



**World Health  
Organization**

# **Global Health Estimates: WHO's monitoring of global health and burden of diseases**

**Bochen CAO**

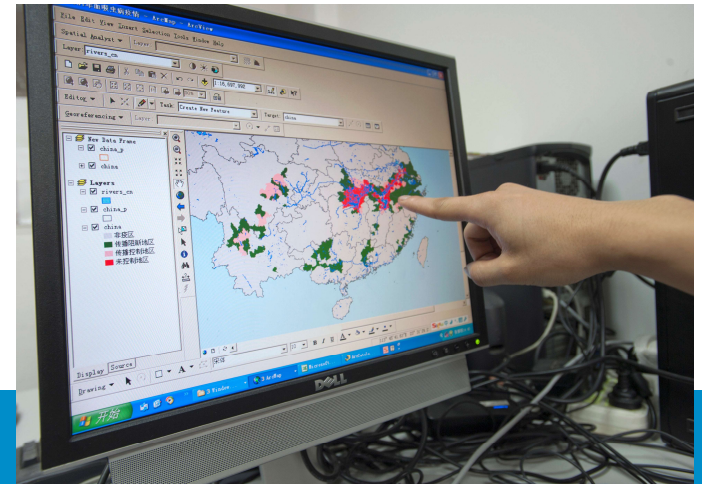
**Division of Data, Analytics and Delivery for Impact**

# | Introduction

# What are Global Health Estimates (GHE)?



- WHO's official estimates of mortality and loss of health by country, sex, age, year, and cause.
- Report on annual health outcomes for over 160 diseases and injuries for WHO Member States from 2000 onwards.
- Consolidates and harmonizes best available data from multiple sources, including national vital registration data, latest estimates from WHO technical programmes, UN partners and inter-agency groups, Global Burden of Disease and other scientific studies.
- Uses a variety of demographic, statistical and epidemiological methods based on the best scientific evidence.



## What GHE reports?

- Mortality and morbidity estimates for:
  - 183 WHO Member States
  - men and women
  - 2000 onwards
  - 160+ causes (I. Communicable, maternal, perinatal and nutritional conditions; II. Noncommunicable diseases; III. Injuries)
  - age groups: 0-1, 1-4, 5-9,...85+
- Related indicators:
  - Completeness of death registration data
  - Life expectancy
  - Years lived with disability (YLD)
  - Disability adjusted life years (DALY)
  - Healthy life expectancy (HALE)

## Important usage of GHE data

- Monitor numerous health-related indicators pertinent to Sustainable Development Goals (SDGs) and WHO's 13<sup>th</sup> General Programme of Work (GPW13).
  - child mortality
  - maternal mortality
  - premature mortality due to non-communicable diseases
  - suicide mortality
  - mortality due to road traffic injuries
  - mortality due to homicide, natural disasters and conflict
  - mortality attributable to poisoning, air pollution and WASH
- Understand global health, trends and shifts in main causes of death by region
- Guide decision-making and resource allocation
- Inputs to WHO flagship publications and external products by the academic community and general public
  - World Health Statistics
  - Global Monitoring Report for UHC

## | GHE & Covid-19

- Covid-19 has profound impacts on population health and has become one of the leading causes of deaths in 2020 and 2021.
- Accurately measuring the impacts of Covid-19 on population-level mortality and morbidity is critical for informing decision making.
- Upcoming updates of GHE will provide the most recent globally comparable time-series data for assess the direct and indirect impacts of COVID-19 on mortality and morbidity.

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# Estimation process:

## Data and Methods

# GHE Workflow

## Inputs

Identify and extract data

Specify data inclusion/exclusion rules

## Estimation

Address data biases and comparability issues

Validate estimation strategy

Characterize uncertainty

## Dissemination

Country consultation

Statistical clearance

Publish estimates and methodology



## Estimating all-cause mortality: countries with good vital registration (VR) data

**Data:** ~80 countries for which WHO Mortality Database held mortality data from vital registration (VR) systems for 75% or more of years since 1990.

### Analytical steps :

- 1) Completeness assessment: quantifying the proportion of deaths occurred in a country in a specific year was registered.
- 2) Death rates estimation and adjustment:
  - i) age < 15 years: countries with good VR systems, use VR; other VR countries, use UN-IGME estimates
  - ii) age 15+ years: completeness adjusted death rates
$$m_x = \text{VR deaths} / (\text{VR population estimate}) / (\text{annual sex-specific completeness estimate})$$

## | Estimating all-cause mortality: other countries

### Data:

- death registration data, e.g. the Disease Surveillance Points (DSP) in China and the Sample Registration Systems (SRS) in India
- census
- nationally representative household surveys
- sibling survival history data

### Methods:

- Age <15 years: use UN-IGME estimates
- Age 15+ years: a model life table system accounting for the level of HIV mortality and using summary mortality indices, i.e child mortality and adult mortality, to generate age-specific estimates of mortality rates.

