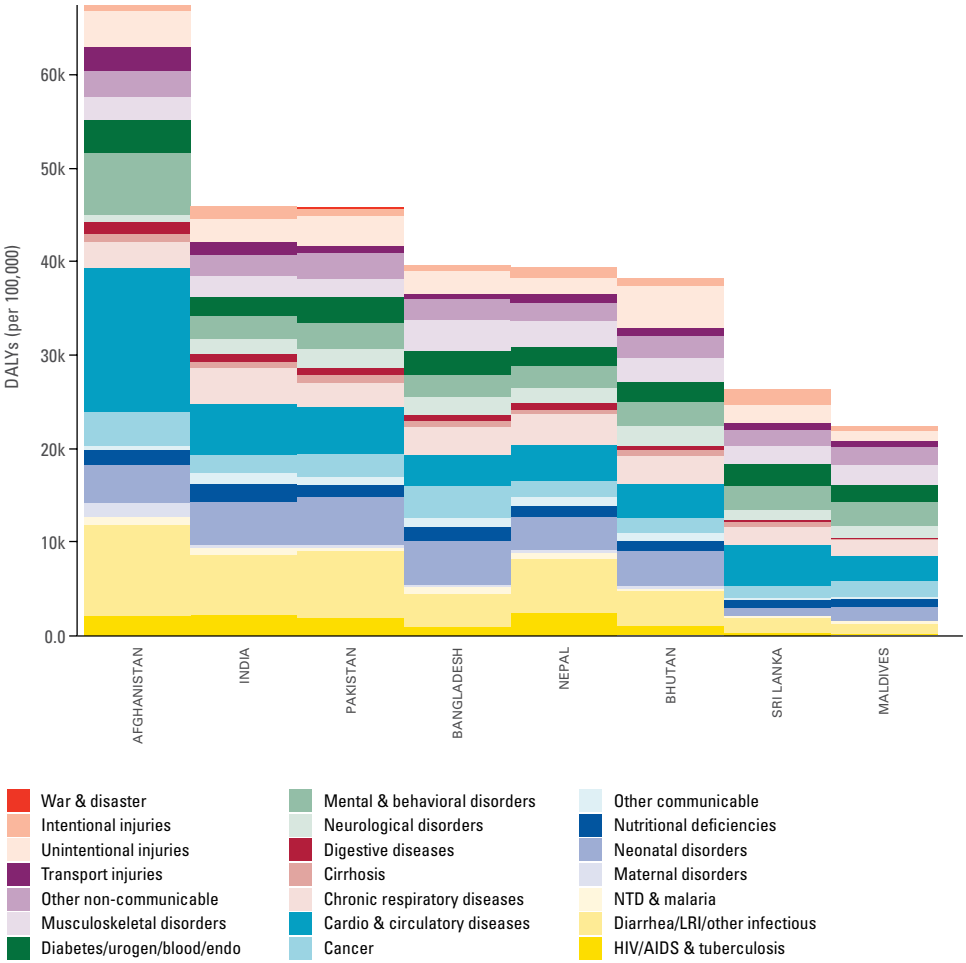
GBD found that factors such as population growth, longer lives, and decreasing mortality are driving up years of healthy life lost, or DALYs, from non-communicable diseases in many countries. Although non-communicable diseases are increasing relative to other health problems as a result of these demographic 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, or years of life lost due to premature death. When this is done, we can see a clear decline in COPD, stroke, and most communicable diseases in South Asia from 1990 to 2010.

GBD compared and contrasted disease patterns across countries by removing the effect of differences in population size and age structure across countries, permitting more direct comparisons of specific disease burdens. Figure 22 shows age-standardized causes of DALYs per 100,000 people. The leading causes of premature death and disability are aggregated. For example, causes such as low back pain and neck pain are grouped into the category musculoskeletal disorders. In the low-income countries (Afghanistan, Bangladesh, and Nepal) and lower-middle-income Bhutan, rates of communicable, newborn, nutritional, and maternal conditions exceeded 10,000 DALYs for every 100,000 people, while the lower- and upper-middle-income countries, aside from India and Pakistan, shown in Figure 22 had lower rates. For example, the Maldives and Sri Lanka had rates of communicable, newborn, nutritional, and maternal conditions that were about 6,000 per 100,000 people or lower. Notably, Afghanistan and Pakistan posted relatively high rates of DALYs due to war and disaster, about 960 and 200, respectively, per 100,000 people. All countries had sizable rates of DALYs from non-communicable diseases, underscoring the double burden of disease from both communicable and non-communicable diseases that many South Asian countries face.

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.

