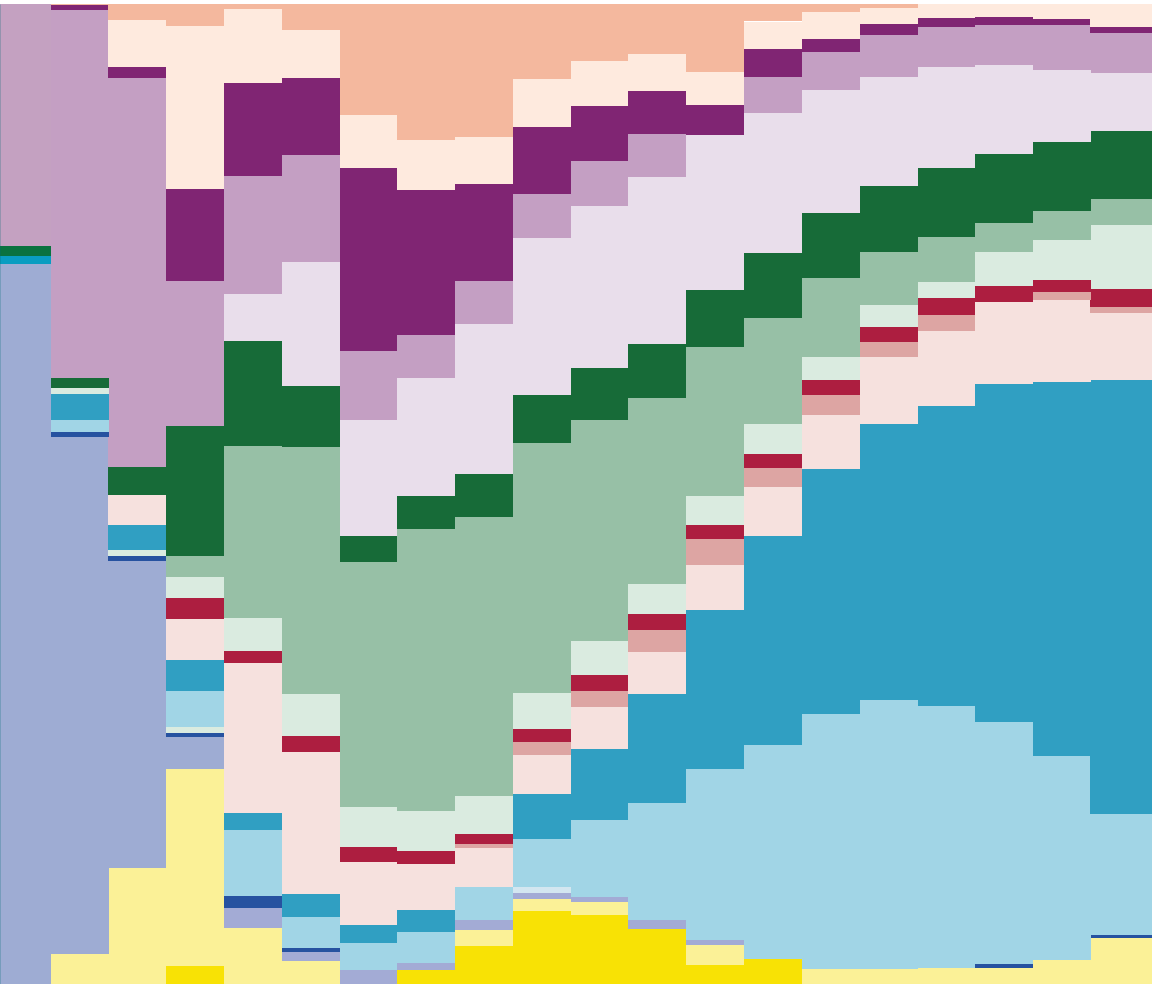
THE GLOBAL BURDEN OF DISEASE: GENERATING EVIDENCE, GUIDING POLICY

EAST ASIA AND PACIFIC 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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ABOUT IHME

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

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

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ACKNOWLEDGMENTS

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 are grateful to the report's writer, William Heisel; to Christopher Murray, Michael MacIntyre, Theo Vos, Rafael Lozano, Marie Ng, and Rhonda Stewart at IHME, Anne-Maryse Pierre-Louis of the Human Development Network at the World Bank, and Toomas Palu 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 and editing; to Katherine Leach-Kemon for writing support and production management; 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.

Finally, we would like to extend our gratitude to the Human Development Network at the World Bank for co-financing this report, and to the Bill & Melinda Gates Foundation for generously funding IHME and for its consistent support of the Global Burden of Disease research.

GLOSSARY

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

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

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

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

Sequelae: Consequences of diseases and injuries.

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

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

Risk factors: Potentially modifiable causes of disease and injury.

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

INTRODUCTION

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

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

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

In the East Asia and Pacific region, many of the leading causes of health loss were non-communicable diseases. Similar to global trends, most communicable, newborn, nutritional, and maternal causes are becoming less important in this region as non-communicable diseases kill more people prematurely and cause increasing disability. However, the burden from HIV/AIDS increased in certain countries between 2005 and 2010, but decreased during this same period in other countries.

HIV/AIDS was one of the five leading causes of disease burden in Malaysia, Myanmar, and Thailand in 2010. Ischemic heart disease and diabetes are on the rise in most countries in the region. The area has also experienced significant growth in the burden of disease from injuries stemming from road injuries. Risk factors such as dietary risks, high blood pressure, smoking, household and ambient particulate matter (PM) air pollution, high fasting plasma glucose (an indicator of diabetes), alcohol use, and high body mass index (BMI) contributed to the rise of burden from non-communicable diseases in the East Asia and Pacific region, while risks related to illness in children remained prominent in countries such as Cambodia, Laos, and Timor-Leste.

Although demographic changes such as population growth and increasing average age have caused growth in burden from non-communicable diseases in East Asia and Pacific, GBD found that multiple countries are making progress in some of these conditions. This progress can be seen when using measurements called age-standardized rates, which remove the effects of demographic changes to isolate health improvements. Age-standardized rates of non-communicable diseases such as stroke and cirrhosis declined over time in China and Vietnam, and age-standardized rates of cervical cancer declined in Thailand between 2005 and 2010. At the same time, age-standardized rates of ischemic heart disease and lung cancer are rising in many countries, underscoring the region's mixed success in combatting different non-communicable diseases.

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

MAIN FINDINGS FOR EAST ASIA AND PACIFIC:

- The East Asia and Pacific region has made dramatic progress in reducing mortality and prolonging life since 1970. The countries that made the most progress in increasing the average age at death between 1970 and 2010 were China, Indonesia, Micronesia, North Korea, Samoa, and Thailand.
- Over the last 20 years, the region has succeeded in decreasing premature death and disability from most communicable, newborn, nutritional, and maternal causes, but HIV/AIDS remains a persistent challenge. For some countries in the region, there have been reductions in the burden from HIV/AIDS since 2005, but HIV/AIDS has risen in other countries during this period. HIV/AIDS ranked among the five leading causes of disability-adjusted life years, or DALYs, in Malaysia, Myanmar, and Thailand.
- Despite improvements, substantial burdens of communicable, newborn, nutritional, and maternal causes persisted in low- and lower-middle-income countries in East Asia and Pacific such as Cambodia, Indonesia, Laos, Myanmar, Papua New Guinea, Timor-Leste, and Vanuatu.

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.

- China is the most epidemiologically advanced country in the region. Similar to developed countries, disease burden in China was dominated by non-communicable diseases and injuries. The health progress made by lower-middle-income Vietnam was comparable to upper-middle-income countries in the region.
- Between 1990 and 2010, demographic changes contributed to rising disease burden from many non-communicable causes, especially from stroke, mental disorders such as major depressive disorders and anxiety, musculoskeletal disorders including low back pain and neck pain, diabetes, and trachea, bronchus, and lung cancers. Today, diabetes disorders are causing more early death and disability in East Asia and Pacific than two decades ago. Removing the effect of demographic changes on disease patterns by using age-standardized rates, however, reveals that China and Vietnam made progress in reducing stroke and cirrhosis and Thailand successfully reduced age-standardized rates of cervical cancer between 2005 and 2010. At the same time, age-standardized rates of ischemic heart disease and lung cancer are rising in many countries in the region.
- As countries in East Asia and Pacific have become more developed, road injuries have taken a growing toll on human health. For example, in Indonesia, Thailand, and Vietnam, road injuries were among the five leading causes of DALYs.
- The leading causes of disability in the region largely mirrored global trends. Low back pain, neck pain, and other musculoskeletal disorders, as well as mental disorders such as depression, were dominant causes of disability in East Asia and Pacific. In contrast to global trends, however, osteoarthritis and diabetes were higher ranking causes of disability in East Asia and Pacific, while drug use disorders, asthma, and Alzheimer's disease all rank lower in the region as a cause of years lived with disability compared to the world as a whole.
- Risk factors such as dietary risks, high blood pressure, smoking, household and ambient particulate matter air pollution, high fasting plasma glucose, alcohol use, and high BMI were leading risk factors for premature death and disability in East Asia and Pacific. Ambient particulate matter air pollution was a more important cause of disease burden than it was in the world as a whole, largely due to China's high levels of this risk factor. Risk factors that primarily cause illness in children, such as household air pollution, childhood underweight, iron deficiency, and suboptimal breastfeeding, were important in Cambodia, Laos, and Timor-Leste.

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 a health system is adequately aligned to a population's true health challenges, policymakers must be able to compare the effects of different diseases that kill people prematurely and cause ill health. The original GBD study's creators developed a single measurement, disability-adjusted life years (DALYs), to quantify the number of years of life lost as a result of both premature death and disability. One DALY equals one lost year of healthy life. DALYs will be referred to by their acronym, as "years of healthy life lost," and "years lost due to premature death and disability" throughout this publication. Decision-makers can use DALYs to quickly assess the impact caused by conditions such as cancer versus depression 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 here: 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

"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*

"If we look at sub-Saharan Africa, you've got the double burden of communicable diseases and the rising instances of non-communicable diseases. The dilemma will be how to deal with the non-communicable diseases without compromising what you've already been doing for communicable diseases." **Dr. Christine Kaseba-Sata**, *First Lady of Zambia*

"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 people to view GBD estimates through hundreds of different dimensions. Only a few examples are explored in the figures throughout this document. We encourage you to visit the IHME website to use the GBD data visualization tools and share them with others.

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

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

GBD REGIONAL CLASSIFICATIONS

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

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

RAPID HEALTH TRANSITIONS: GBD 2010 RESULTS

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

In terms of disease burden at the global level, GBD 2010 found that the leading causes of DALYs have evolved dramatically over the past 20 years. Figure 1 shows the changes in the global leading causes of DALYs in 1990 and 2010. Communicable, newborn, maternal, and nutritional causes are shown in red, non-communicable diseases appear in blue, and injuries are shown in green. Dotted lines indicate causes that 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, or DALYs, have changed over time in East Asia and Pacific. Figures showing changes in the leading causes of DALYs by country can be found in the Annex of this report.

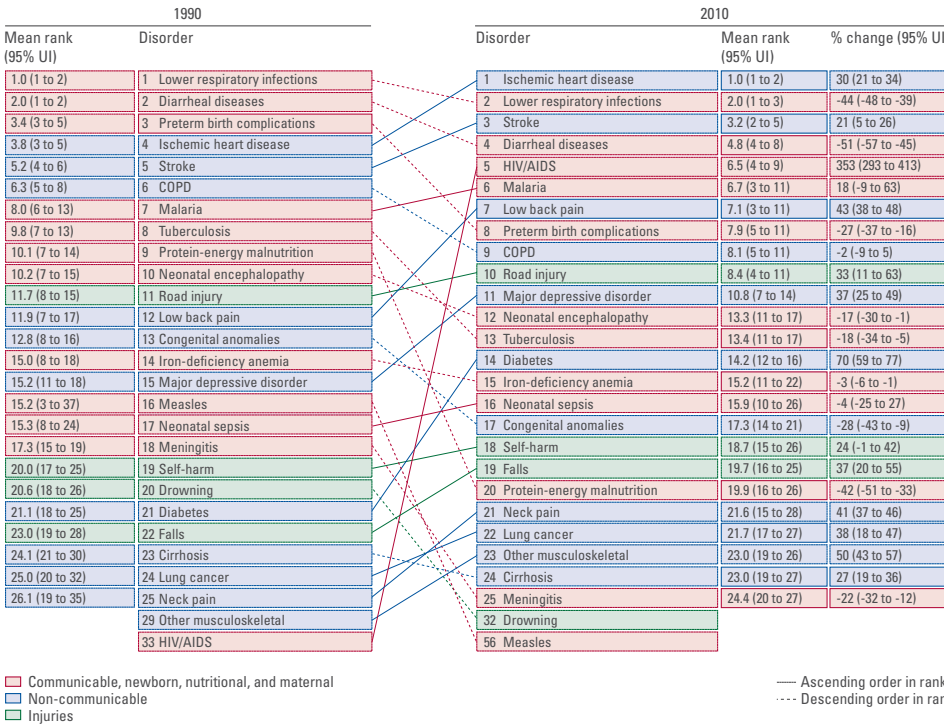
Cerebrovascular disease – or stroke – was the leading cause of premature death and disability in East Asia and Pacific in 2010, and rose from second to first place as a cause of DALYs between 1990 and 2010. Ischemic heart disease was the second leading cause of DALYs in the region.

Certain non-communicable diseases and injuries were much more prominent causes of premature death and disability in East Asia and Pacific compared to the world as a whole. Depression ranked sixth in this region, but ranked 11th globally. At the country level, depression ranked among the five leading causes of DALYs in

Malaysia, Thailand, Tonga, and Vietnam. Diabetes also ranked higher in East Asia and Pacific than it ranked at the global level – ninth versus 14th – and was a leading cause of DALYs in most of the smaller countries in the region, including Kiribati, the Marshall Islands, the Federated States of Micronesia, Samoa, the Solomon Islands, and Tonga.

Of the 25 leading causes of disease burden, trachea, bronchus, and lung cancers showed the biggest increase in terms of DALYs, rising 86% between 1990 and 2010. Diabetes, similar to global trends, rose 76% in the same period. Road injuries also were prominent health problems in the region. While road injuries were the 10th leading cause of disease burden globally, in East Asia and Pacific, they ranked third. The shift in rank between 1990 and 2010 was driven by a 51% increase in DALYs from traffic accidents and other road-related injuries. In Indonesia, Thailand, and Vietnam, road injuries were among the five leading causes of DALYs.

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

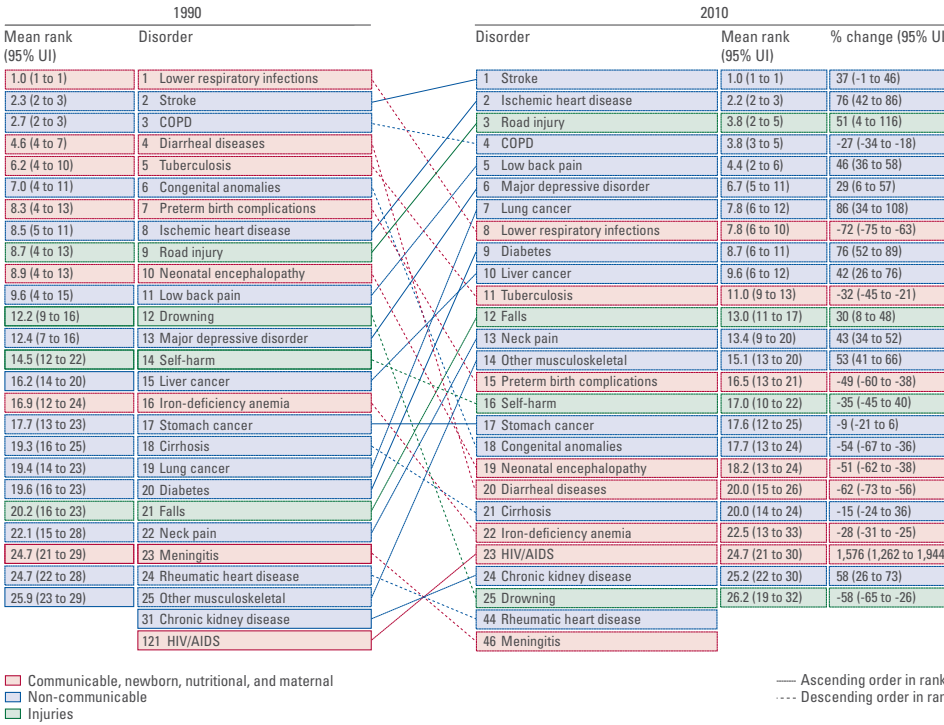


Note: Solid lines indicate a cause that has moved up in rank or stayed the same. Broken lines indicate a cause that has moved down in rank. The causes of DALYs are color coded, with blue for non-communicable diseases, green for injuries, and red for communicable, newborn, nutritional, and maternal causes.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

There also were significant decreases in some causes of disease burden. DALYs due to self-harm fell 35% and from drownings, 58%. The burden of chronic obstructive pulmonary disease (COPD), a term used to describe emphysema and other chronic respiratory diseases, fell by 27%. On the whole, most communicable, newborn, maternal, and nutritional causes of DALYs dropped in rank in East Asia and Pacific, mirroring global trends in the epidemiological transition toward chronic diseases and injuries. The burden from diarrheal diseases, preterm birth complications, and lower respiratory infections fell in nearly every country in the region.

China stood out, in particular, for how advanced it was in transitioning from a profile more typical of a developing country to a health picture that is now dominated by non-communicable diseases and injuries. Of the 20 leading causes of DALYs in this country, only one infectious disease remained a leading cause: lower respiratory infections. The burden from these diseases fell by 80% in China between 1990 and 2010.

Figure 2: Disability-adjusted life year ranks, top 25 causes, and percentage change in East Asia and Pacific, 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.

HIV/AIDS did increase in terms of DALYs by 1,576% between 1990 and 2010. There have been reductions in the burden from HIV/AIDS in multiple countries in the region since 2005, but it remained among the five leading causes of DALYs in Malaysia, Myanmar, and Thailand. HIV/AIDS has risen in China, Indonesia, and the Philippines since 2005.

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.