## | Overall mortality and life tables: Mortality shocks

**Mortality shocks**, e.g. armed conflicts and natural disasters, may cause significant discontinuity in mortality rates in specific country-years, and hence separately estimated and added back to adjust for shock-free estimates for VR countries and the remaining countries.

### Source of data input:

*Natural disasters*: EM-DAT/CRED International Disaster Database.

*Armed conflicts*: vital registration systems, Uppsala Conflict Data Program (UCDP), International Institute for Strategic Studies (IISS), Armed Conflict Location & Event Data Project (ACLED), Global Terrorism Database (GTD), supplemented by other relevant data sources.

## Inputs for cause-of-death data

Estimates from WHO technical programmes and interagency groups.

- **Group I: Communicable, maternal, perinatal and nutritional conditions**

  - Tuberculosis; HIV/AIDS; Malaria; Whooping cough; Measles; Hepatitis; Schistosomiasis;

  - Cysticercosis, echinococcosis and food-borne trematodes; Rabies; Ebola;

  - Maternal causes of death;

- **Group II: Noncommunicable diseases**

  - Alcohol use and drug use disorders;

- **Group III: Injuries**

  - Road injuries; Homicide;

## **Inputs for cause-of-death data**

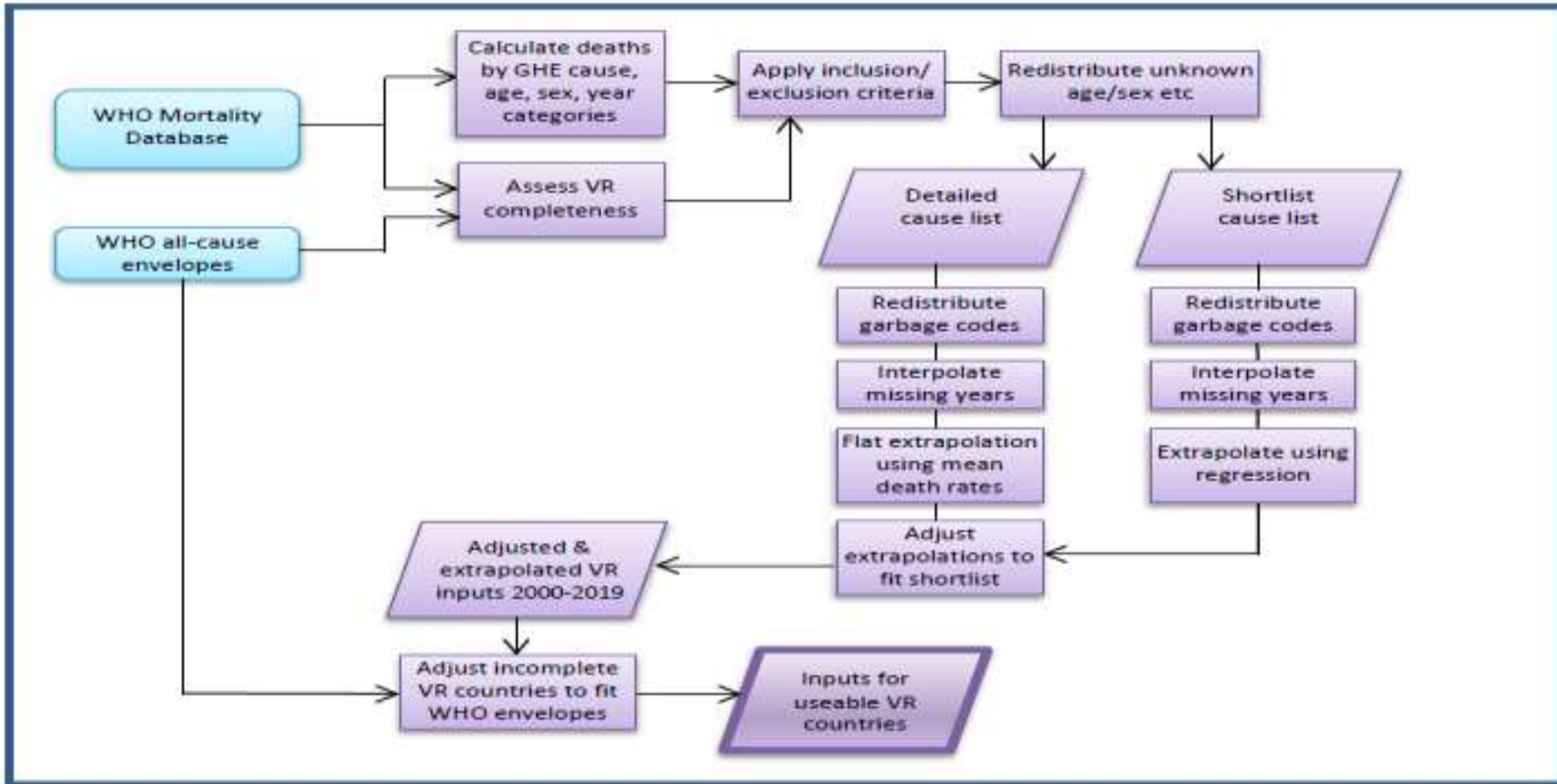
### **Usable vital registration data for other causes**