Figure 22: Age-standardized DALY rates across countries in South Asia, 2010



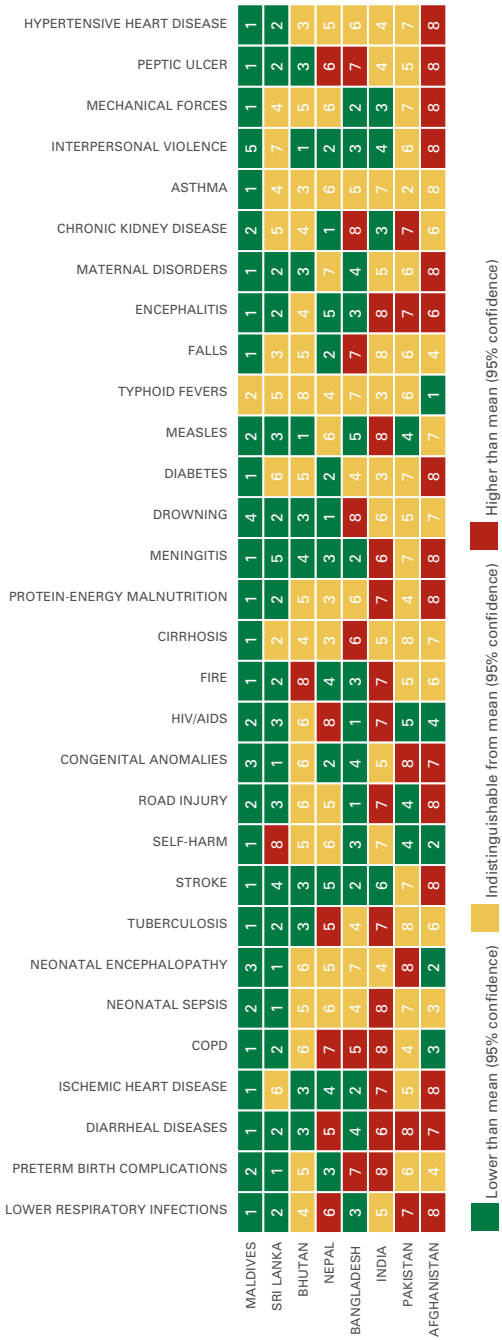
Note: The size of the colored portion in each bar represents number of age-standardized DALYs per 100,000 people attributable to each cause. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain. To view an interactive version of this figure, visit IHME's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

As an example of a benchmarking exercise, Figure 23 shows levels of YLLs in countries within the South Asia region, ranked relative to the regional average in 2010. The columns are arranged by the top 30 causes of YLLs in South Asia. 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 are in red; yellow indicates that, for the given cause, the country's rank is not statistically distinguishable from the regional rank in 2010. In South Asia, the Maldives and Sri Lanka generally performed significantly better than the region as a whole. Exceptions include typhoid fevers (i.e., the only country that performed better than the region was Afghanistan); a host of non-communicable diseases for Sri Lanka (i.e., the country and regional performances were not significantly different); and self-harm (i.e., Sri Lanka performed significantly worse than the region and all other countries in the region). Lower-income countries, such as Bangladesh, Bhutan, and Nepal, generally outperformed wealthier countries on several non-communicable conditions (e.g., ischemic heart disease and stroke), as well as on some communicable diseases (e.g., meningitis). Afghanistan, India, and Pakistan performed significantly worse than the regional average concerning diarrheal diseases and encephalitis. In comparison to overall regional trends, Afghanistan and India recorded significantly more YLLs from several communicable and childhood diseases (e.g., lower respiratory diseases and congenital anomalies).

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 with those of 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 United Kingdom's provision of universal health coverage and its implementation of numerous public health interventions.

For the United Kingdom, GBD estimates of life expectancy and healthy life expectancy (HALE), years lost due to premature death (YLLs), years lived with disability (YLDs), and healthy years lost (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 United Kingdom 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.

Figure 23: Causes of leading years of life lost, South Asia 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 8 as the worst.

CONCLUSION

The Global Burden of Disease study 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.

The Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (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 by what ails us. In 1990, childhood underweight was the leading risk factor for ill health, but high body mass index 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 caused a greater share of health loss in 2010 than in 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 this region, such as reductions in mortality from malaria, HIV/AIDS, and maternal conditions.

In South Asia, GBD 2010 documented important regional trends that reveal substantial declines in health loss due to communicable, maternal, and childhood diseases; nonetheless, despite great progress, these conditions still topped many countries' health burdens. At the same time, most countries experienced an increasing disease burden due to non-communicable diseases from 1990 to 2010. This dual burden of communicable and non-communicable diseases was largely driven by India, which is the largest country in the region. Road injuries and self-harm were also dominant causes of premature death and disability in the region. For two countries, Afghanistan and Pakistan, an increase in health loss occurred due to past and ongoing war and civil unrest. Sri Lanka, a country that experienced a conflict from the early 1980s through 2009, showed a huge decrease in health loss due to interpersonal violence.