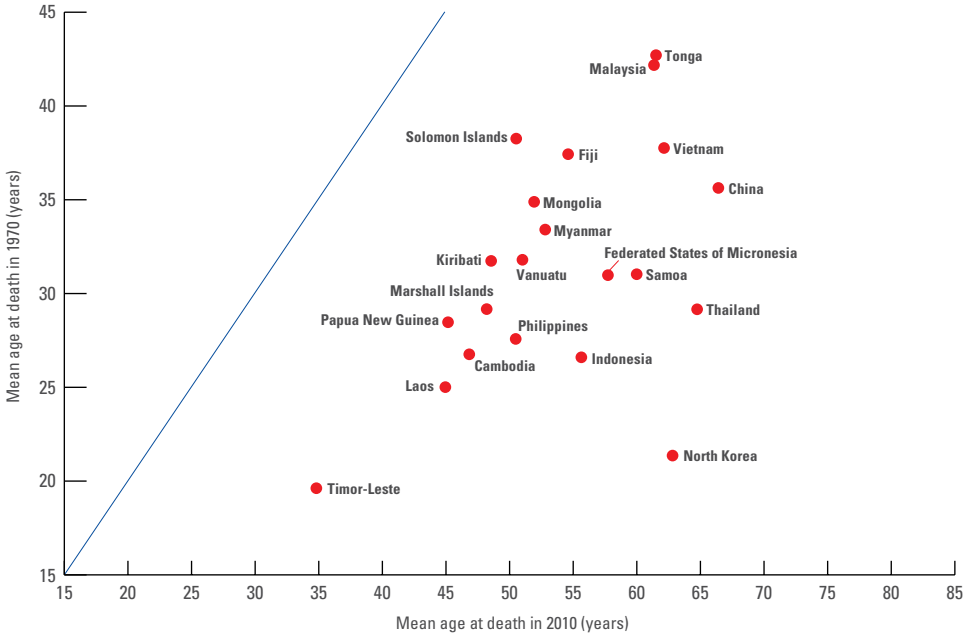
In East Asia and Pacific, the countries that made most progress in increasing the average age at death between 1970 and 2010 were China, Indonesia, Micronesia, North Korea, Samoa, and Thailand (Figure 3). All of these countries saw increases in the mean age of death by 25 years or more. Most of the other countries in the region succeeded in extending the average age at death between 15 and 24 years. The Solomon Islands saw an increase of only 12 years between 1970 and 2010. While globally the biggest increases in the mean age of death have tended to be in higher-income countries, East Asia and Pacific presents a mixed picture. The country with the biggest increase was North Korea, one of only three low-income countries in the region, ranking it among the fastest increases in the world, alongside upper-middle-income countries such as the Dominican Republic, Iran, and the Maldives. By contrast, Malaysia, an upper-middle-income country, saw a slower increase than Cambodia and Myanmar, the two other low-income countries in the region.

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

Figure 5 shows decreases in mortality rates in East Asia and Pacific. There were declines in every age group between 1970 and 2010, ranging from 12% for men aged 80 and older to more than 88% in males and females in the 1- to 4-year-old age group between 1970 and 2010.

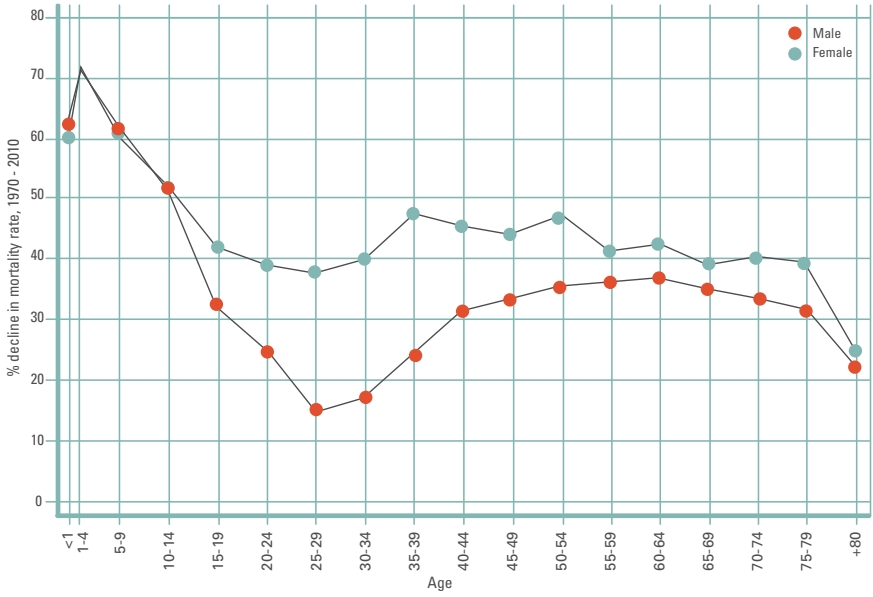
As with the global results, women in most age groups in the region experienced greater declines in death rates than men. The most dramatic differences appeared in the 15 to 44 year age groups. Women between 20 and 24, for example, saw a 70.5% decline in mortality while men only saw a 43% decline.

Figure 3: Average age of death for countries in East Asia and Pacific region, 1970 compared with 2010



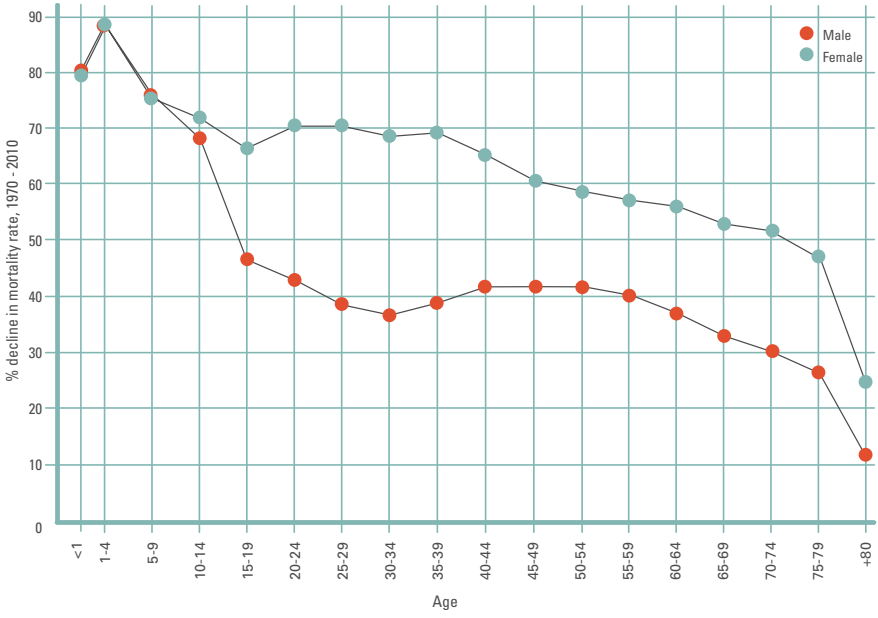
Note: Countries falling on the right side of the 45-degree-angle line had a greater average age of death in 2010 compared to 1970.

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



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

Figure 5: Decline in age-specific mortality rate in East Asia and Pacific, 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 6 shows global changes in the 25 leading causes of DALYs between 1990 and 2010 ordered from highest to lowest ranking cause from top to bottom.

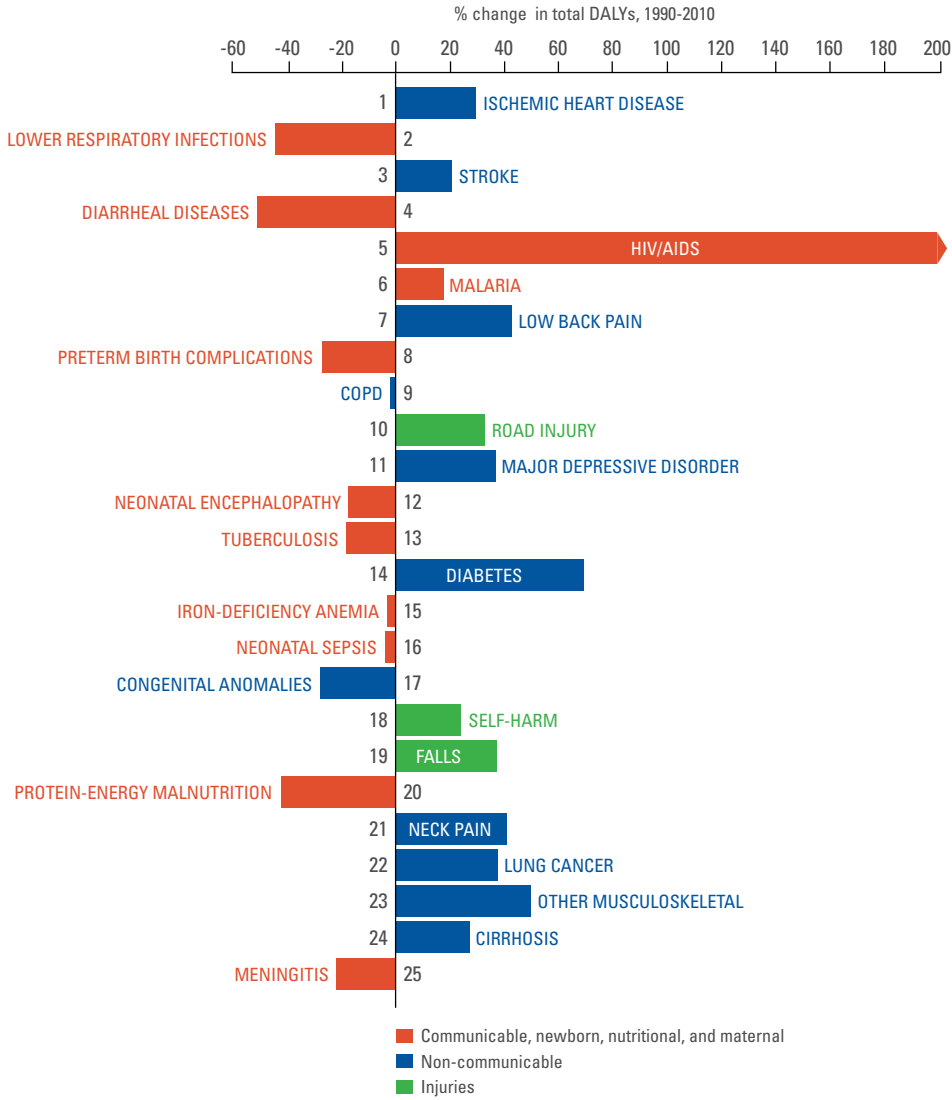
Figure 7 shows the changes in the leading causes of premature death and disability in the East Asia and Pacific region from 1990 to 2010. Conditions such as ischemic heart disease, lung cancer, diabetes, and chronic kidney disease were the non-communicable diseases that experienced the most growth in this region. COPD, stomach cancer, congenital anomalies, and cirrhosis declined.

Globally, non-communicable diseases accounted for 54% of all DALYs in 2010. Communicable, maternal, neonatal, and nutritional causes accounted for 35% of DALYs, and injuries made up the remaining 11%. In most countries outside of 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%.

Figure 8 shows the important role played by non-communicable diseases in the East Asia and Pacific region. Singapore had the highest percentage of DALYs due to non-communicable diseases (84%), while Timor-Leste had the lowest percentage of DALYs from these conditions (41%).

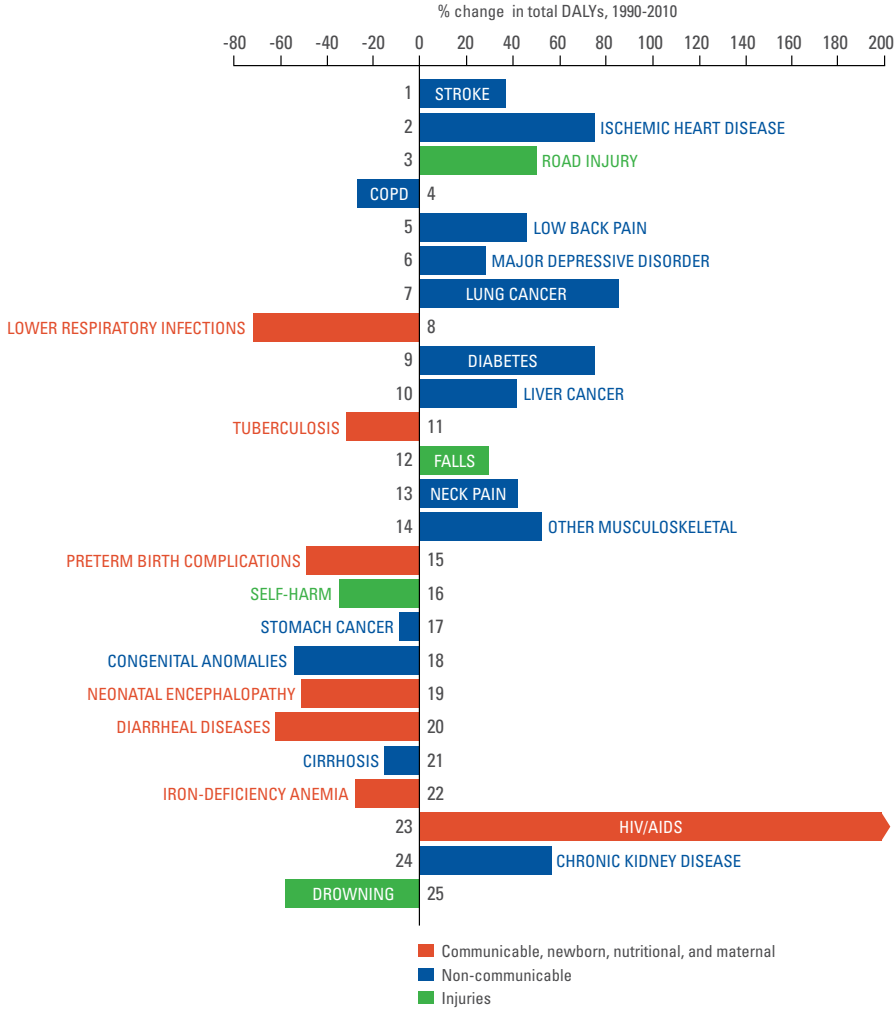
An in-depth look at the country-level data reveals the specific diseases that are driving overall shifts from communicable to non-communicable diseases. As an example, Figure 9 displays the changes in the top 20 causes of DALYs in females in the Philippines between 1990 and 2010. The causes are organized by rank from top to bottom. Most non-communicable diseases rose over time. Among the top 20 causes in 2010, diabetes increased the most (288%); followed by breast cancer, which grew 200%; and chronic kidney disease and stroke, which each grew by more than 100%. Of the non-communicable diseases, asthma had the slowest rise at just 18% between 1990 and 2010, a trend seen throughout the region. Among communicable, nutritional, newborn, and maternal conditions, lower respiratory infections experienced the most dramatic decline, falling by 47%. Unlike many countries in the region and throughout the world, diarrheal diseases actually saw an increase of 37%, and many other communicable, newborn, nutritional, and maternal conditions also rose.

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



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

Figure 7: Shifts in leading causes of DALYs in East Asia and Pacific, 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: Percent of global DALYs due to non-communicable diseases, 2010

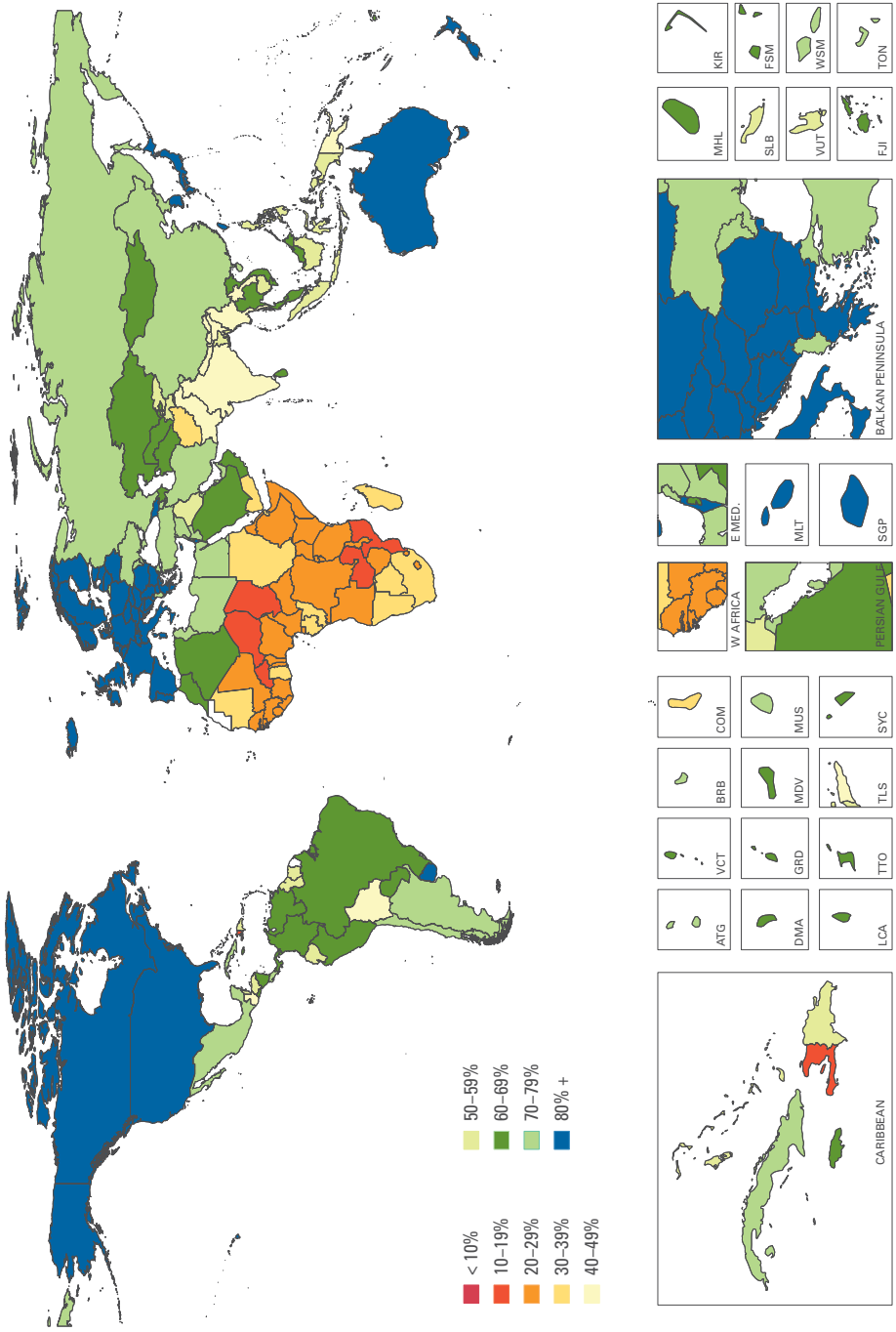
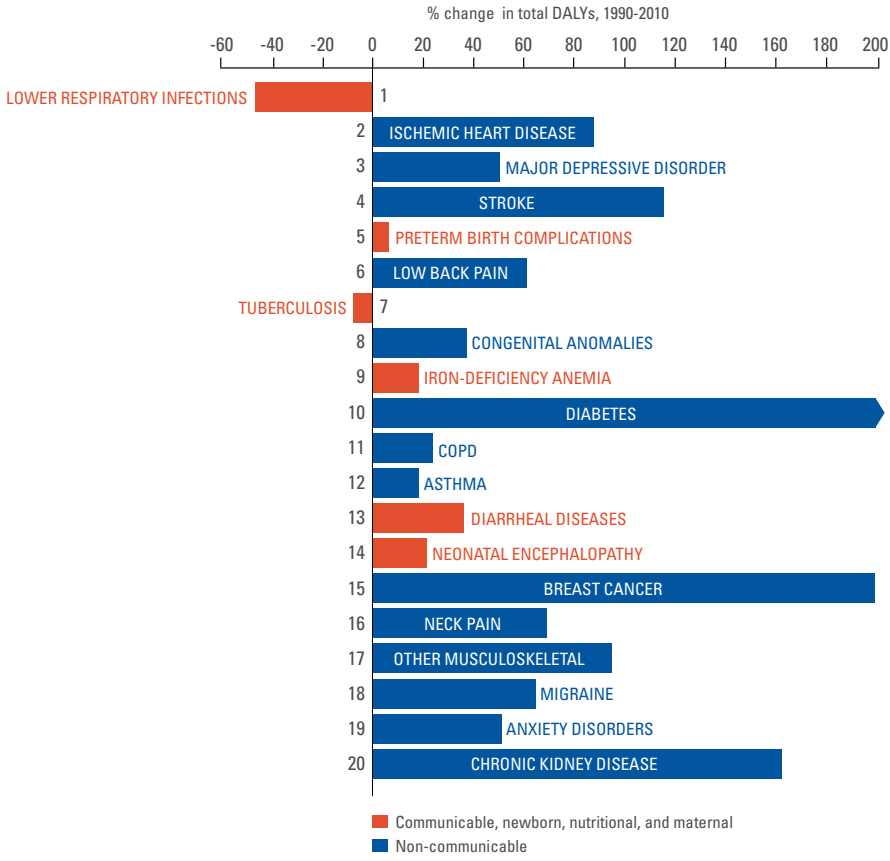