-adjust for incompleteness and redistribute ill-defined causes

### **Global Burden of Diseases (GBD) study cause fractions**

-for other causes for countries without useable VR data

# Cause-of-death analysis: countries with good vital registration

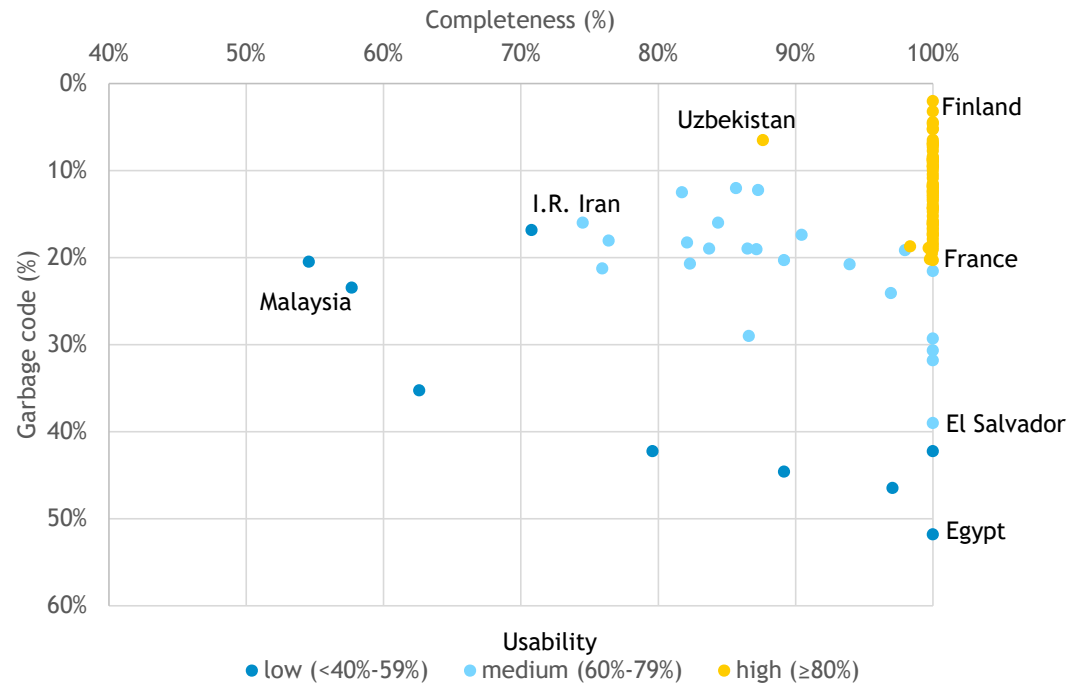


## Inclusion criteria for death registration data

WHO analyzes data in the mortality database that fulfill the following criteria:

- The data are available for 5-year age groups to ages 85 and over;
- Data reported to WHO were coded using ICD-9 or ICD-10;
- At least five years of data that fulfill the above criteria are available by ICD code (vs. a summary list);
- Both early (1998-2006) and the most recent 5 years of data were reported to WHO;
- The average prevalence of HIV among adults aged 15 to 49 was 1.5% or lower since 2000; and
- Data are of at least medium quality, meaning that: average usability during 2008-latest available is at least 60%

## Two main dimensions of quality of cause of death data



Data: averages for 2008-latest available year, in 98 countries reporting  $\geq 5$  years data, including  $\geq 1$  year by ICD code