Risk factors such as suboptimal breastfeeding, vitamin deficiencies, and childhood underweight have declined substantially throughout South Asia, which has likely contributed to the regional progress in reducing health loss associated with several childhood conditions. However, dietary risks (e.g., lack of fruit or nuts) and smoking have become important threats to public health in many countries in South Asia.

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, staffs 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 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 workshops 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-by-side comparisons of these estimates with 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

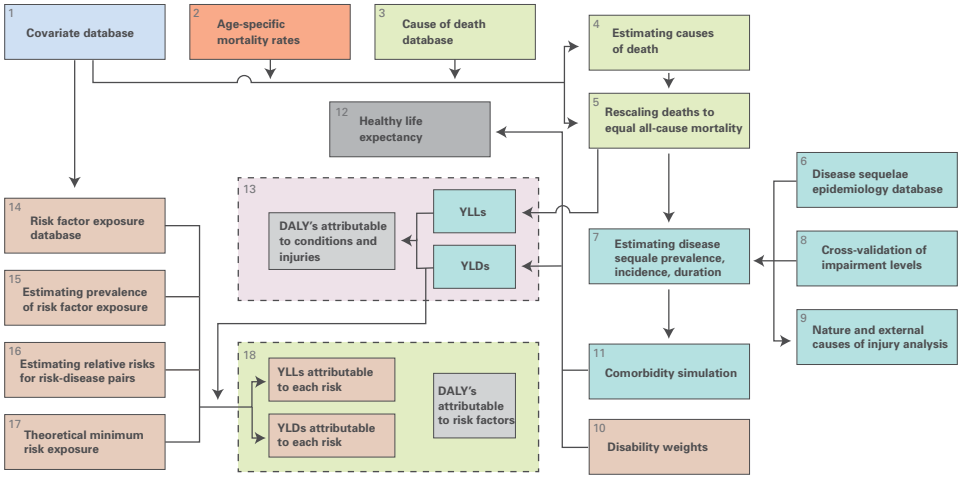
The analytical strategy of GBD

The Global Burden of Disease (GBD) approach contains 18 distinct components, as outlined in Figure A1. The components of GBD are interconnected. For example, when new data are 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 (HALE) (component 12), years of life lost (YLLs) and years lived with disability (YLDs) (component 13), and estimation of YLLs and YLDs attributable to each risk factor (component 18). The inner workings of key components are briefly described in this annex, 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 those 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 where 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.

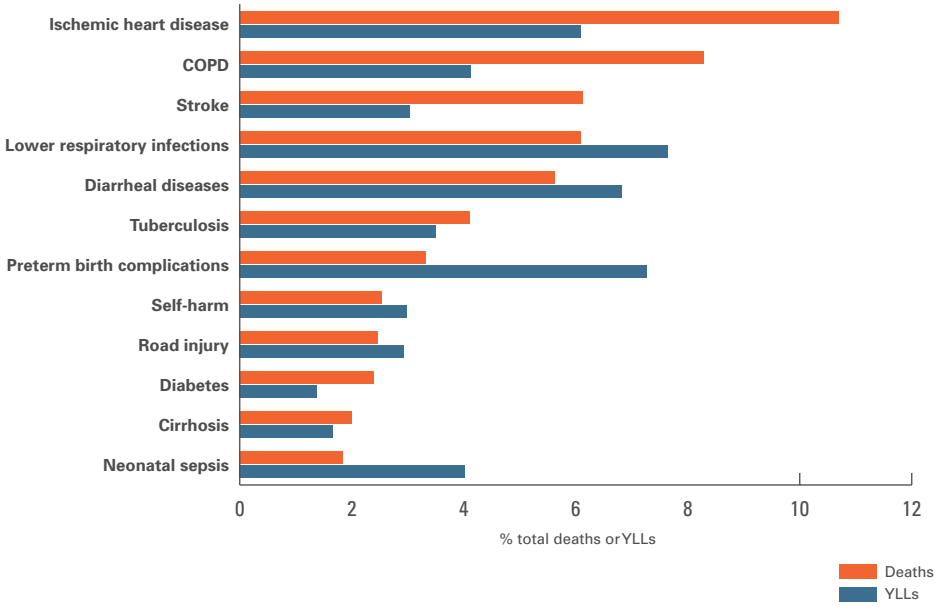
After addressing data-quality issues, researchers used a variety of statistical models to determine the number of deaths from each cause. This approach, named CODEm (for Cause of Death Ensemble modeling), was designed based on statistical techniques called "ensemble modeling." Ensemble modeling was made 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 did not exceed the total number of deaths estimated in a separate GBD demographic analysis, researchers applied 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 YLLs. For every death from a particular cause, researchers estimated the YLLs 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 Pakistan in 2010, he has 66 YLLs, 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, lower respiratory infections represent a greater percentage of total YLLs than total deaths since they are leading killers of children under age 5. Ischemic heart disease, by contrast, accounts for a smaller percentage of total YLLs than total deaths, as it primarily kills older people.