Figure 10 shows declines in DALYs among males in the Philippines from some communicable, nutritional, and newborn conditions coupled with increases in non-communicable diseases and injuries between 1990 and 2010. As with females, however, DALYs due to diarrheal diseases and neonatal encephalopathy increased. Out of all the non-communicable diseases shown in Figure 10, diabetes increased the most over the period (294%). Other leading causes of DALYs saw a doubling of the related disease burden, including chronic kidney disease (179%), hypertensive heart disease (178%), cirrhosis (158%), and interpersonal violence (134%). The Philippines was one of the few countries in the region where violence was among the five leading causes of DALYs for males.

Another visualization tool, GBD Compare, displays proportional changes in disease patterns over time using a treemap diagram, which is essentially a square pie chart.

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

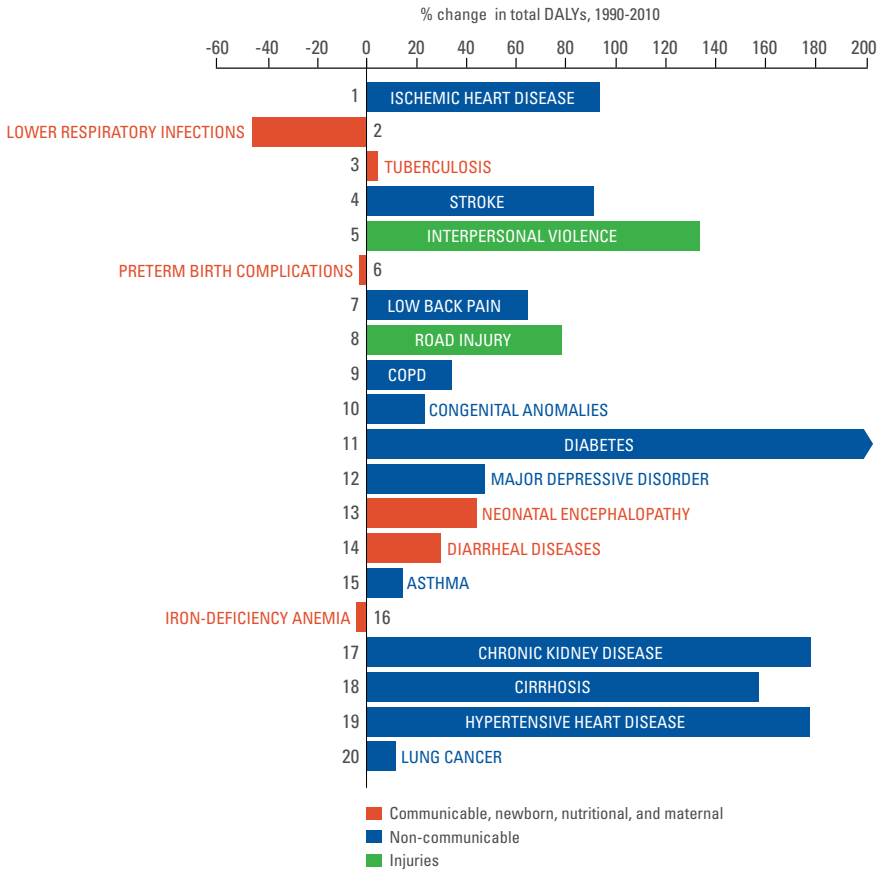


Note: The leading 20 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows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

Causes of DALYs are shown in boxes. The size of each box represents the percentage of total DALYs due to a specific cause. Figures 11a and 11b show how DALYs changed in Indonesia between 1990 and 2010. In 1990, non-communicable diseases accounted for 37% of DALYs in both sexes, while communicable, nutritional, maternal, and newborn causes accounted for 56%. Injuries made up the remaining 7%. By 2010, non-communicable diseases represented 58% of total disease burden. Communicable, nutritional, maternal, and newborn causes shrank to 33%, and injuries increased to 9%.

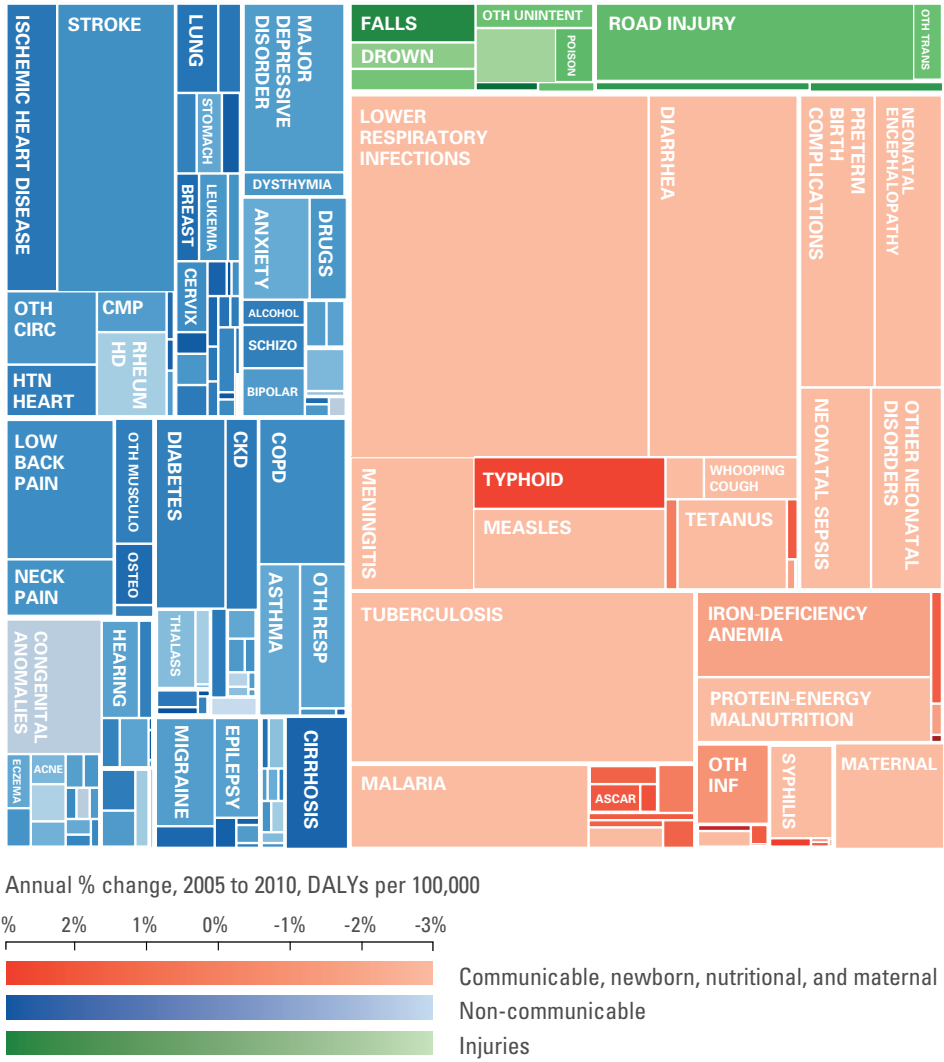
Premature death and disability from most communicable, nutritional, maternal, and newborn causes decreased during this period. The amount of health loss from most of the leading communicable diseases fell dramatically, with tetanus, syphilis, measles, meningitis, malaria, and lower respiratory infections all declining by more than

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



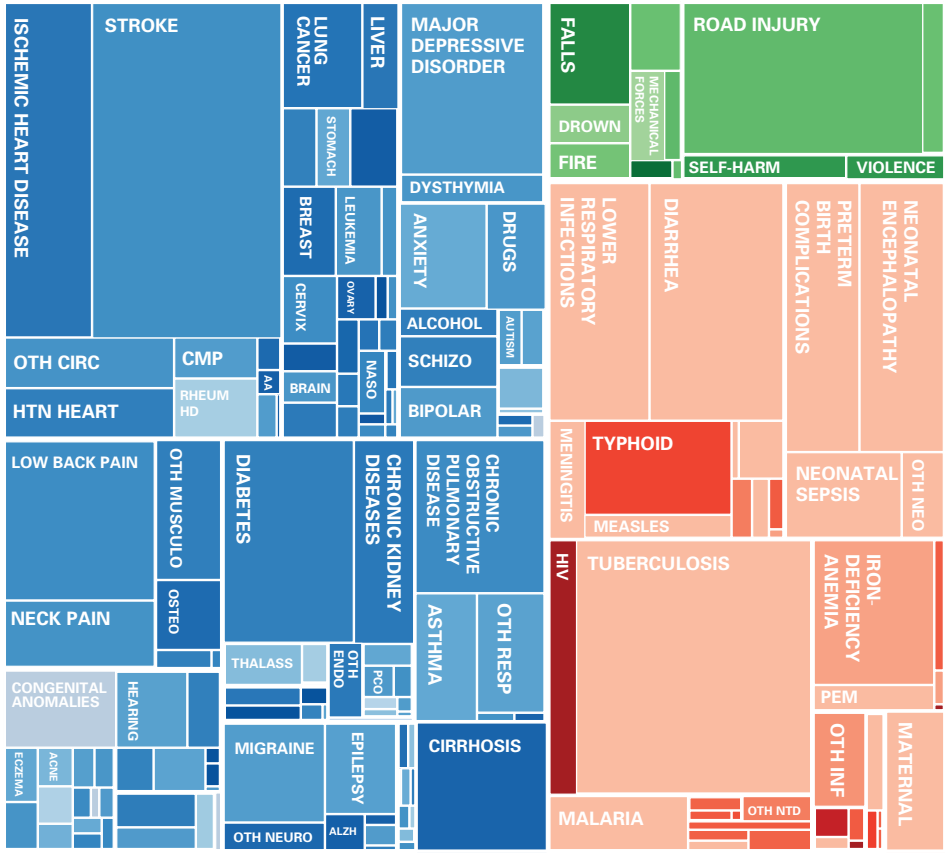
Note: The leading 20 causes of DALYs are ranked from top to bottom in order of the number of DALYs they contributed in 2010. Bars to the right of the vertical line show the percent by which DALYs have increased since 1990. Bars on the left show the percent by which DALYs have decreased. Pointed arrows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

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

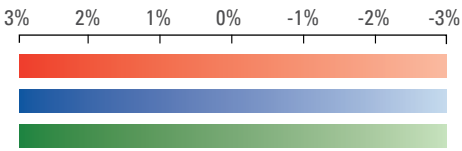


Note: The size of each box in this square pie chart represents the percentage of total DALYs caused by a particular disease or injury. To view an interactive version of this figure, visit IHME's website: http://ihmeuw.org/gbdcompare.

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



Annual % change, 2005 to 2010, DALYs per 100,000



Communicable, newborn, nutritional, and maternal

Non-communicable

Injuries

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.

50%. Still, the considerable burden of tuberculosis in Indonesia, and in other countries in the region, kept it as the second-leading cause of disease burden in 2010, accounting for over 5.8 million DALYs. DALYs from acute hepatitis C increased. At the same time, DALYs from many non-communicable causes rose. Increases occurred in causes such as lung cancer (105% increase), cirrhosis (95% increase), chronic kidney disease (90% increase), diabetes (86% increase), ischemic heart disease (85% increase), and stroke (76% increase). Between 1990 and 2010, health loss from injuries such as road traffic injuries and falls increased 36% and 52%, respectively.

DISABILITY INCREASES IN MIDDLE- AND HIGH-INCOME COUNTRIES

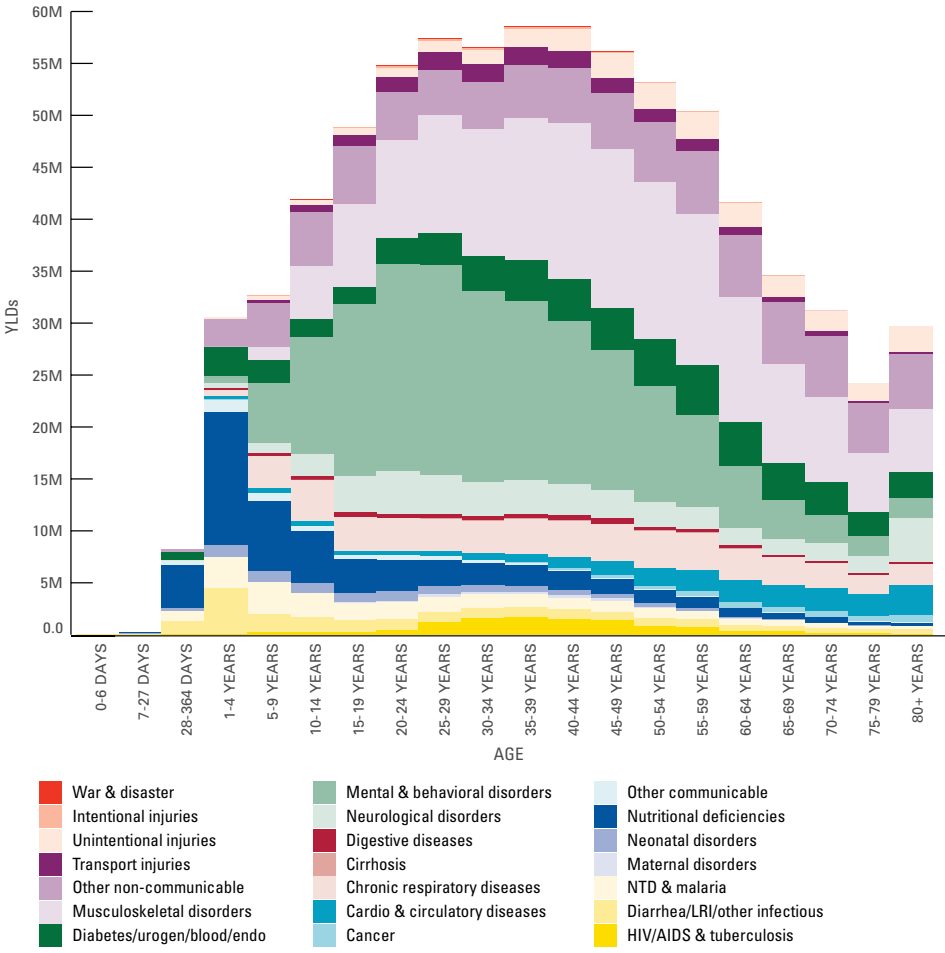
Most countries in the world have succeeded in reducing deaths early in life. To a growing extent, longer lives are redefining "old age" in many countries, and people in all age groups are dying at lower rates than in the past. Simply living longer does not mean that people are healthier. Little progress 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.

DALYs, or healthy years lost, are calculated by adding together years lived with disability (YLDs) and years of life lost (YLLs, also known as years lost to premature death). Between 1990 and 2010, years lived with disability 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 the Middle East and North Africa, parts of Latin America, and many parts of Asia. The percentage of burden from YLDs also increased in sub-Saharan Africa with the exception of the southern part of the region.

Figure 12 tells a detailed story about the different conditions that caused disability globally in 2010. It is important to keep in mind that these estimates reflect both how many individuals suffered from a particular condition as well as 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 years of disability in 20- to 29-year-olds. Musculoskeletal conditions, which include low back pain and neck pain, accounted for the next largest number of years lived with disability. People aged 45 to 54 were most impacted by these conditions, as musculoskeletal disorders caused over 30 million years of disability in each of these age groups.

Figure 13 shows disability patterns in East Asia and Pacific. Similar to the global disability results, mental and behavioral as well as musculoskeletal disorders dominated in this region. As seen in the world as a whole, most disability in children under 5 was from nutritional deficiencies in East Asia and Pacific.