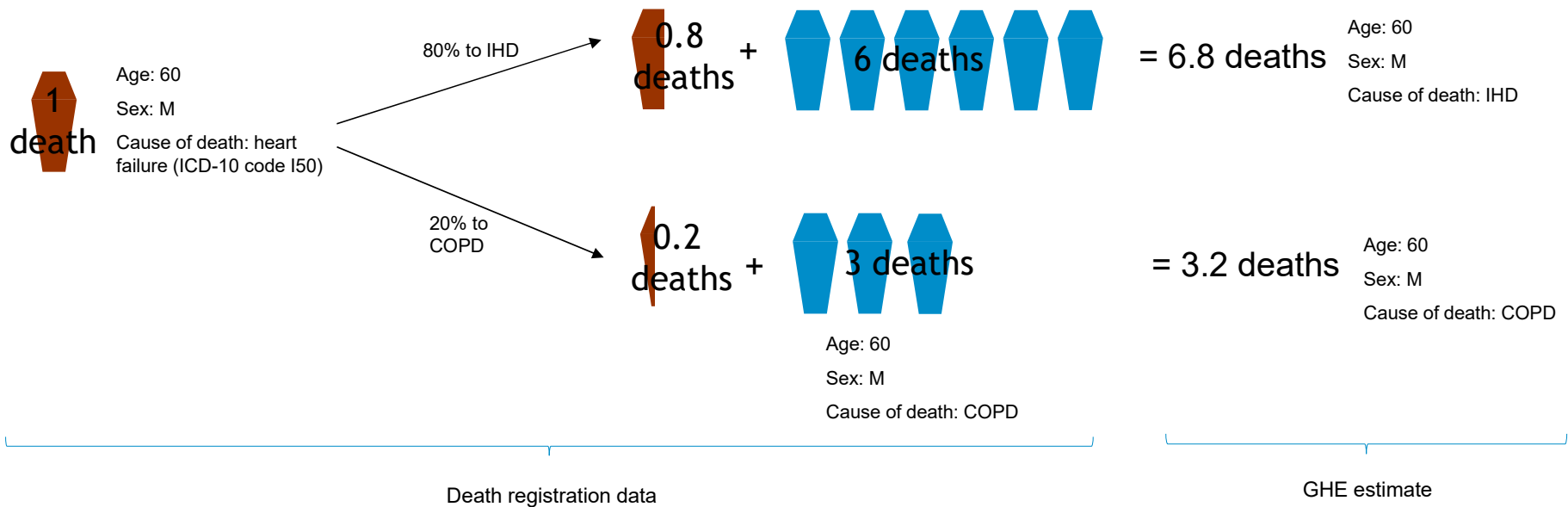


# Redistribute deaths assigned to garbage codes (example)

1. Identify deaths assigned to garbage codes in the country data:

2. Redistribute to target causes (method varies by garbage code):

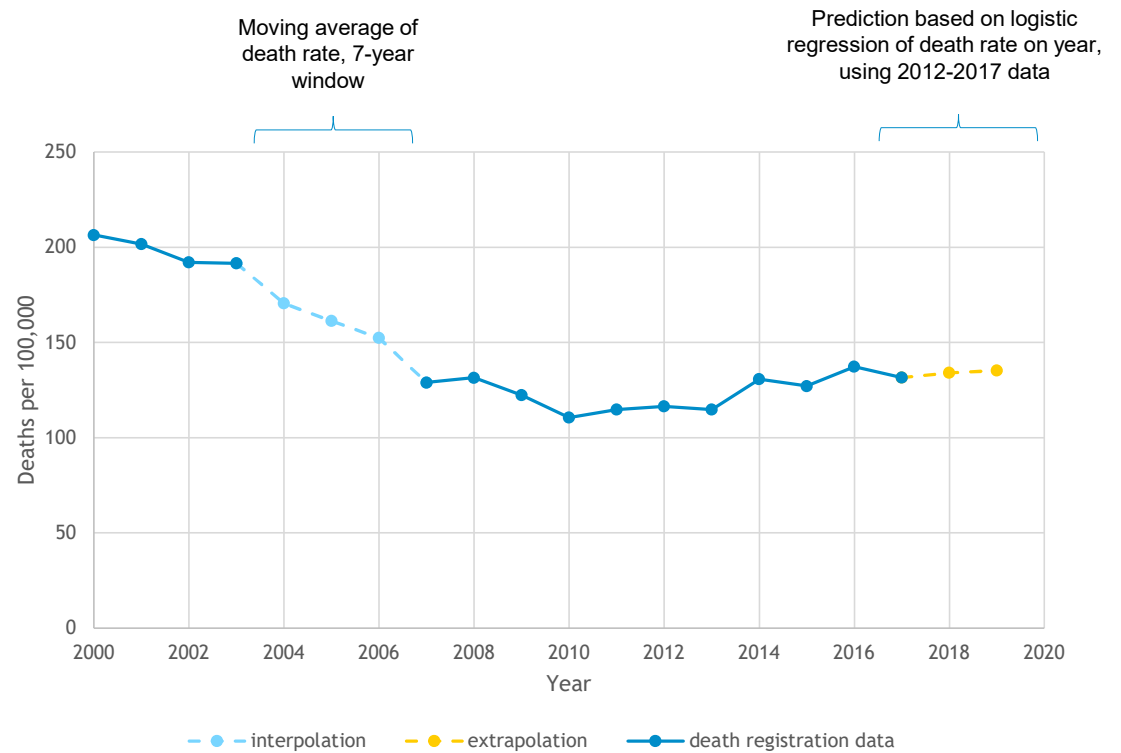
3. Sum the redistributed deaths to the deaths assigned to each target cause in the country data to obtain GHE estimates:



IHD = ischemic heart disease; COPD = chronic obstructive pulmonary disease

# Analysis of cause of death data from the WHO mortality database

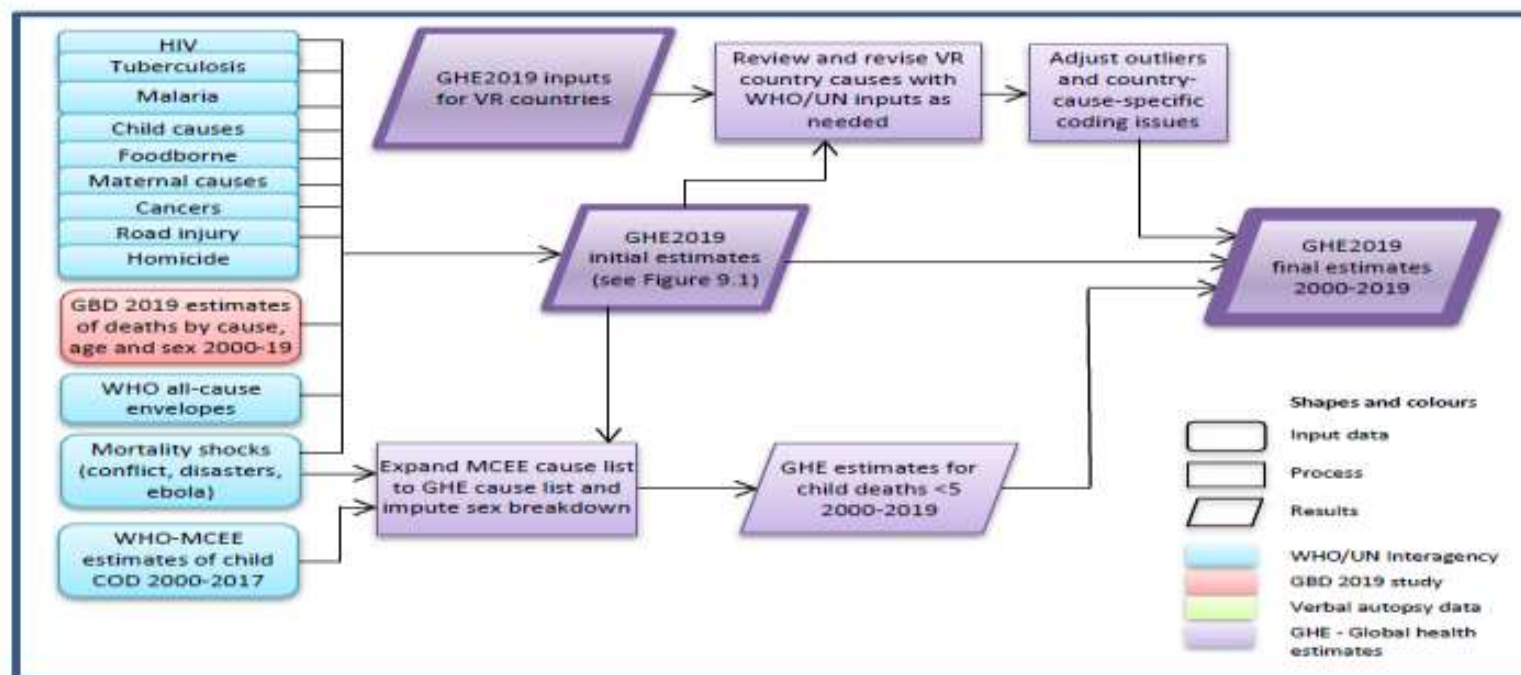
- Interpolate / extrapolate death rates to estimate deaths in years with no data



Data shown: Portugal, males aged 60-64, ischemic heart disease

# Cause-of-death analysis: countries without good vital registration data

For a few causes where WHO/UN estimates are available, these are used to replace GBD estimates for non-VR countries and adjust values in certain cases for VR countries.



# | Member States Consultation

# Member States Consultation



# Global Health Estimates

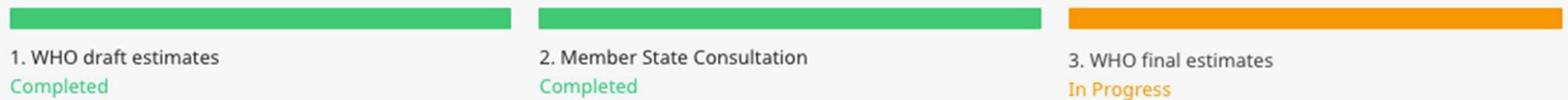
WHO is presenting estimates for life expectancy and causes of death from 2000 to 2019. Through this consultation Member States are able to:

- review their country estimates, data sources and methods;
- provide advice on primary data sources that may not have been previously reported or used;
- share inputs or additional feedback required.

The production of country level health estimates is based on WHO's quality standards for data publication, as adopted by the Executive Board members during its 111th session.

**WHO requesting team**[GHE](#)**WHO Global focal point**[Bochen CAO](#)**Member State focal point**[Roxanne Further MOORE](#)

## Consultation progress



## 1. Members State feedback

If you have additional or more up-to-date data from your civil registration system, kindly provide us with the number of deaths and mid-year population both by sex and age (<1 year, 1-4, 5-9, ..., 85+). For infant and neonatal mortality, kindly Commented [MF1]: Hyperlink to method file (stage 1) share the number of infant and neonatal deaths by sex and age (in days), as well as the number of live births. Please use the template for vital registration data, even if you have previously shared these data with UNICEF, WHO or other partners.