Figure A2: Leading causes of death and premature death in South Asia, 2010



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 from surveys and other sources.

Confronted with the challenge of data gaps in many regions and for numerous types of sequelae, researchers developed a statistical modeling tool named DisMod-MR (for 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, YLDs were calculated as prevalence of a sequela multiplied by the disability weight for that sequela. The number of YLDs for a specific disease or injury was calculated as the sum of the YLDs from each sequela arising from that cause.

Estimating disability-adjusted life years

Disability-adjusted life years (DALYs) were calculated by adding together YLLs and YLDs. Figure A3 compares the 10 leading diseases and injuries calculated as percentages of both regional deaths and regional DALYs. This figure also shows the top 10 risk factors attributable to deaths and DALYs in the South Asia region. It illustrates how a decision-maker looking only at the top 10 causes of death would fail to see the importance of iron-deficiency anemia, 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 larger percentage of total deaths than DALYs, as it primarily impacts older people.

Estimating DALYs attributable to risk factors

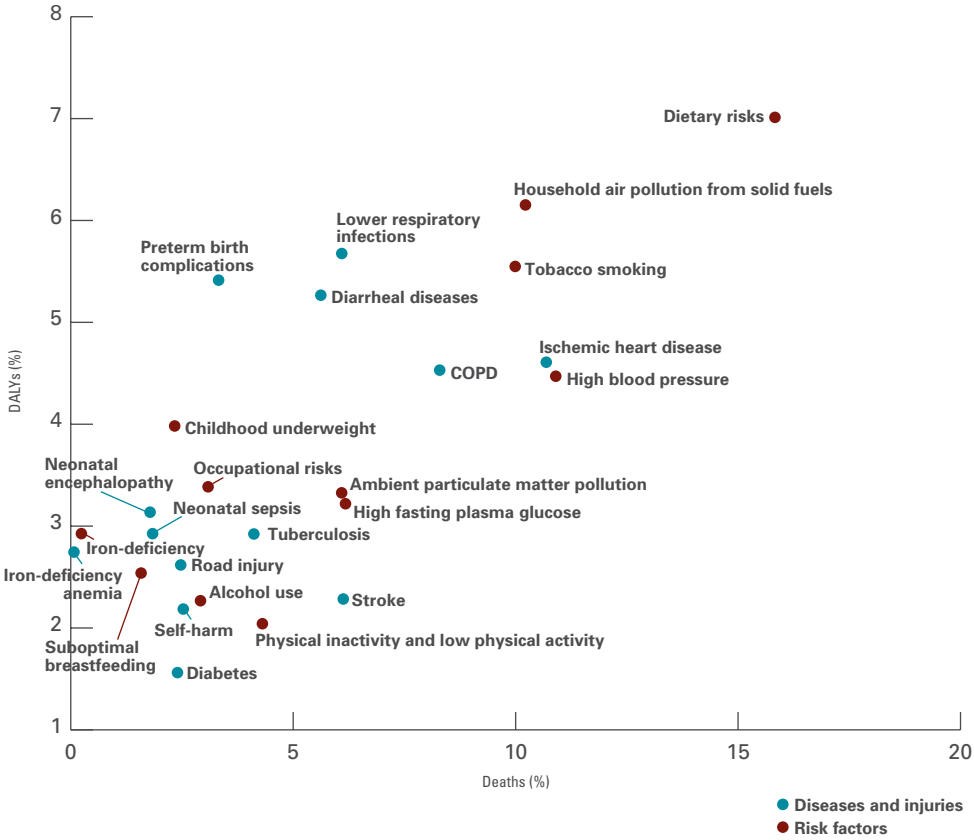
To estimate the number of healthy years lost, or DALYs, attributable to potentially avoidable risk factors, researchers collected detailed data on exposure to different risk factors. The study used data from sources such as satellite data on air pollution, breastfeeding data from population surveys, 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 South Asia, 2010



Note: This figure compares the percentage 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 iron deficiency, cause a substantial numbers of DALYs but few deaths. DALYs are an important tool for decision-makers because they capture years of healthy life lost from both premature death and years lived with disability.