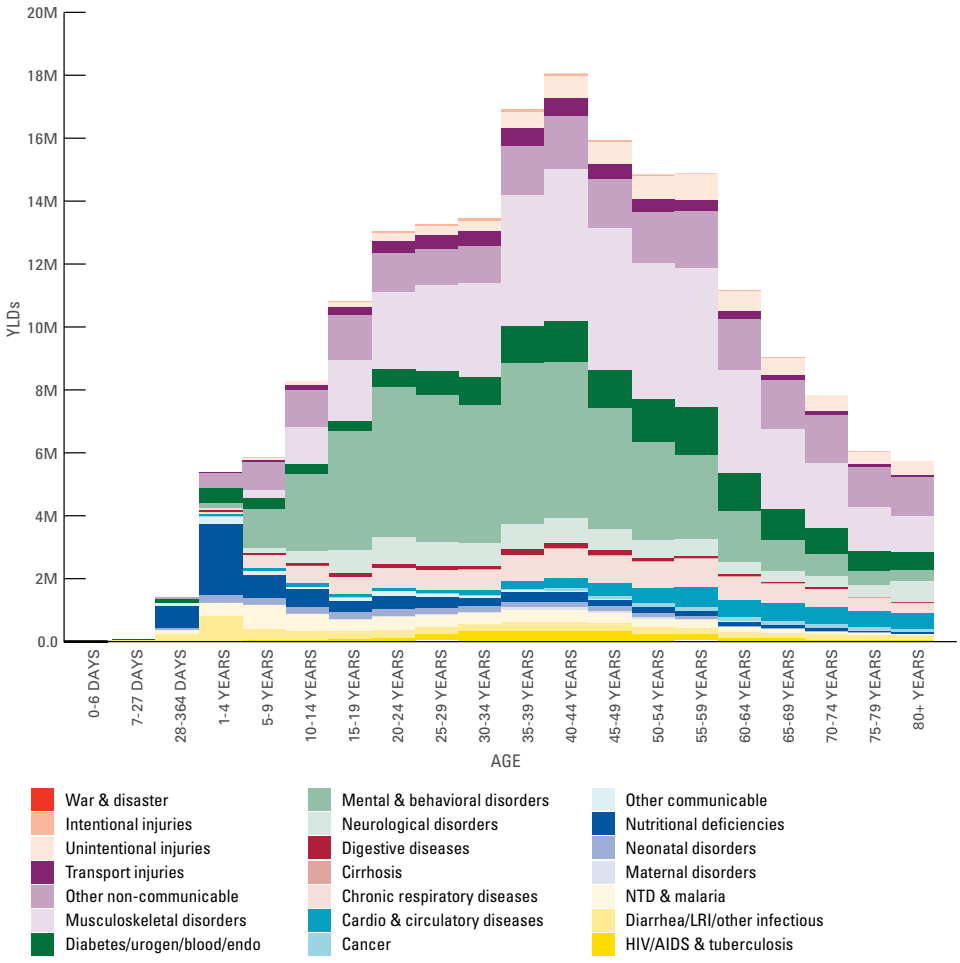
Figure 12: Global disability patterns by broad cause group and age, 2010



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

Another way to view the world's health challenges is by comparing how different conditions rank. Figure 14 ranks the leading causes of disability in the world and each of the six World Bank regions, using color coding 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. This condition can inhibit people's ability to perform different types of work both inside and outside the home and impair their mobility. In addition to low back pain, neck pain and other musculoskeletal disorders ranked in the top 10 causes of disability in most regions. Another musculoskeletal disorder, osteoarthritis, appeared in the top 20 causes of disability in every region.

Figure 13: Disability patterns by broad cause group and age in East Asia and Pacific, 2010

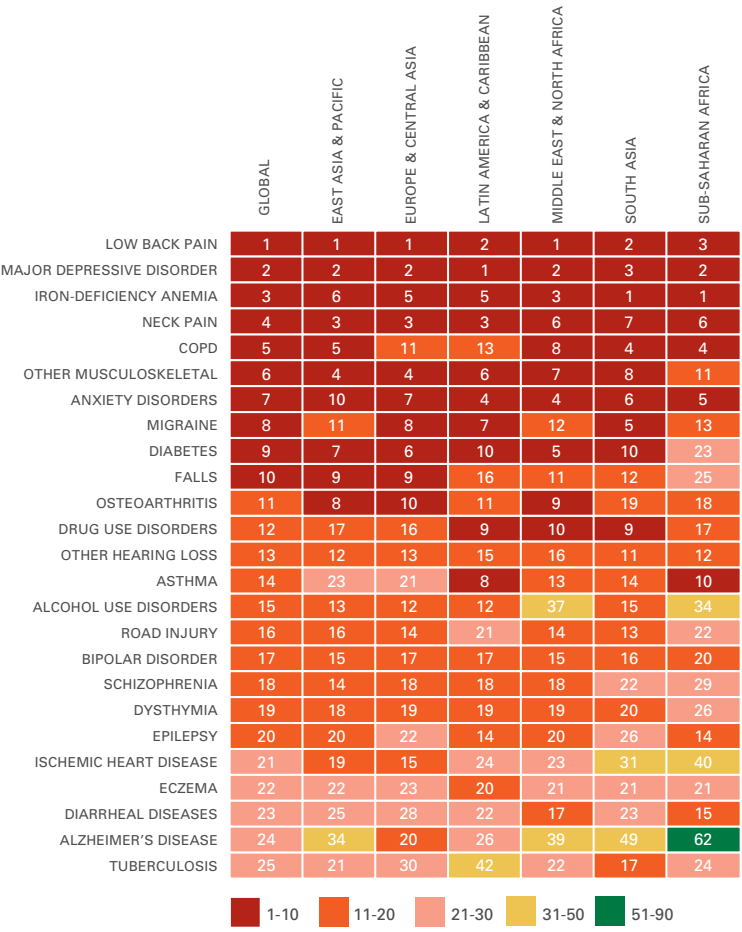


Note: The size of the colored portion in each bar represents the number of YLDs attributable to each cause for a given age group. The height of each bar shows total YLDs for a given age group in 2010. The causes are aggregated. For example, musculoskeletal disorders include low back pain and neck pain.

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. Anxiety, a different type of mental disorder, was one of the top 10 causes of disability in all regions. Additionally, two other mental disorders, schizophrenia and bipolar disorder, appeared among the top 20 causes of disability in many regions.

While mental and musculoskeletal disorders ranked high among causes of disability across regions, Figure 14 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 it was less important as a cause of disability in the other regions. The substantial burden in these two regions contributed to iron-deficiency

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



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

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.

COPD was the fourth top cause of disability in South Asia and sub-Saharan Africa, and it ranked fifth for the East Asia and Pacific region. In many other regions, COPD appeared in the list of the top 10 causes.

In East Asia and Pacific, many of the leading causes of disability were similar to global rankings, but there were key differences. Drug use disorders, asthma, and Alzheimer's disease all ranked lower as causes of years lived with disability in this region than they did in the world as a whole.

Other causes of disability were more important in East Asia and Pacific compared to global trends. Osteoarthritis was the eleventh cause of disability globally, but ranked eighth in East Asia and Pacific. Diabetes also ranked higher in this region compared to the world as a whole. Diabetes was the ninth-leading cause of disability globally, but ranked seventh in East Asia and Pacific.

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

THE GLOBAL RISK FACTOR TRANSITION

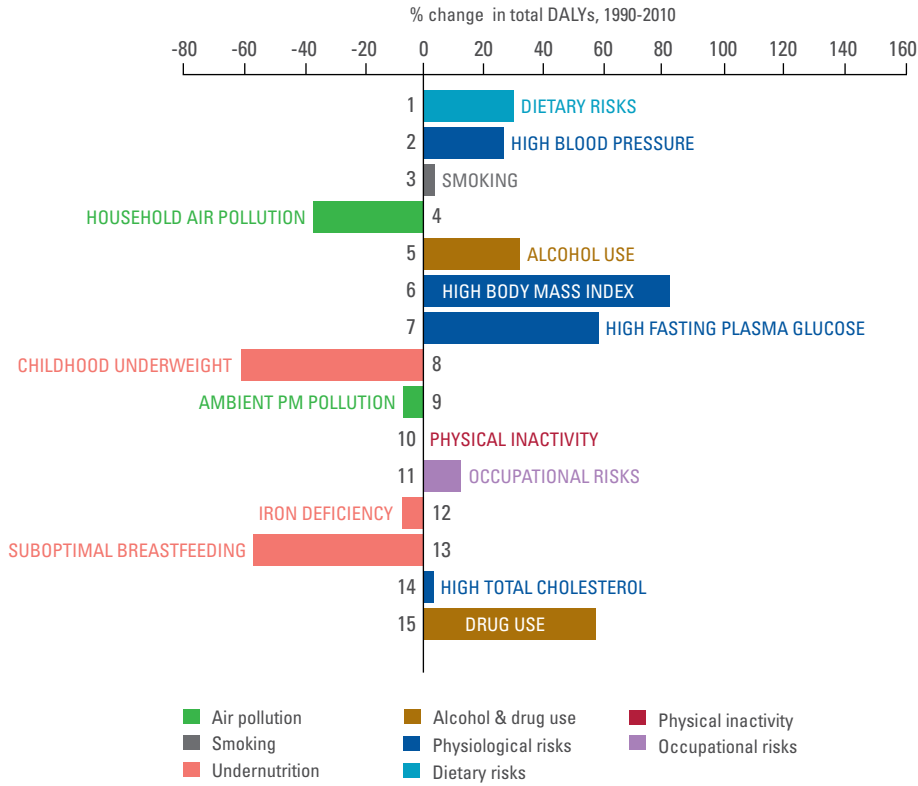
Data on potentially modifiable causes of health loss, or risk factors, can help policymakers and donors prioritize prevention strategies to achieve maximum health gains. GBD tools estimate the number of deaths, premature deaths, years lived with disability, and DALYs attributable to 67 risk factors worldwide.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

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

Slow progress in reducing iron deficiency helps explain why iron-deficiency anemia ranks as the third-leading cause of disability globally.

As most risk factors for communicable diseases in children have declined, many risks associated with non-communicable diseases have grown. As the leading global risk factor for 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 grains. GBD found the diseases linked to poor diets are primarily cardiovascular diseases as well as cancer and diabetes. While the focus of 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 15: Global shifts in rankings of DALYs for top 15 risk factors, 1990-2010



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

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

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

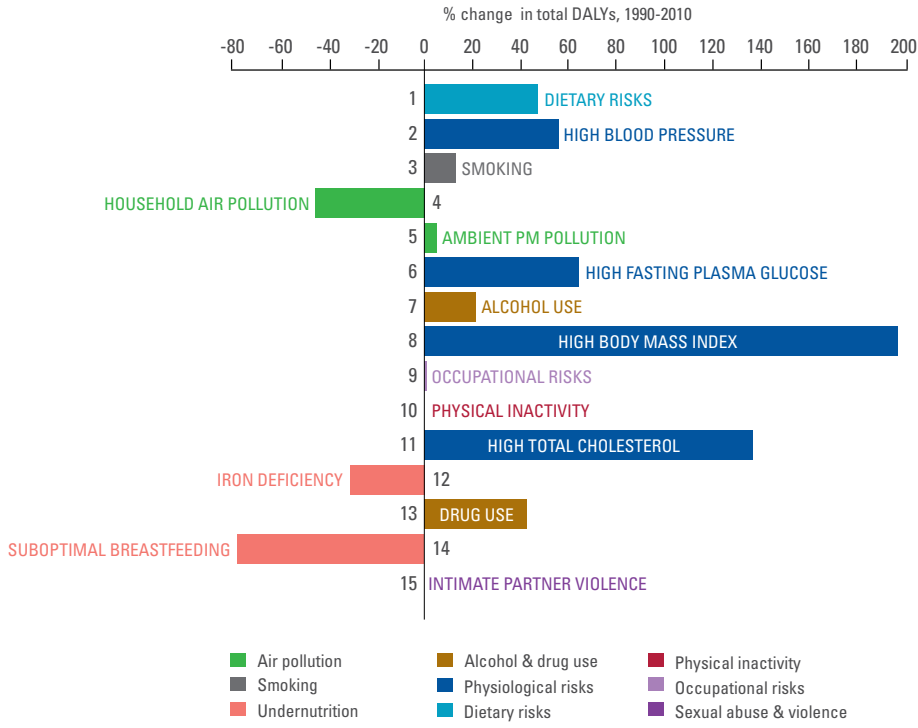
High BMI was another major contributor to DALYs in 2010 and was the sixth-leading risk factor. High BMI is typically used as an indicator of overweight and obesity. It increased by a dramatic 82% over the period 1990 to 2010. High BMI is a leading risk factor for cardiovascular and circulatory diseases 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.

Figure 16 shows changes in leading risk factors for East Asia and Pacific. Similar to global trends, many risk factors for communicable diseases declined between 1990 and 2010, but decreases were even more dramatic in the East Asia and Pacific region. However, in comparison to the world overall, premature death and disability attributable to risk factors for non-communicable diseases such as dietary risks, high blood pressure, smoking, and high BMI increased by greater amounts in this region. For example, DALYs attributable to high BMI increased 82% globally from 1990 to 2010, but rose by 198% in East Asia and Pacific. Ambient PM air pollution was a more important cause of premature death and disability (fifth) in the region than it was in the world as a whole (ninth), largely due to China's high levels of this risk factor. Increases in DALYs attributable to drug use between 1990 and 2010 were lower in the region than global increases.

Global and regional rankings of risk factors mask important differences across countries. Figure 17 shows substantial variation in leading risk factors for DALYs in select East Asia and Pacific countries in 2010. Dietary risks were the leading risk factors in most Southeast Asian countries, but high BMI dominated in many Pacific nations. High fasting plasma glucose also ranked high in the Pacific nations shown in Figure 17. Smoking ranked second or third in Cambodia, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, the Philippines, Thailand, Timor-Leste, and Vietnam.

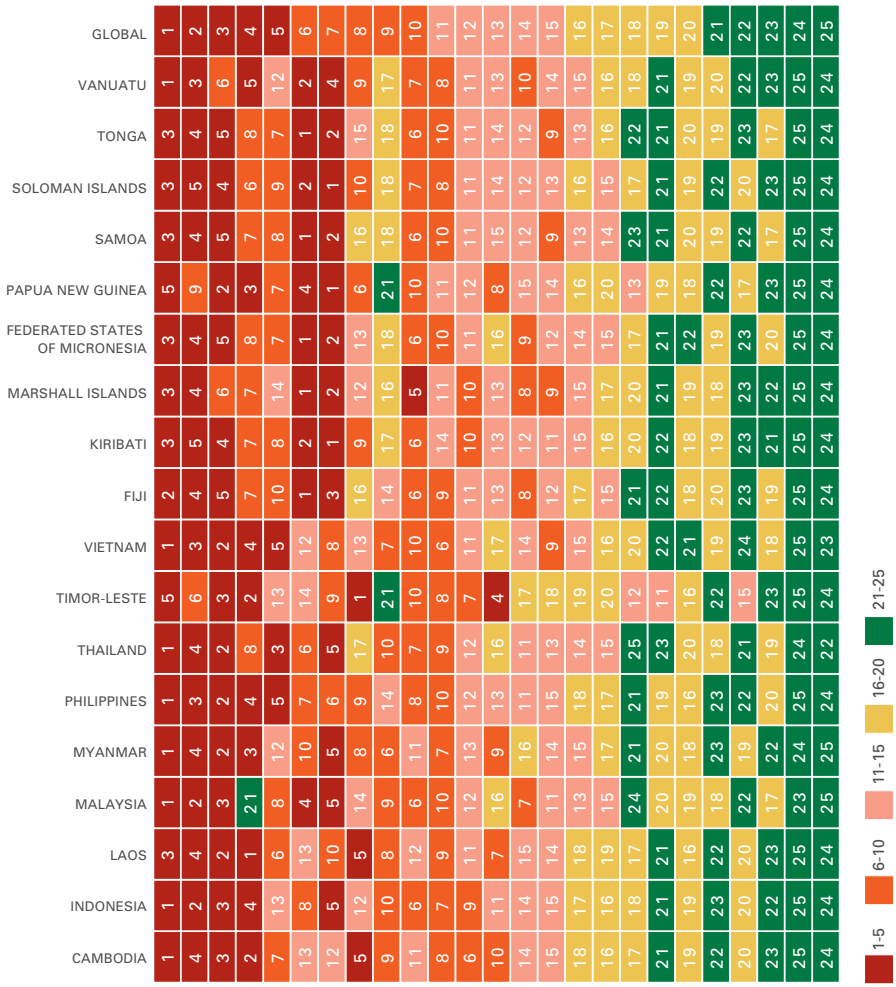
Stark contrasts existed between risk factors in upper-middle-income countries such as Malaysia and Thailand, where risk factors for non-communicable diseases constituted most of the top 10 risk factors, and low- and lower-middle-income countries including Cambodia, Laos, and Timor-Leste, where many more risks associated with childhood illness appeared among the top 10 risk factors. Household air pollution was the second-leading risk factor attributable to DALYs in Cambodia and Timor-Leste, and ranked first in Laos. Childhood underweight was the number one cause of premature death and disability in Timor-Leste, and was the fifth-leading cause in Cambodia and Laos. Suboptimal breastfeeding and iron deficiency were other risk factors that ranked among the top 10 in these low- and lower-middle-income countries. In Malaysia and Thailand, many non-communicable disease risks such as dietary risks, smoking, high BMI, high blood pressure, and high fasting plasma glucose were the dominant causes of DALYs.

Figure 16: Shifts in rankings of DALYs in East Asia and Pacific for top 15 risk factors, 1990-2010



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

Figure 17: Rankings of DALYs attributable to leading risk factors across select countries in East Asia and Pacific, 2010



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

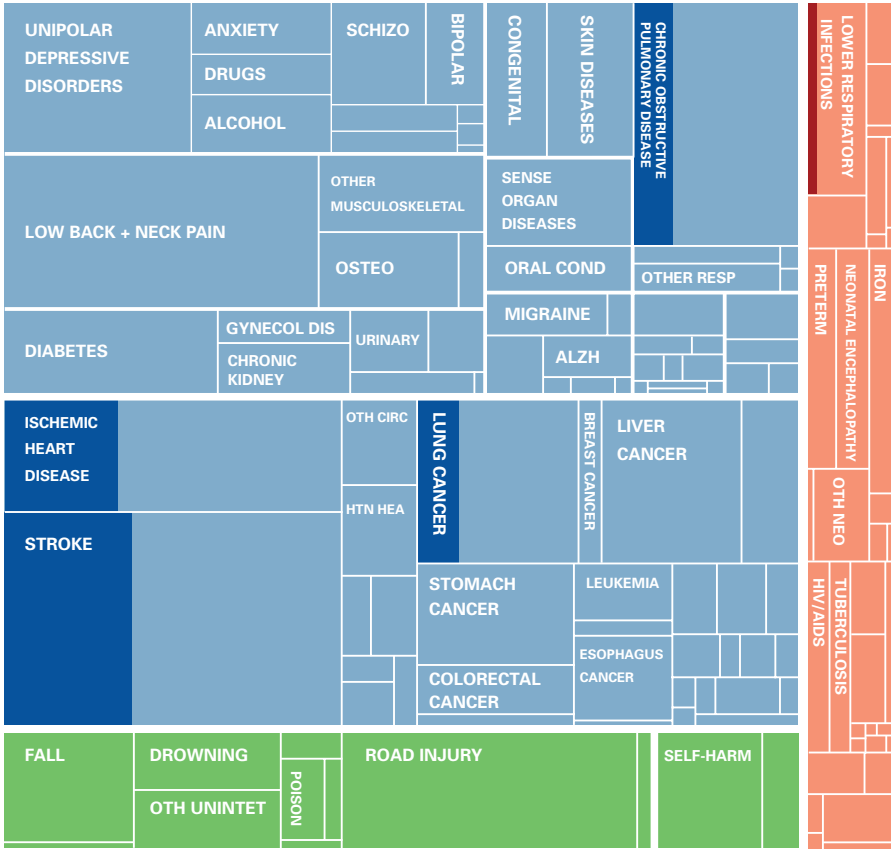
In addition to allowing users to explore how different risk factors rank across countries, decision-makers can use GBD visualization tools to understand how many DALYs could potentially be averted by addressing different risk factors. Figure 18 shows the number of DALYs attributable to outdoor air pollution, also known as ambient PM air pollution, that contributed to different diseases in China. The percentage of DALYs that could be averted by reducing this risk factor is shown in dark shading.