### Instructions:

Please use the excel template to share more recent or updated Vital Registry data. Once the template is complete please upload. As part of the upload process, there is the ability to comment directly on the uploaded file.

DATA ENTRY

UPLOAD FILES

## Supporting Files



[ExcelSpecifications English.xls](#)

## Uploaded Files



[Stages Loading.mov](#)  
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# | Tools and use of GHE data



# Leading causes of deaths, by country



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## Top 10 causes of death in Afghanistan for both sexes aged all ages (2019)

[Hide filters](#) | [Top-10 deaths](#) | [Top-10 DALYs](#) | [Underlying data](#) | [Download with OData API](#)

### Filters

#### Country

Afghanistan ▾

#### Year

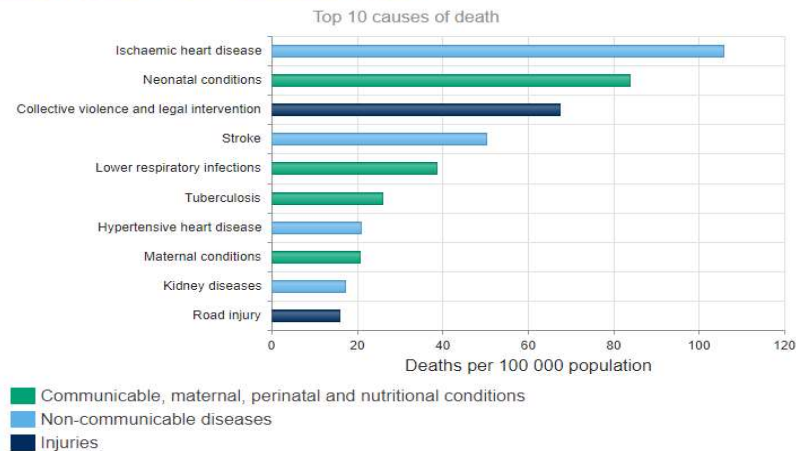
2019 ▾

#### Sex

Both sexes ▾

#### Age group

All ages ▾



## Data download

### About the download files

The latest global, regional and country-level cause-specific mortality estimates for the year 2000, 2010, 2015 and 2019 are available for download below.

Recommended citation: Global Health Estimates 2020: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2019. Geneva, World Health Organization; 2020.

A summary of data sources and methods is available. Due to changes in data and some methods, the 2000–2019 estimates are not comparable to previously-released WHO estimates.

[Link: Global health estimates: Leading causes of death \(who.int\)](#)

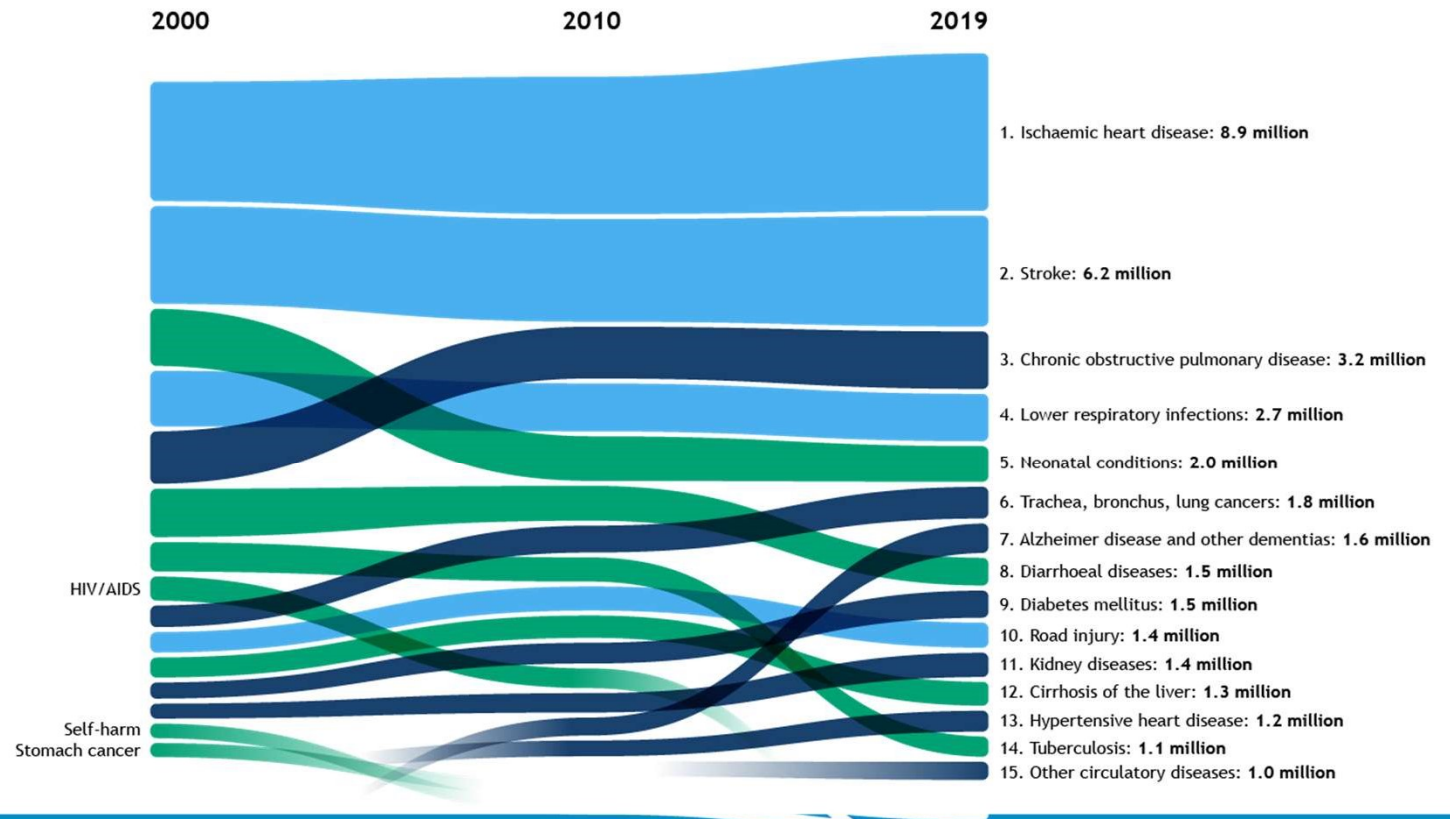
# Leading causes of death globally, 2000-2019