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

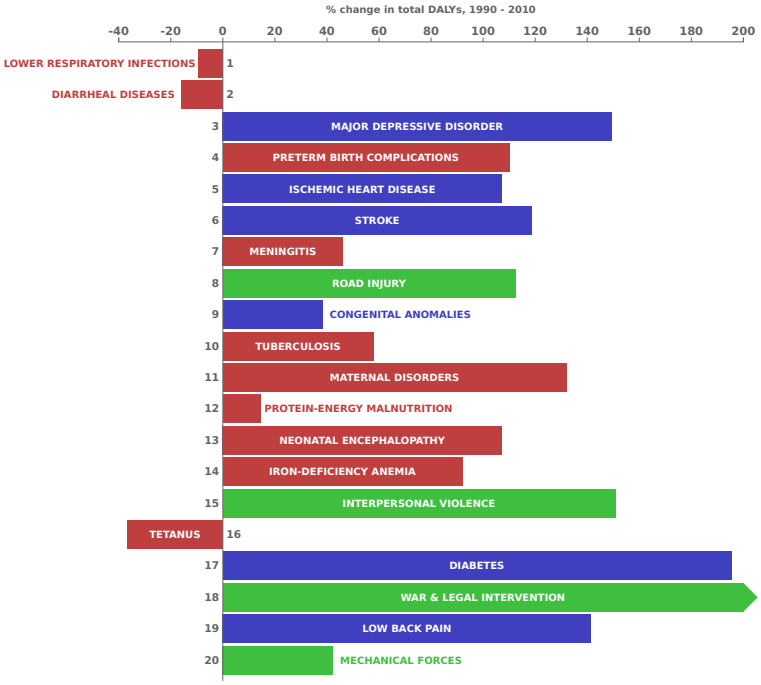
Country	**Age-standardized death rate** (per 100,000)				**Age-standardized YLL rate** (per 100,000)			
	1990		2010		1990		2010	
	Rate	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*
Afghanistan	1,931 (1,752-2,232)	8 (8-8)	1,668 (1,497-1,897)	8 (8-8)	68,958 (62,444-79,302)	8 (8-8)	52,078 (46,284-58,742)	8 (8-8)
Bangladesh	1,295 (1,206-1,373)	6 (4-6)	864 (802-912)	5 (3-5)	49,258 (45,947-52,446)	4 (4-7)	26,361 (24,424-27,828)	5 (3-5)
Bhutan	1,284 (1,105-1,497)	4 (3-7)	822 (649-990)	3 (3-5)	49,438 (43,249-56,520)	5 (4-7)	26,020 (21,479-30,644)	3 (3-5)
India	1,447 (1,389-1,530)	7 (6-7)	1,097 (1,011-1,166)	7 (7-7)	50,084 (47,613-53,409)	7 (4-7)	33,366 (30,670-35,506)	6 (6-7)
Maldives	997 (949-1,042)	2 (2-2)	440 (419-454)	1 (1-1)	34,466 (32,069-36,731)	2 (2-2)	11,060 (10,413-11,637)	1 (1-1)
Nepal	1,285 (1,210-1,385)	5 (4-6)	832 (777-885)	4 (3-5)	49,745 (46,653-53,434)	6 (4-7)	26,361 (24,803-28,050)	4 (3-5)
Pakistan	1,120 (1,057-1,185)	3 (3-4)	982 (866-1,073)	6 (6-6)	41,231 (39,066-43,805)	3 (3-3)	33,518 (29,921-36,510)	7 (6-7)
Sri Lanka	712 (688-736)	1 (1-1)	620 (595-642)	2 (2-2)	20,846 (19,888-21,801)	1 (1-1)	14,898 (14,239-15,608)	2 (2-2)