The figure indicates how reducing exposure to air pollution could prevent large amounts of premature death and disability from ischemic heart disease and stroke, as indicated by the portion of these causes that are shaded in dark blue. Lower levels of air pollution could also reduce DALYs from lung cancer and COPD.

Figure 19 shows how, in Vietnam, many DALYs could be averted by eliminating tobacco smoking, including second-hand smoke. Most DALYs from COPD and lung cancer were caused by tobacco smoking and second-hand smoke, as indicated by the dark blue portion of the boxes representing these causes. Substantial numbers of healthy years lost from ischemic heart disease, stroke, and liver cancer could also be prevented by reducing exposure to these risk factors.

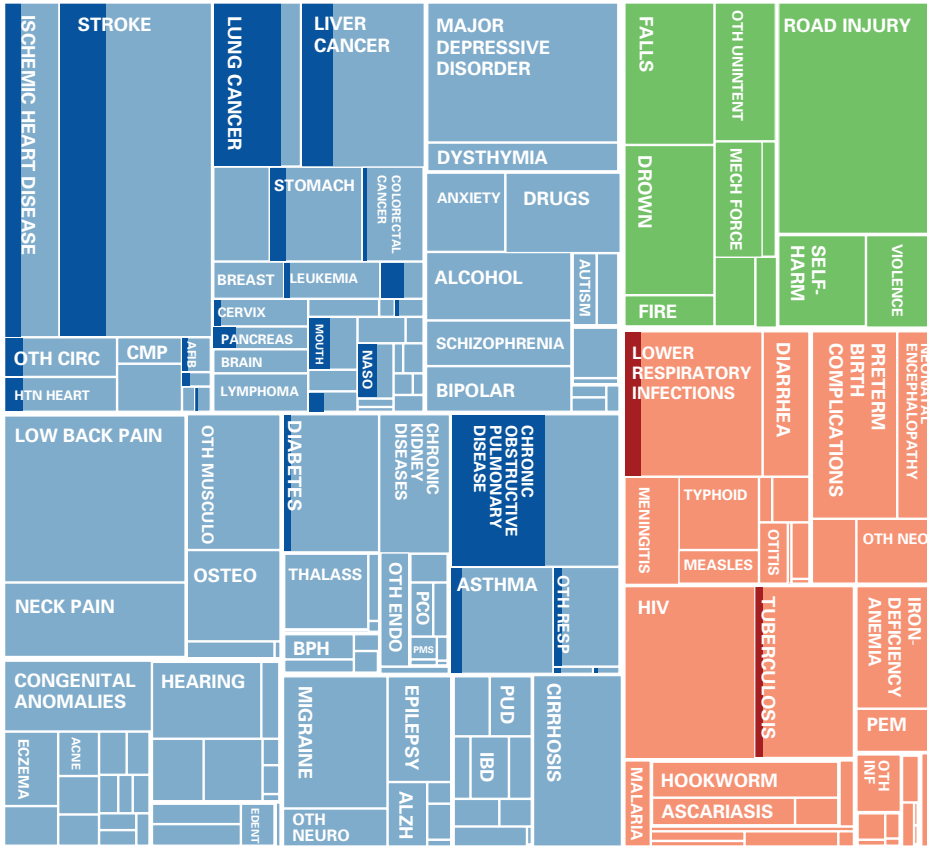
Figure 20 shows the number of DALYs attributable to childhood underweight in children from 1 month to 11 months old in Timor-Leste. This figure can be used to understand the number of years of healthy life that could potentially be gained by ensuring that all children in this age group in Timor-Leste are a healthy weight. Children of healthy weight is defined as a population of children that matches the 2006 World Health Organization Child Growth Standards reference. 65% of the DALYs attributable to diarrhea and 100% of DALYs attributable to protein-energy malnutrition could also potentially be prevented in this age group, as indicated by the dark shading in the boxes representing these causes. Ensuring more children achieve a healthy weight would also greatly reduce illness from lower respiratory infections.

Figure 18: DALYs attributable to ambient particulate matter air pollution, both sexes, all ages, China, 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.

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



DALYs attributable to risk factor

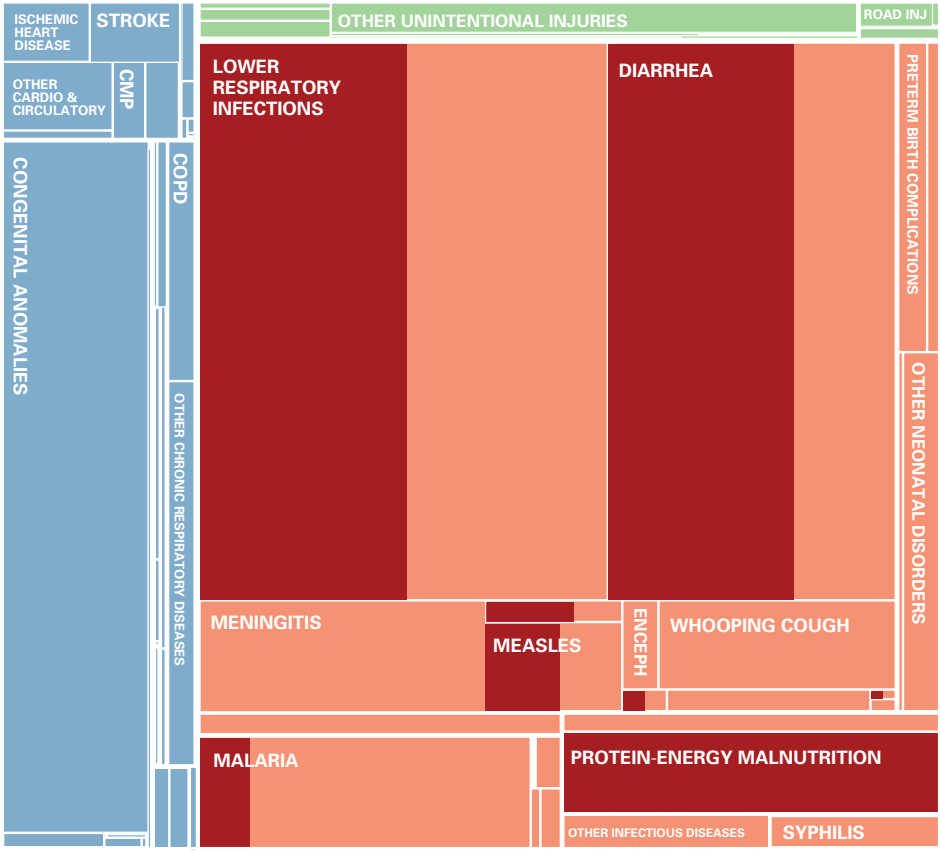
- Communicable, newborn, nutritional, and maternal
- Non-communicable
- Injuries

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 20: DALYs attributable to child underweight, both sexes, ages 1-11 months, Timor-Leste, 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

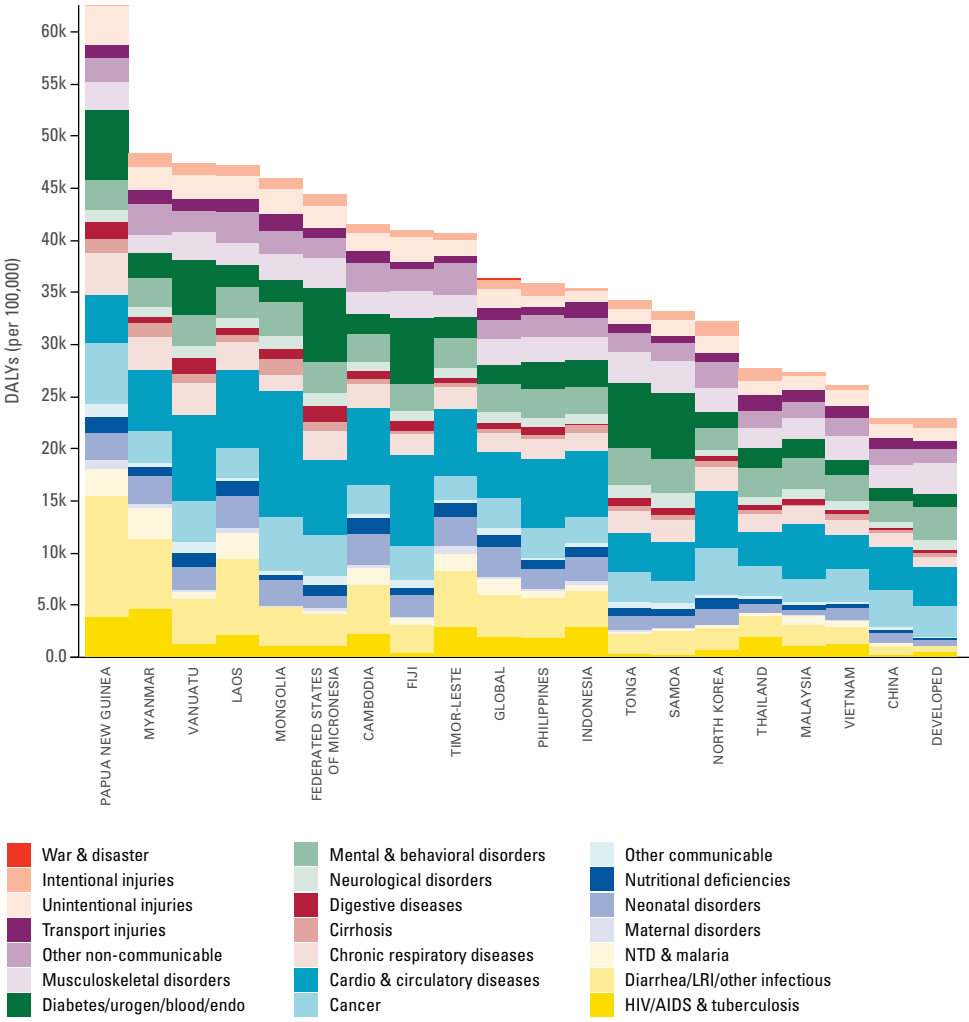
GBD found that factors such as population growth, longer lives, and decreasing mortality are driving up the years of healthy life lost, or DALYs, from non-communicable diseases in many countries. Although non-communicable diseases are increasing relative to other health problems as a result of these 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.

For example, many countries in the East Asia and Pacific region have made steady progress in reducing age-standardized DALY rates from lower respiratory infections, tuberculosis, neonatal disorders such as preterm birth complications and neonatal encephalopathy, and diarrheal diseases. Countries including China and Vietnam made progress in reducing age-standardized rates of non-communicable diseases including stroke and cirrhosis, and age-standardized rates of cervical cancer dropped in Thailand between 2000 and 2005. However, rates of ischemic heart disease and lung cancer rose in many countries in the region. Most countries in the region made little or no progress in causes such as low back pain and depression. To explore age-standardized rates of diseases and injuries at the country level between 1990 and 2010, visit IHME's data visualization tools at www.ihmeuw.org/GBDcountryviz.

GBD can be used to compare and contrast disease patterns across countries. Figure 21 shows causes of age-standardized DALYs per 100,000 people. Many countries in East Asia and Pacific had rates of DALYs from communicable, newborn, nutritional, and maternal conditions that were lower than all countries of the world as a whole. Low- and lower-middle-income countries including Cambodia, Indonesia, Laos, Myanmar, Papua New Guinea, Timor-Leste, and Vanuatu had the highest age-standardized rates of communicable, newborn, nutritional, and maternal conditions of all the countries shown in Figure 21. Fiji, the Federated States of Micronesia, Papua New Guinea, Samoa, Tonga, and Vanuatu stood out as countries with high age-standardized rates of diabetes, urogenital, blood, and endocrine disorders, while Cambodia, Fiji, and Mongolia had elevated levels of cardiac and circulatory diseases. Compared to other countries shown in Figure 21, upper-middle-income countries such as China, Malaysia, and Thailand and lower-middle-income Vietnam had age-standardized rates of total DALYs that were closer to rates seen in developed countries.

Figure 21: Age-standardized DALY rates across select countries in East Asia and Pacific, 2010



Note: The size of the colored portion in each bar represents the 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.

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

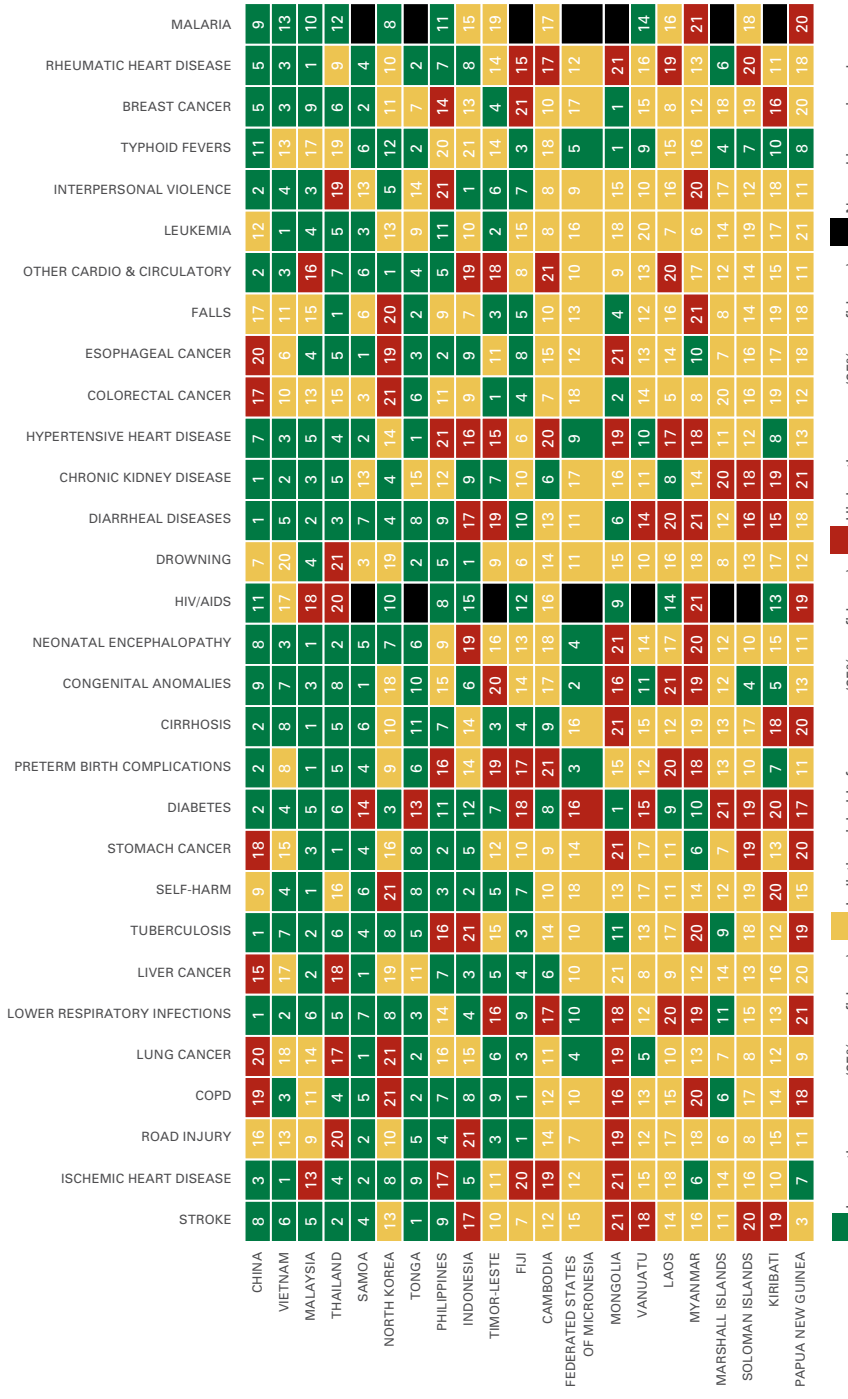
As an example of a benchmarking exercise, Figure 22 ranks levels of premature mortality or years of life lost in East Asia and Pacific countries in 2010. The columns are arranged by the top 30 causes of years of life lost in the region. The countries are ordered according to levels of premature mortality.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

Figure 22 can be used to compare the performance of East Asia and Pacific countries and can help countries identify priority areas for improvement. For example, Malaysia performed better than the regional average for most causes of premature death, but performed poorly in areas such as ischemic heart disease, HIV/AIDS, and other cardiovascular and circulatory diseases. Thailand was a top performer in the region for causes including stroke, stomach cancer, neonatal encephalopathy, and falls, but ranked near the bottom for road injury, lung cancer, liver cancer, HIV/AIDS, drowning, and interpersonal violence. Country comparisons can be used for selecting case studies to understand why performance differs across countries. For example, case studies could potentially reveal why Vietnam performed much better than most of its lower-income counterparts in many disease areas.

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

For the UK, 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 UK performs both better and worse than its peers. In addition, analysis of potentially modifiable risk factors can shed light on ways that public health policy could address major causes of ill health and premature death. The IHME-UK benchmarking study aims to identify key opportunities to speed up the pace of health improvements in the nation.

Figure 22: Causes of leading years of life lost, East Asia and Pacific 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 21 as the worst.

CONCLUSION

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

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

In East Asia and Pacific, GBD 2010 documented important regional trends that reveal increasing disease burden due to non-communicable diseases and injuries. The burden of non-communicable diseases such as stroke; ischemic heart disease; low back pain; trachea, bronchus, and lung cancers; and diabetes grew in these countries between 1990 and 2010. Road injuries were the third-leading cause of premature death and disability in the region. Removing the effects of demographic changes by using age-standardized rates to measure health progress in the region shows that countries including China and Vietnam have reduced rates of non-communicable diseases such as stroke and cirrhosis, but ischemic heart disease and lung cancer remained problem areas in many countries.