Number of deaths



Change in rank, 2000-2019

- Increased
- Decreased
- No change



# Healthy life expectancy and burden of disease

Progress were made in 2000-2019, but inadequate for meeting SDGs.

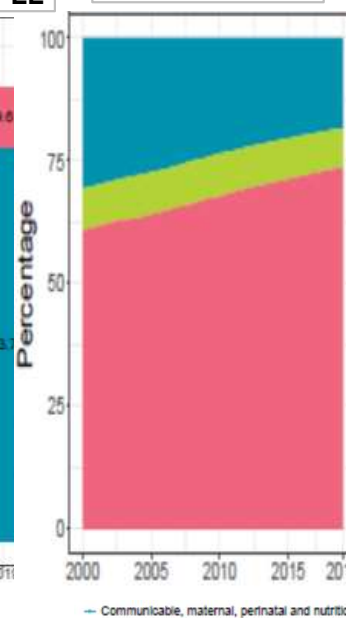
## Key Findings

- Life expectancy: 66.8 years (2000) → 73.3 years (2019)
- HALE: 58.3 years (2000) → 63.7 years (2019)
- % of NCD deaths: 60.8% (2000) → 73.6% (2019)
- Progress in morbidity were lacking, with stagnation in NCD and injuries

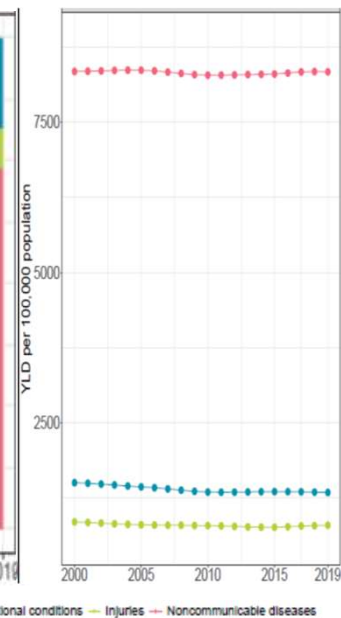
Global HALE & LE



Global CoD Dist.