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*
17,727 (14,746-21,160)	8 (8-8)	17,252 (14,177-20,566)	8 (8-8)	52.0 (49.0-54.4)	8 (8-8)	57.8 (54.3-61.1)	8 (8-8)	42.6 (39.8-45.0)	8 (8-8)	47.5 (44.3-50.5)	8 (8-8)
14,743 (12,132-17,743)	7 (6-7)	13,206 (10,774-15,936)	7 (5-7)	58.9 (57.6-60.3)	5 (4-7)	69.0 (67.8-70.1)	5 (3-5)	49.5 (47.4-51.5)	7 (4-7)	58.6 (56.1-60.7)	5 (3-6)
13,781 (11,147-16,513)	5 (2-7)	12,113 (9,779-14,641)	3 (1-7)	59.0 (53.9-63.7)	4 (3-7)	69.5 (65.2-73.6)	3 (3-7)	50.1 (45.9-53.8)	5 (3-7)	59.8 (55.9-63.6)	3 (3-6)
13,727 (11,265-16,542)	6 (3-6)	12,494 (10,287-14,967)	5 (3-7)	58.3 (56.9-59.7)	7 (4-7)	65.2 (63.5-66.9)	7 (6-7)	49.8 (47.8-51.7)	6 (4-7)	56.2 (53.8-58.3)	7 (6-7)
13,138 (10,779-15,911)	3 (1-6)	11,281 (9,200-13,584)	1 (1-4)	65.1 (64.5-65.7)	2 (2-2)	78.8 (78.2-79.4)	1 (1-1)	55.6 (53.5-57.3)	2 (2-2)	68.0 (65.7-70.1)	1 (1-1)
13,660 (11,255-16,417)	4 (2-7)	12,959 (10,598-15,442)	6 (4-7)	58.8 (57.3-60.4)	6 (4-7)	69.2 (67.7-70.9)	4 (3-5)	50.0 (48.1-51.9)	4 (4-7)	58.9 (56.7-61.1)	4 (3-5)
12,877 (10,612-15,370)	2 (1-5)	12,323 (10,153-14,644)	4 (2-7)	62.4 (60.9-63.8)	3 (3-4)	65.8 (63.3-68.1)	6 (5-7)	53.4 (51.4-55.3)	3 (3-4)	56.6 (54.0-58.9)	6 (5-7)
12,231 (10,031-15,133)	1 (1-4)	11,452 (9,269-14,503)	2 (1-7)	72.3 (71.5-72.9)	1 (1-1)	75.5 (74.6-76.3)	2 (2-2)	62.0 (59.6-63.9)	1 (1-1)	65.2 (62.4-67.3)	2 (2-2)

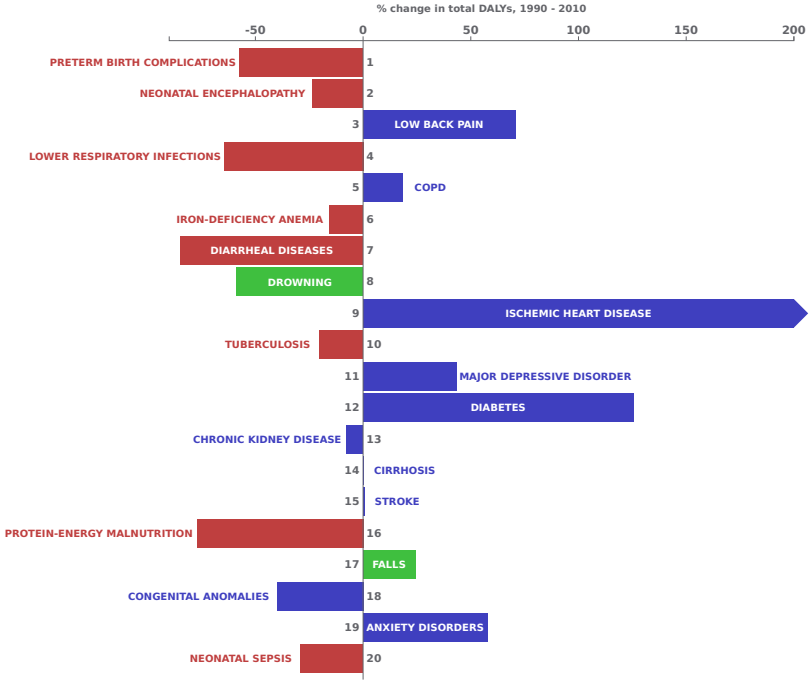
CHANGES IN LEADING CAUSES OF DALYS BETWEEN 1990 AND 2010 FOR COUNTRIES IN SOUTH ASIA

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.

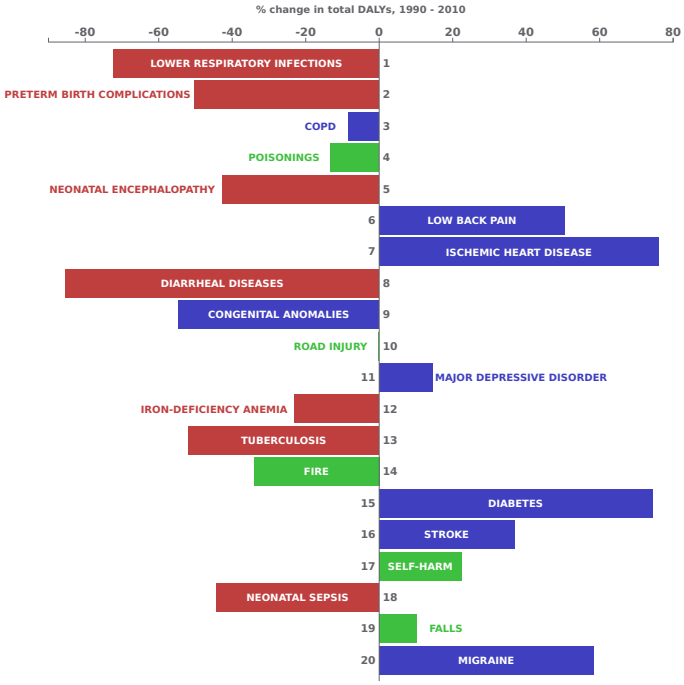
Shifts in leading causes of DALYs in Afghanistan, 1990-2010