Risk factors such as dietary risks, high blood pressure, smoking, household and ambient particulate matter air pollution, high fasting plasma glucose, and high BMI have become important threats to public health in many countries in East Asia and Pacific. At the same time, risk factors related to illness in children persist in certain countries such as Cambodia, Laos, and Timor-Leste.

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

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

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

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

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

ANNEX

METHODS

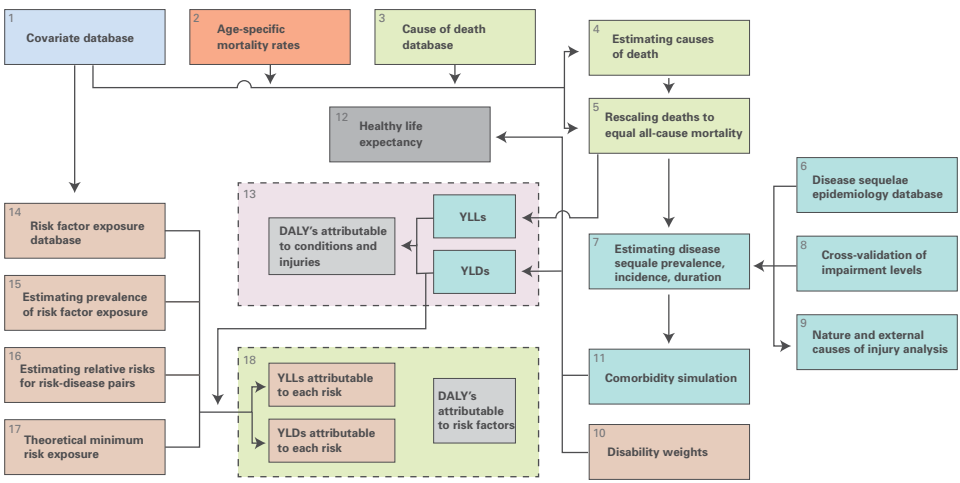
The analytical strategy of GBD

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

Estimating age- and sex-specific mortality

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

Figure A1: The 18 components of GBD and their interrelations

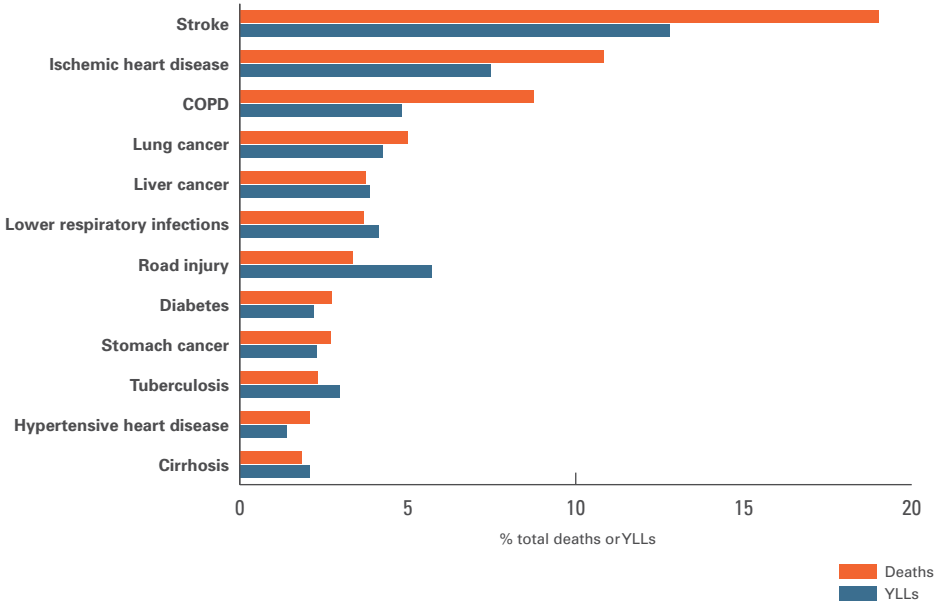


Estimating years lost due to premature death

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

Next, researchers examined the accuracy of the data, scouring rows and rows of data for "garbage codes." Garbage codes are misclassifications of death in the data, and researchers identified thousands of them. Some garbage codes are instances 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.

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



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

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

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

Estimating years lived with disability

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

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

Estimating disability-adjusted life years

DALYs are calculated by adding together YLLs and YLDs. Figure A3 compares the 10 leading diseases and injuries calculated as percentages of both deaths and DALYs in East Asia and Pacific. This figure also shows the top 10 risk factors attributable to deaths and DALYs worldwide. It illustrates how a decision-maker looking only at the top 10 causes of death would fail to see the importance of low back pain and depression, for example, which were leading causes 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.

Estimating DALYs attributable to risk factors

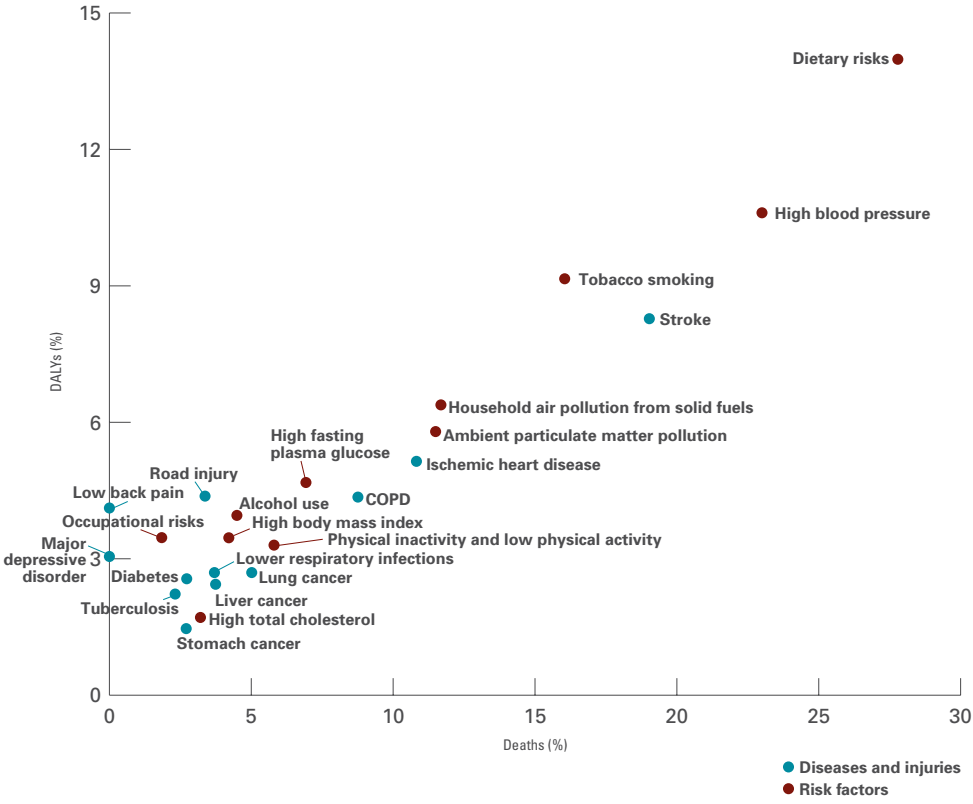
To estimate the number of healthy years lost, or DALYs, attributable to potentially avoidable risk factors, researchers collected detailed data on exposure to different risk factors. The study used data from sources such as satellite data on air pollution, breastfeeding data from population surveys,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



Note: This figure compares the percent of DALYs and deaths attributable to different diseases and injuries (shown in blue) as well as risk factors (shown in red). Certain causes, such as low-back pain, cause substantial numbers of DALYs, but cause few deaths. DALYs are an important tool for decision-makers because they capture years of healthy life lost from both fatal and non-fatal causes.

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

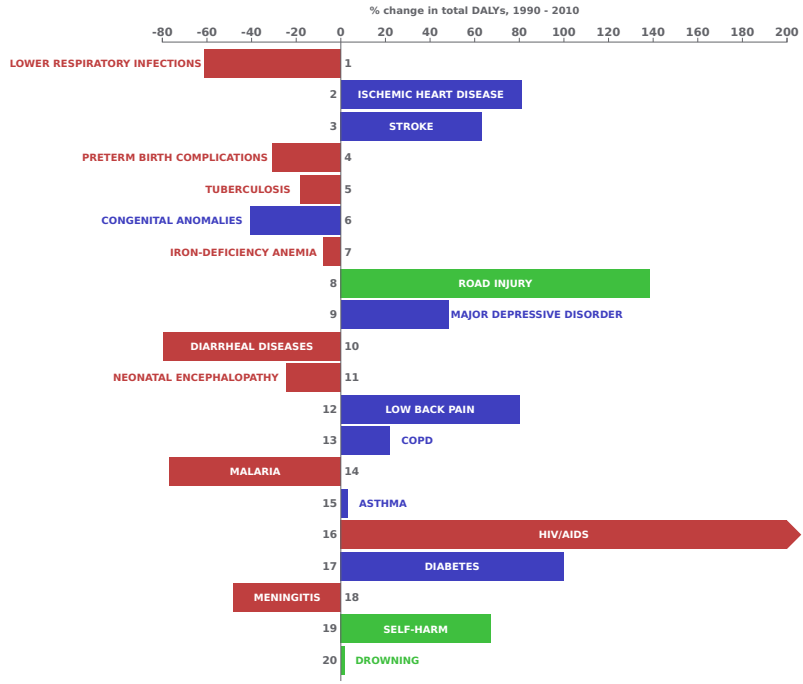
Country	**Age-standardized death rate** (per 100,000)				**Age-standardized YLL rate** (per 100,000)			
	1990		2010		1990		2010	
	Rate	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*	*Rate*	*Rank*
Cambodia	1,355 (1,298-1,426)	14 (13-16)	957 (906-1,000)	11 (9-12)	47,844 (44,932-51,313)	17 (14-18)	28,770 (26,898-30,476)	12 (11-14)
China	896 (859-944)	5 (3-7)	607 (581-633)	2 (1-2)	24,989 (23,792-26,293)	4 (4-6)	14,024 (13,416-14,996)	1 (1-2)
Fiji	1,184 (1,044-1,291)	10 (9-13)	1,068 (988-1,112)	12 (12-14)	32,309 (27,799-35,689)	9 (8-10)	28,494 (25,708-30,188)	11 (10-13)
Indonesia	1,033 (1,005-1,062)	8 (8-9)	867 (831-903)	7 (5-10)	34,584 (33,009-36,082)	10 (9-12)	24,178 (23,026-25,502)	9 (7-9)
Kiribati	1,879 (1,713-2,011)	20 (18-21)	1,528 (1,272-1,954)	20 (18-21)	58,098 (51,979-62,930)	20 (17-21)	43,508 (35,532-58,322)	20 (18-21)
Laos	1,532 (1,235-1,967)	17 (11-21)	1,094 (915-1,345)	13 (10-18)	56,031 (45,954-70,719)	19 (15-21)	34,746 (28,598-43,683)	16 (13-20)
Malaysia	825 (817-831)	2 (2-3)	726 (714-735)	4 (4-4)	19,850 (19,533-20,190)	1 (1-2)	16,000 (15,721-16,270)	3 (2-3)
Marshall Islands	1,270 (1,204-1,340)	12 (11-15)	1,309 (1,134-1,507)	18 (15-19)	36,253 (33,971-38,609)	11 (10-12)	36,337 (30,584-43,200)	18 (14-19)
Federated States of Micronesia	1,476 (1,226-1,760)	15 (12-19)	1,258 (1,015-1,620)	16 (12-19)	42,732 (34,521-51,343)	13 (11-18)	31,526 (24,359-41,443)	13 (10-18)
Mongolia	1,283 (1,226-1,334)	13 (11-15)	1,218 (1,134-1,275)	15 (14-18)	44,720 (42,159-47,172)	14 (12-16)	34,325 (31,672-36,281)	15 (13-18)
Myanmar	1,640 (1,317-2,192)	18 (14-21)	1,185 (924-1,549)	14 (10-19)	55,134 (45,237-72,341)	18 (16-21)	36,251 (28,627-47,420)	17 (13-20)
North Korea	895 (806-996)	4 (2-7)	832 (769-898)	5 (5-10)	25,915 (21,408-31,689)	5 (3-8)	21,755 (19,020-24,828)	6 (5-9)
Papua New Guinea	1,990 (1,552-2,531)	21 (18-21)	1,700 (1,249-2,230)	21 (17-21)	64,195 (51,321-81,065)	21 (18-21)	49,553 (36,132-66,110)	21 (19-21)
Philippines	909 (889-928)	7 (4-7)	868 (839-894)	8 (6-10)	28,515 (27,455-29,543)	8 (6-8)	23,262 (22,258-24,190)	8 (6-9)
Samoa	1,088 (979-1,225)	9 (8-11)	863 (760-1,012)	6 (5-11)	28,245 (25,185-32,115)	7 (5-9)	21,441 (18,386-25,965)	5 (5-9)
Solomon Islands	1,707 (1,360-2,295)	19 (15-21)	1,510 (1,194-1,898)	19 (17-21)	47,851 (36,744-65,204)	16 (12-20)	40,489 (30,586-52,994)	19 (15-21)
Thailand	712 (694-734)	1 (1-1)	663 (629-689)	3 (3-3)	20,676 (19,744-21,829)	2 (2-3)	17,227 (16,358-18,065)	4 (4-4)
Timor-Leste	1,223 (1,141-1,330)	11 (10-14)	872 (829-932)	9 (5-10)	45,244 (41,396-49,626)	15 (12-17)	26,770 (25,276-28,562)	10 (9-12)
Tonga	914 (828-990)	6 (3-7)	882 (811-1,018)	10 (5-12)	22,822 (20,145-24,995)	3 (2-4)	22,195 (20,160-26,850)	7 (5-10)
Vanuatu	1,507 (1,239-1,830)	16 (12-19)	1,291 (1,051-1,587)	17 (13-19)	41,590 (33,925-51,437)	12 (10-17)	34,595 (27,270-42,984)	14 (12-19)
Vietnam	876 (832-931)	3 (3-7)	595 (530-636)	1 (1-2)	26,230 (24,565-28,008)	6 (4-7)	15,123 (13,425-16,427)	2 (1-3)

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*
14,501 (11,962-17,393)	18 (14-21)	12,603 (10,397-15,123)	15 (9-19)	59.2 (58.5-59.9)	17 (15-18)	67.5 (66.5-68.5)	11 (10-14)	50.0 (48.1-51.8)	17 (15-19)	58.0 (56.0-59.8)	10 (10-15)
9,639 (7,954-11,700)	1 (1-2)	8,782 (7,291-10,497)	1 (1-1)	69.3 (68.3-70.3)	4 (3-6)	75.7 (74.9-76.5)	1 (1-2)	61.7 (59.9-63.3)	3 (2-5)	67.8 (66.1-69.3)	1 (1-1)
13,180 (10,848-16,091)	10 (7-18)	12,351 (10,104-14,980)	12 (7-18)	65.4 (63.0-67.6)	9 (7-13)	67.2 (65.7-68.4)	12 (10-15)	56.0 (53.4-58.6)	10 (7-12)	58.0 (55.6-59.9)	12 (10-15)
12,101 (9,909-14,596)	6 (4-10)	11,107 (9,122-13,402)	5 (3-10)	65.0 (64.5-65.5)	10 (8-12)	69.7 (68.5-70.9)	9 (6-11)	56.2 (54.4-57.8)	9 (8-11)	60.9 (59.0-62.7)	7 (5-9)
15,513 (12,565-18,794)	21 (18-21)	14,585 (12,011-17,599)	21 (18-21)	56.0 (53.0-58.8)	20 (17-21)	61.2 (56.3-65.3)	20 (15-21)	47.2 (44.5-49.8)	20 (17-21)	51.9 (47.8-55.8)	20 (17-21)
13,297 (10,942-15,971)	11 (8-17)	12,323 (10,175-14,872)	11 (7-17)	56.4 (50.6-61.1)	19 (14-21)	64.8 (59.0-69.8)	14 (8-21)	48.4 (43.6-52.5)	19 (14-21)	56.0 (51.0-60.5)	15 (10-20)
11,926 (9,901-14,286)	5 (3-9)	11,186 (9,322-13,427)	6 (3-10)	71.6 (71.5-71.6)	2 (2-3)	73.7 (73.5-73.9)	4 (3-4)	62.0 (60.2-63.7)	2 (2-4)	64.4 (62.5-66.0)	4 (3-4)
14,368 (11,695-17,264)	17 (12-21)	13,968 (11,409-16,775)	20 (16-21)	63.9 (62.3-65.5)	11 (9-13)	63.9 (60.6-66.9)	18 (13-20)	54.0 (51.7-56.2)	11 (10-14)	54.4 (51.2-57.1)	19 (14-20)
13,632 (11,181-16,374)	16 (9-19)	12,681 (10,357-15,299)	17 (9-19)	61.4 (55.0-67.2)	13 (8-20)	66.0 (59.5-71.5)	13 (6-20)	52.5 (47.6-57.0)	14 (9-19)	56.9 (51.8-61.5)	13 (7-20)
11,523 (9,367-13,876)	4 (2-9)	11,482 (9,373-13,782)	7 (4-14)	60.5 (59.8-61.1)	15 (13-16)	64.6 (63.2-66.0)	17 (13-19)	52.8 (51.1-54.3)	13 (11-15)	56.5 (54.6-58.3)	14 (12-17)
13,542 (11,178-16,362)	15 (9-18)	11,974 (9,854-14,386)	10 (6-16)	56.8 (49.8-61.8)	18 (13-21)	64.2 (57.9-69.5)	16 (9-21)	48.7 (43.4-52.9)	18 (14-21)	55.8 (50.5-59.9)	16 (10-20)
10,569 (8,572-13,047)	2 (1-4)	10,347 (8,372-12,618)	3 (2-6)	68.9 (63.8-72.2)	6 (1-11)	70.8 (68.2-72.9)	6 (5-10)	60.7 (55.8-64.1)	4 (1-9)	62.4 (59.7-64.8)	5 (4-8)
14,891 (12,129-17,954)	20 (16-21)	13,793 (11,185-16,647)	19 (16-21)	54.3 (47.0-59.9)	21 (15-21)	59.2 (51.8-65.2)	21 (15-21)	46.1 (40.7-50.8)	21 (16-21)	50.8 (44.5-55.8)	21 (16-21)
13,334 (11,117-16,042)	13 (9-17)	12,483 (10,313-15,012)	14 (9-17)	67.8 (67.5-68.1)	7 (6-8)	70.1 (69.2-71.0)	8 (5-10)	57.7 (55.6-59.4)	8 (6-9)	60.2 (58.1-62.0)	9 (7-10)
12,397 (10,122-15,071)	8 (4-13)	11,587 (9,532-14,088)	8 (4-16)	67.3 (64.2-70.3)	8 (3-11)	70.8 (68.7-72.6)	5 (5-10)	58.0 (55.1-61.0)	7 (4-10)	61.4 (59.0-63.8)	6 (5-9)
13,520 (11,141-16,339)	14 (9-19)	12,482 (10,122-15,101)	13 (8-18)	59.8 (52.8-65.5)	16 (10-21)	62.3 (56.3-67.9)	19 (12-21)	51.5 (45.8-56.1)	15 (10-21)	54.2 (49.2-58.9)	18 (11-21)
11,069 (9,071-13,228)	3 (2-5)	10,369 (8,591-12,324)	2 (2-5)	72.4 (71.6-73.2)	1 (1-2)	74.1 (73.1-75.3)	3 (2-4)	63.1 (61.1-64.8)	1 (1-2)	65.2 (63.3-66.9)	3 (2-4)
14,698 (12,107-17,655)	19 (14-21)	13,715 (11,212-16,588)	18 (15-21)	60.5 (59.2-61.6)	14 (12-17)	68.7 (67.6-69.8)	10 (8-12)	50.7 (48.6-52.7)	16 (14-18)	58.0 (55.7-60.1)	11 (10-15)
12,546 (10,245-15,204)	9 (5-15)	11,940 (9,710-14,478)	9 (5-17)	70.1 (67.6-72.0)	3 (2-7)	70.5 (68.6-72.2)	7 (5-10)	60.1 (57.5-62.6)	5 (3-7)	60.9 (58.3-63.3)	8 (5-10)
13,346 (10,934-16,107)	12 (8-18)	12,657 (10,303-15,379)	16 (8-19)	61.9 (54.2-67.7)	12 (7-20)	64.6 (58.7-69.6)	15 (9-21)	53.3 (47.2-57.9)	12 (8-19)	55.8 (51.0-60.1)	17 (10-20)
12,188 (10,027-14,672)	7 (4-10)	10,909 (9,038-13,075)	4 (2-8)	68.9 (67.9-69.9)	5 (3-7)	75.6 (74.1-77.2)	2 (1-3)	59.4 (57.4-61.3)	6 (4-7)	65.8 (63.5-67.8)	2 (2-4)

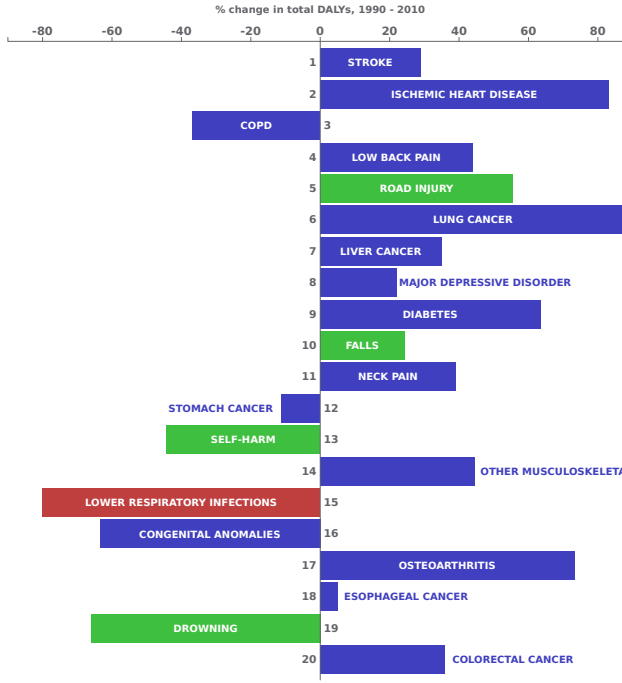
CHANGES IN LEADING CAUSES OF DALYS BETWEEN 1990 AND 2010 FOR COUNTRIES IN EAST ASIA AND PACIFIC

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

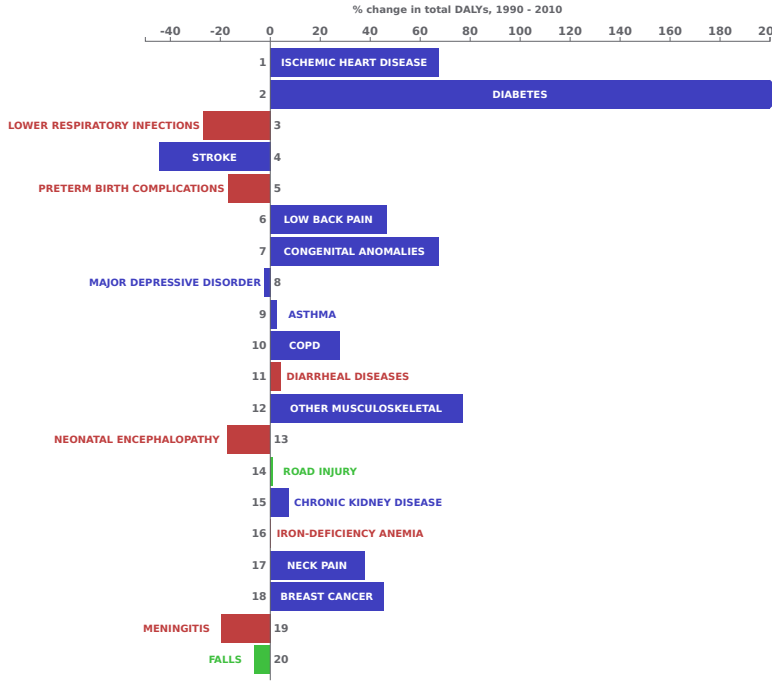
Shifts in leading causes of DALYs in Cambodia, 1990-2010



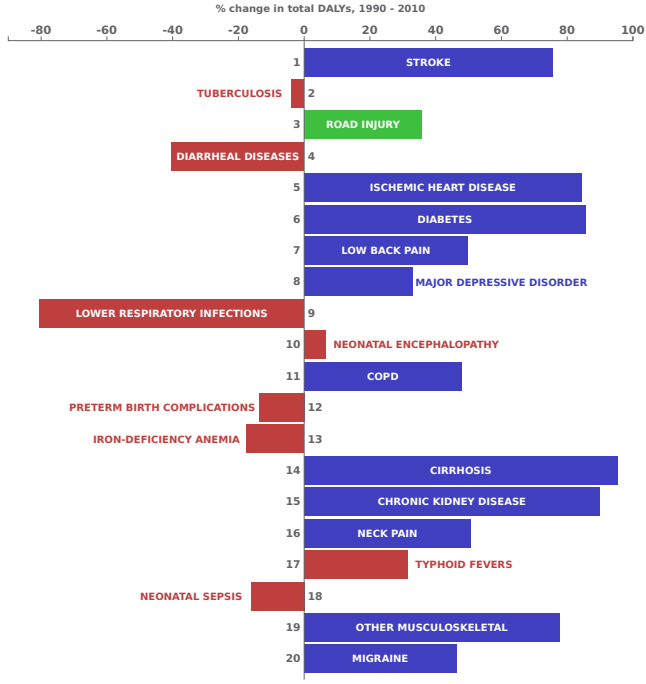
Shifts in leading causes of DALYs in China, 1990-2010



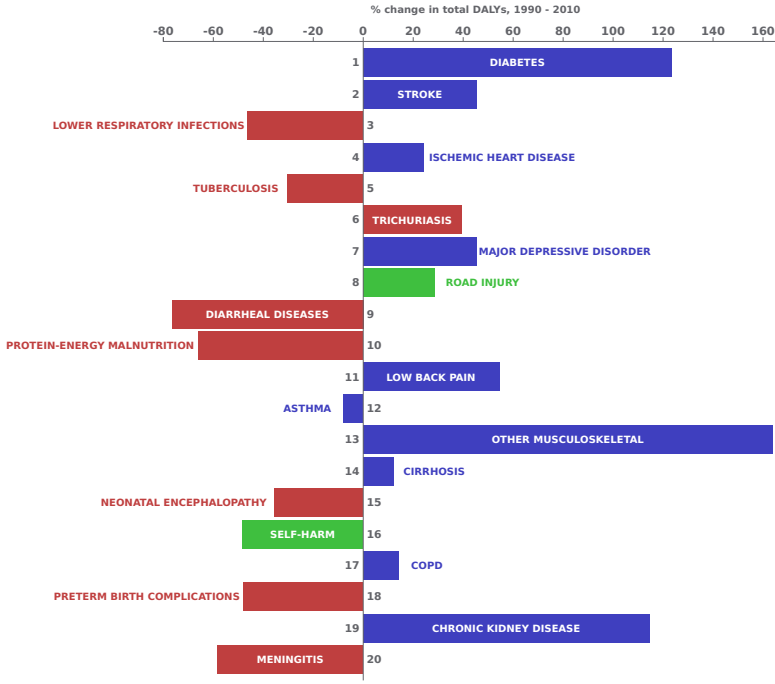
Shifts in leading causes of DALYs in Fiji, 1990-2010



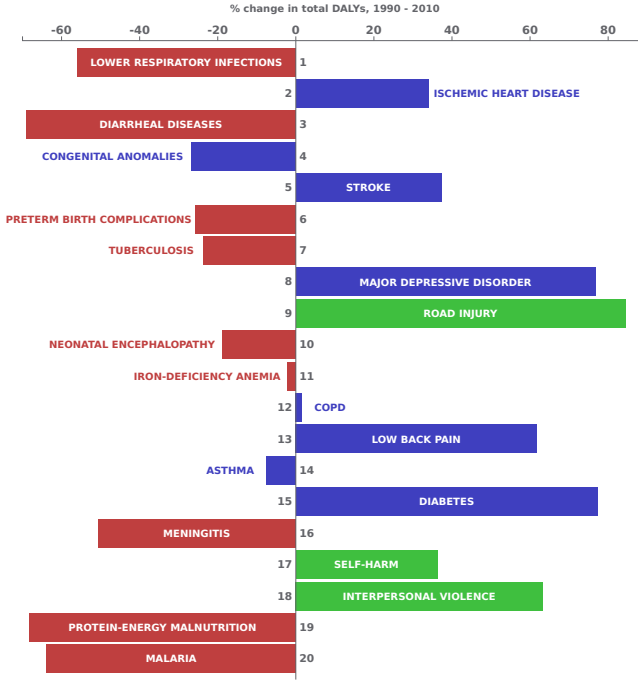
Shifts in leading causes of DALYs in Indonesia, 1990-2010



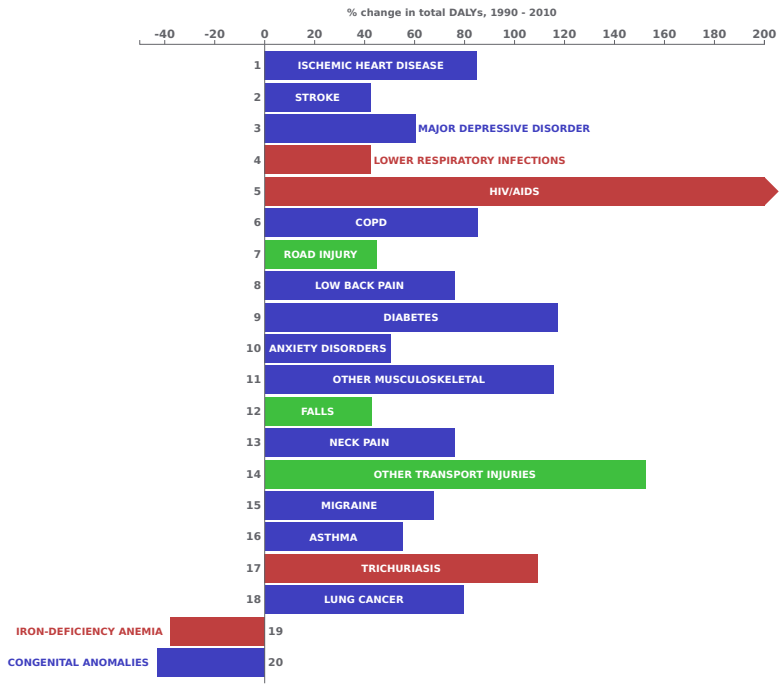
Shifts in leading causes of DALYs in Kiribati, 1990-2010



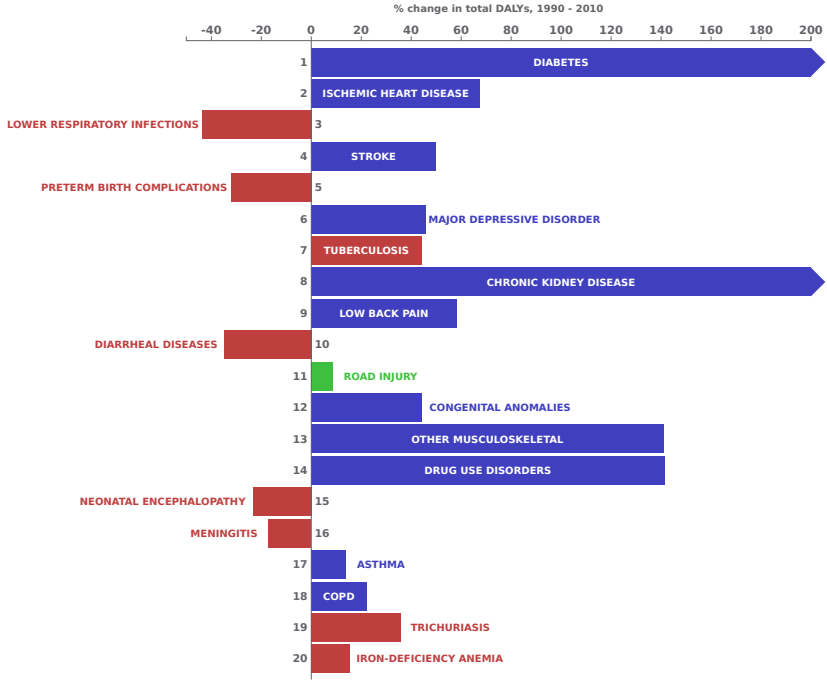
Shifts in leading causes of DALYs in Laos, 1990-2010



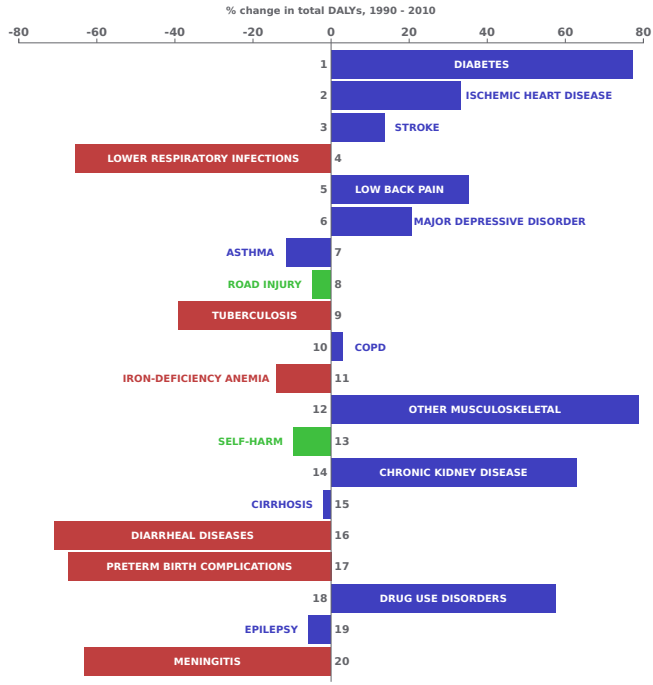
Shifts in leading causes of DALYs in Malaysia, 1990-2010



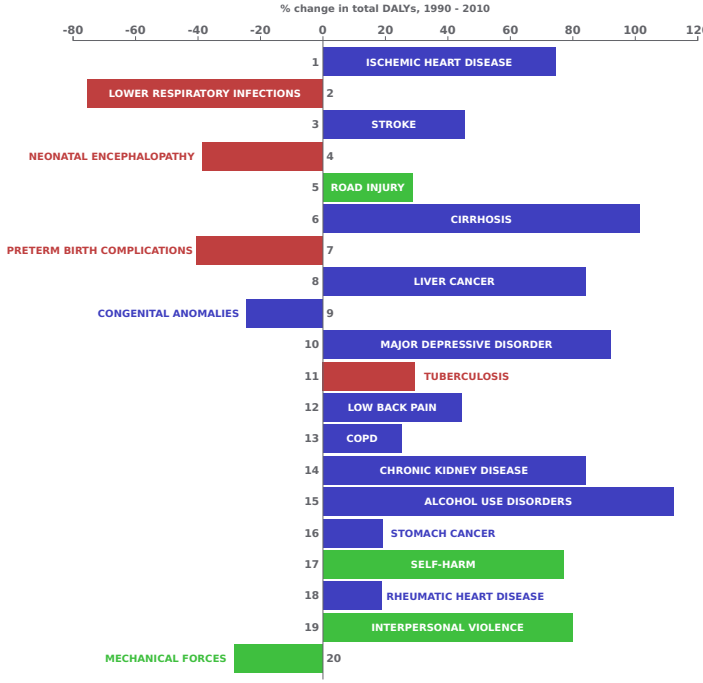
Shifts in leading causes of DALYs in the Marshall Islands, 1990-2010



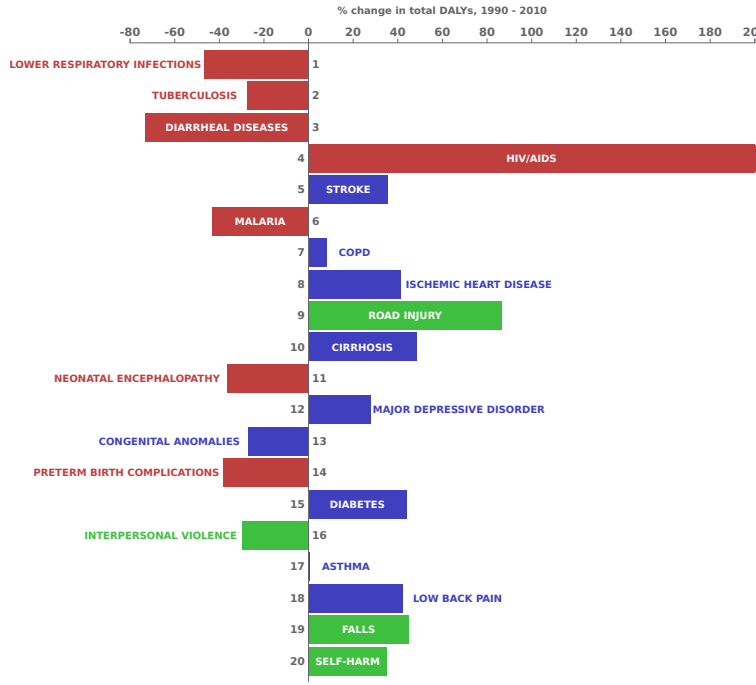
Shifts in leading causes of DALYs in the Federated States of Micronesia, 1990-2010