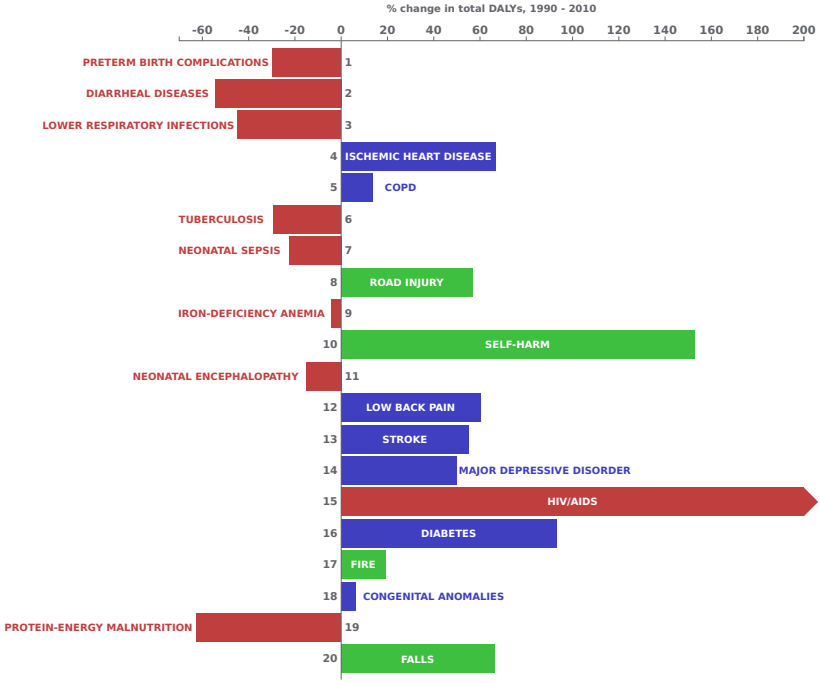
Shifts in leading causes of DALYs in Bangladesh, 1990-2010



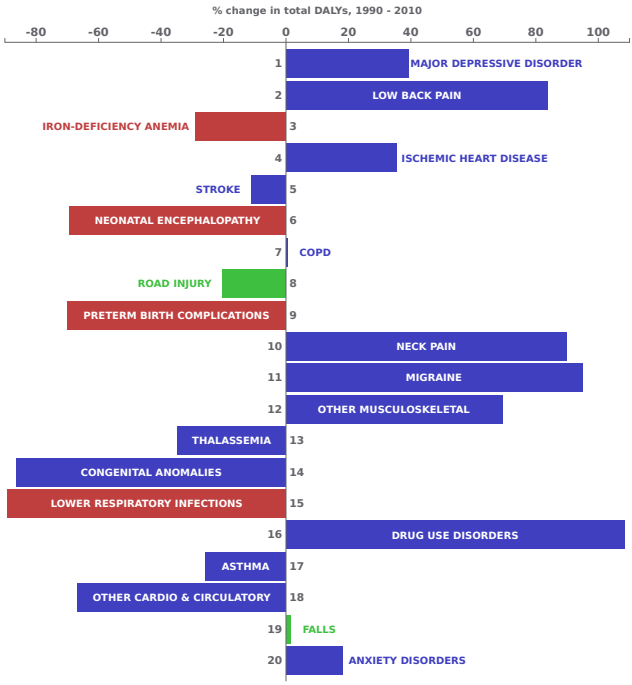
Shifts in leading causes of DALYs in Bhutan, 1990-2010