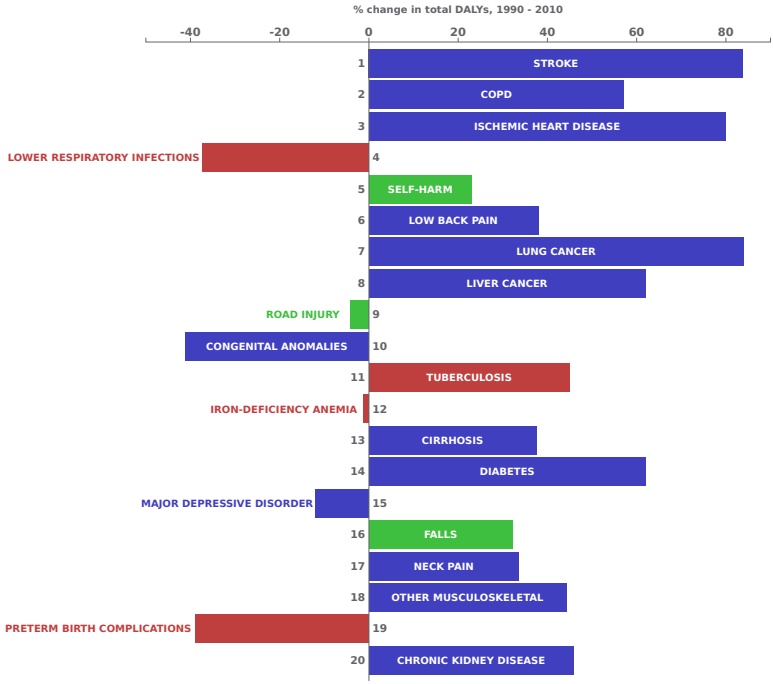
Shifts in leading causes of DALYs in Mongolia, 1990-2010



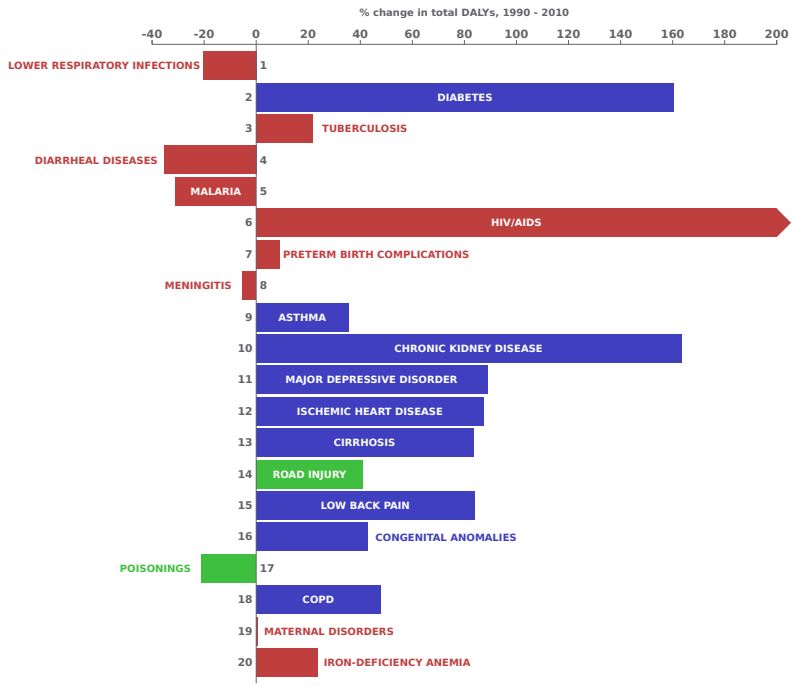
Shifts in leading causes of DALYs in Myanmar, 1990-2010



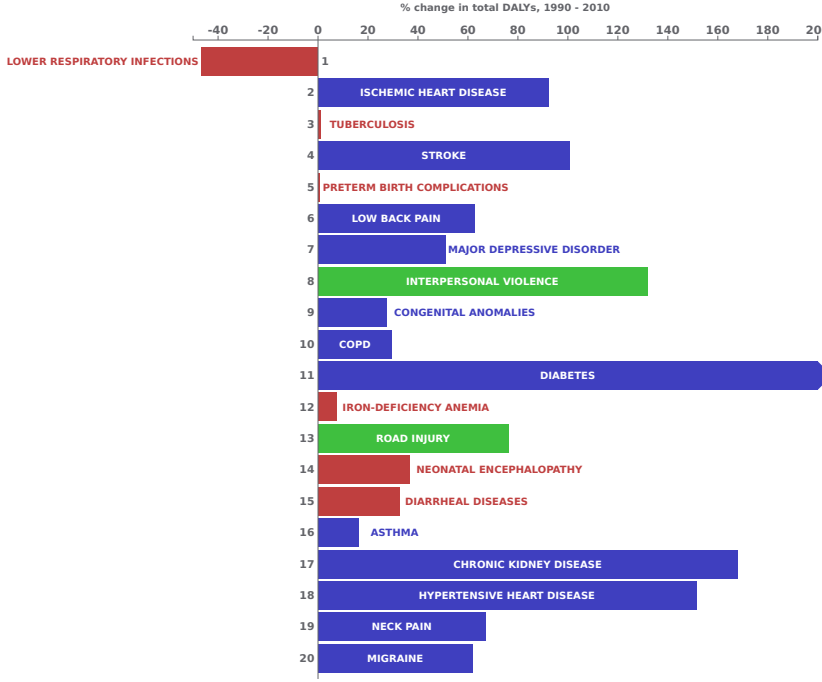
Shifts in leading causes of DALYs in North Korea, 1990-2010



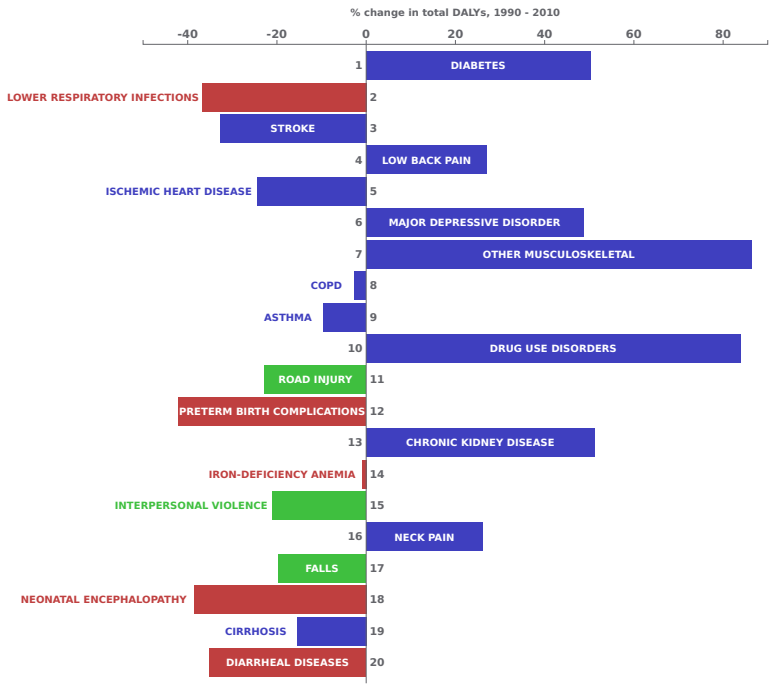
Shifts in leading causes of DALYs in Papua New Guinea, 1990-2010



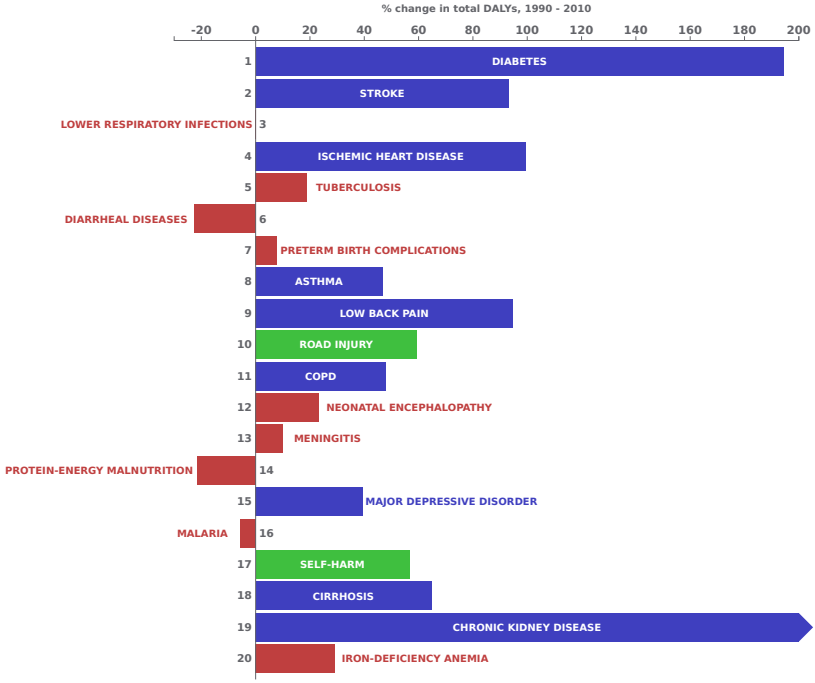
Shifts in leading causes of DALYs in the Philippines, 1990-2010



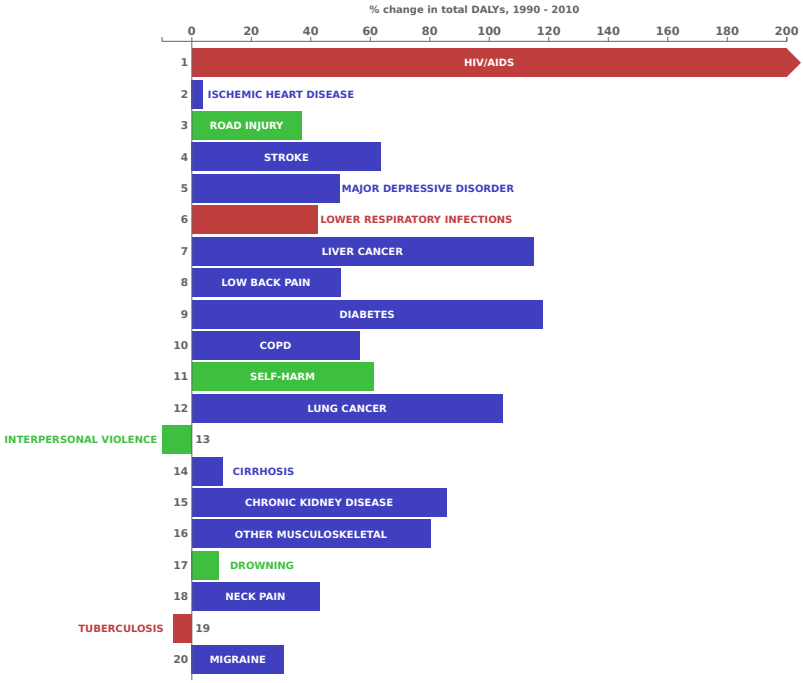
Shifts in leading causes of DALYs in Samoa, 1990-2010



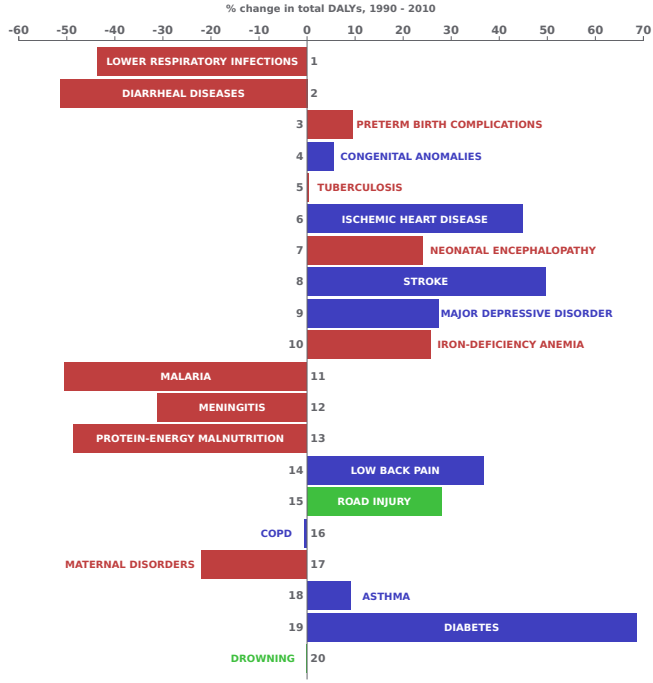
Shifts in leading causes of DALYs in the Solomon Islands, 1990-2010



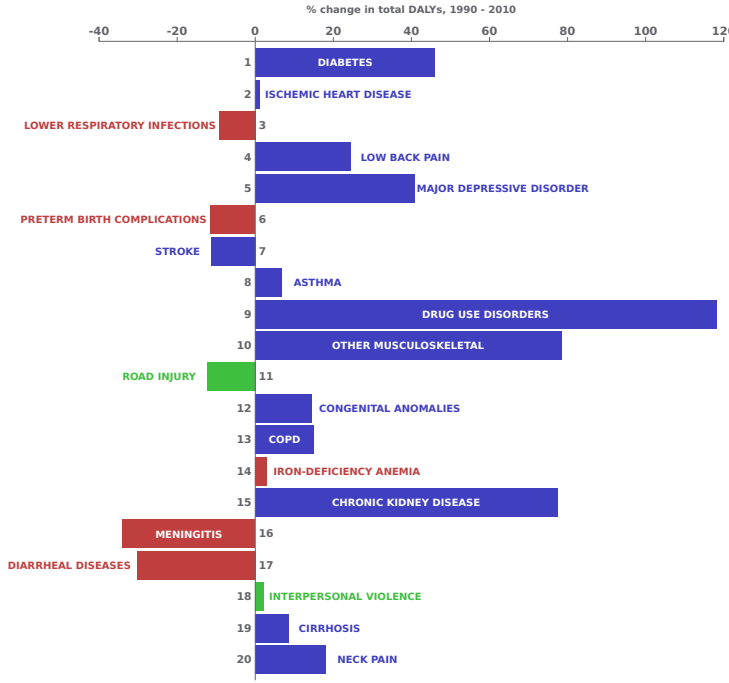
Shifts in leading causes of DALYs in Thailand, 1990-2010



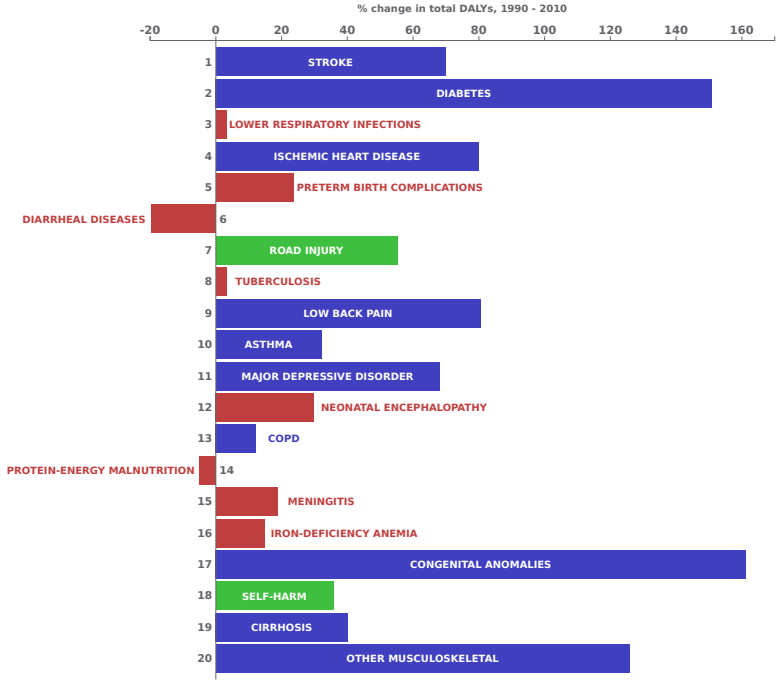
Shifts in leading causes of DALYs in Timor-Leste, 1990-2010



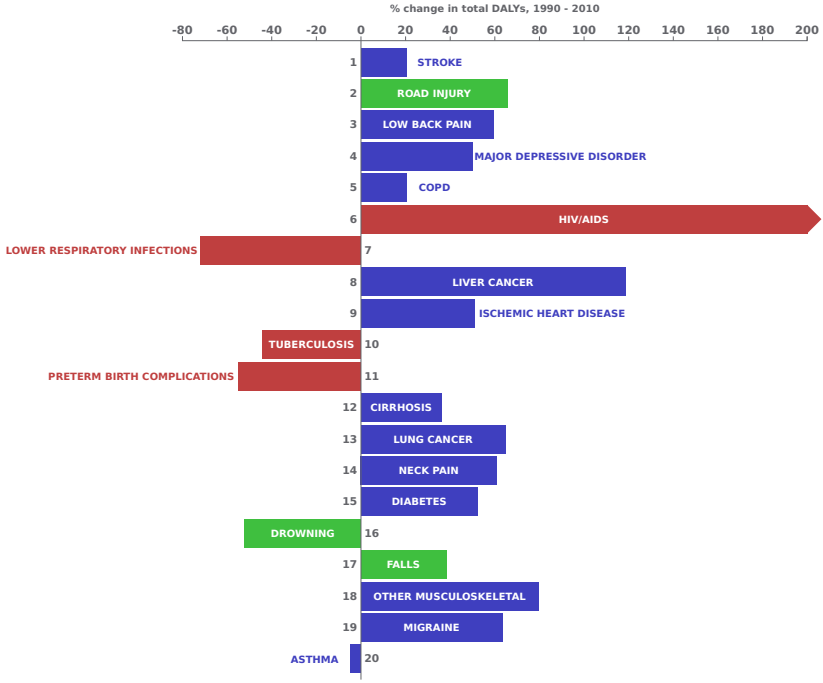
Shifts in leading causes of DALYs in Tonga, 1990-2010



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



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



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