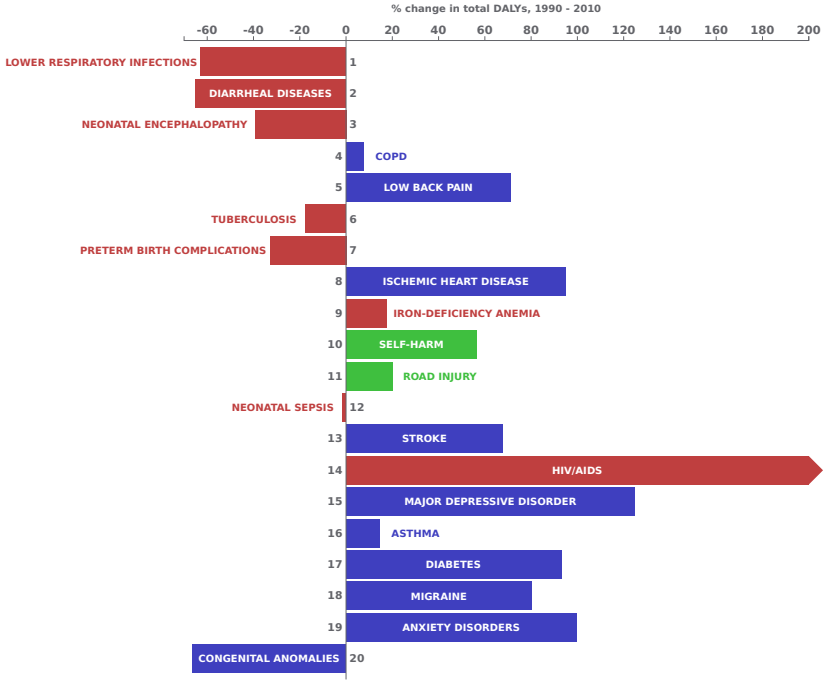
Shifts in leading causes of DALYs in India, 1990-2010



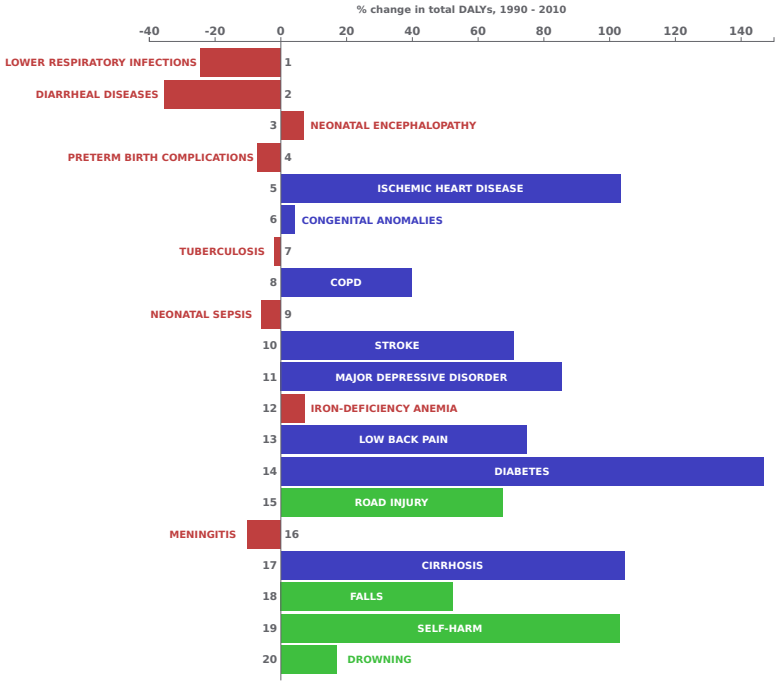
Shifts in leading causes of DALYs in the Maldives, 1990-2010



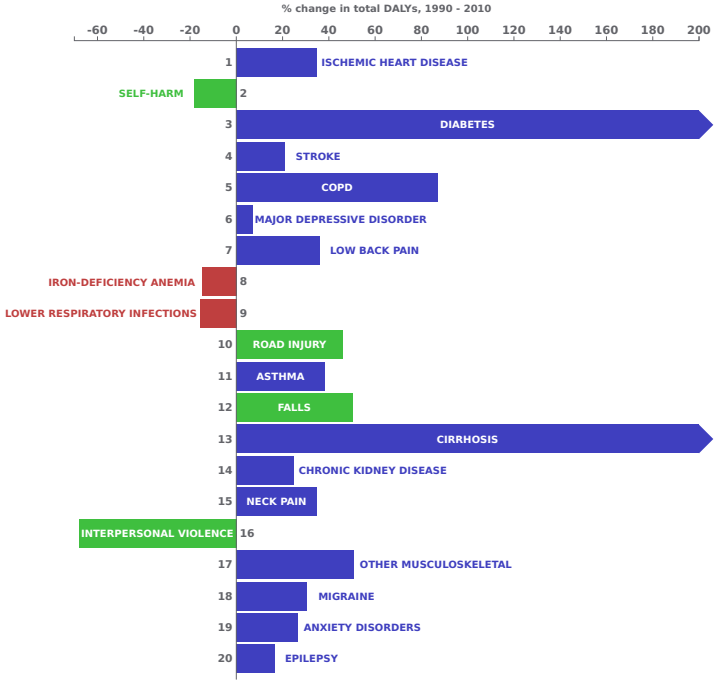
Shifts in leading causes of DALYs in Nepal, 1990-2010



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



Shifts in leading causes of DALYs in Sri Lanka, 1990-2010



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