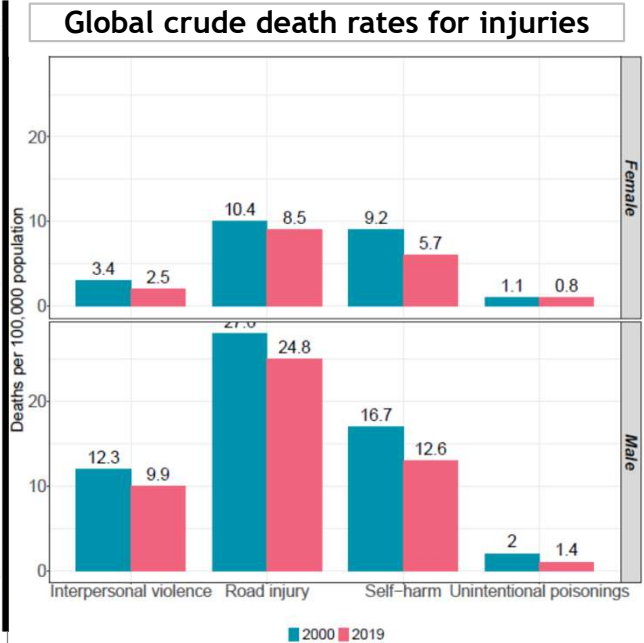
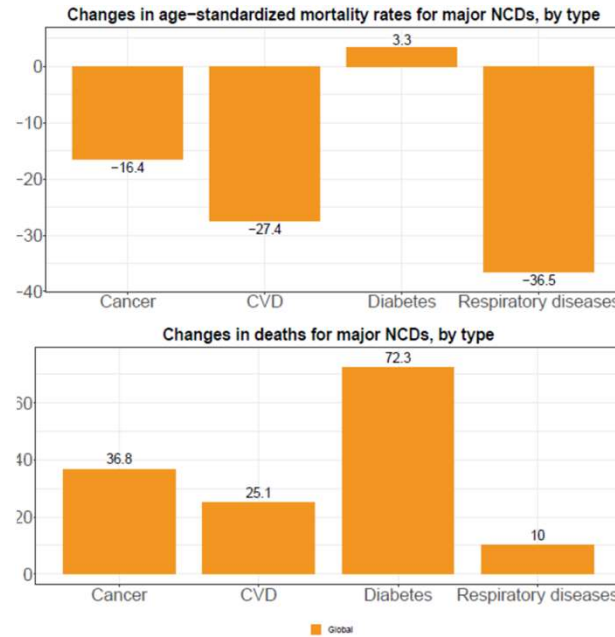
Global Disabilities



## Healthy life expectancy and burden of disease

### key findings

- *Steady decline in communicable diseases since 2000, incl. TB, HIV, malaria, etc.*
- *Mortality rates of NCDs* ↓
- *Absolute #deaths of NCDs* ↑
- *Deaths rates of injuries* ↓
- *Men face much higher risks of injury deaths*



# Use of GHE data in monitoring SDG

Articles

## Effect on longevity of one-third reduction in premature mortality from non-communicable diseases by 2030: a global analysis of the Sustainable Development Goal health target

Rochee Gao, Freddie Bray, André Rossi, Isabel Soerjomataram

### Summary

**Background** To curb the rising global burden of non-communicable diseases (NCDs), the UN Sustainable Development Goals (SDGs) include a target to reduce premature mortality from NCDs by a third by 2030. A quantitative assessment of the effect on longevity of meeting this target is one of the many important measures needed to advocate and inform national disease control policies. We did a global analysis to estimate improvements in average expected years lived between 30 and 70 years of age that would result from meeting the SDG target.

**Methods** We estimated age-specific mortality in 183 countries in 2015, for the four major NCDs (cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes) and all NCDs combined, using data from WHO Global Health Estimates. We then estimated the potential gains in average expected years lived between 30 and 70 years of age ( $LE_{30-70}$ ) by eliminating all or a third of premature mortality from specific causes of death in countries grouped by World Bank income groups. The feasibility of reducing mortality to the targeted level of over 15 years was also assessed on the basis of historical mortality trends from 2000 to 2015.

**Findings** Reducing a third of premature mortality from NCDs over 15 years is feasible in high-income and upper-middle-income countries, but remains challenging in countries with lower income levels. National longevity will improve if this target is met, corresponding to an average gain in  $LE_{30-70}$  of 0.44 years worldwide from reduced premature mortality for the four major NCDs and 0.50 years for all NCDs. According to major NCD type, the largest gains attributable to cardiovascular diseases would be in lower-middle-income countries (a gain of 0.45 years), whereas gains attributable to cancer would be in low-income countries (0.33 years).

**Interpretation** A one-third reduction in premature mortality from the major NCDs in 2015–30 would have substantial effects on longevity. High-level political commitments to effective and equitable national surveillance and prioritised prevention, early detection, and treatment programmes tailored to the major NCD types are needed urgently in lower-resourced settings if this SDG target is to be met by 2030.

### Funding Note

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### Introduction

Non-communicable diseases (NCDs) are the leading cause of death worldwide, accounting 70% of total deaths estimated in 2015 and representing a substantial barrier to healthy ageing.<sup>1</sup> Deaths due to NCDs have increased from 31.4 million in 2000 to 39.5 million in 2015, of which 15.0 million (or 38%) were premature deaths in people aged between 30 and 70 years.<sup>1</sup> The burden from NCDs is expected to continue to increase during the next decades as populations age and communicable diseases are successfully controlled, particularly in transitioning countries, where environmental factors and adoption of unhealthy lifestyle choices increase the risk of NCDs.<sup>1</sup> In an effort to curb the rapid growth in NCDs, the UN has set—as part of the Sustainable Development Goals (SDGs)—a global target

to reduce the total premature mortality (in ages 30–70 years) from NCDs by a third by 2030.<sup>2</sup>

According to the estimates for 2015 from WHO, the four major NCDs caused 12.4 million premature deaths: 6.2 million due to cardiovascular diseases, 4.4 due to cancer, 1.1 due to chronic respiratory diseases, and 0.7 due to diabetes, equivalent to 82.7% of all premature deaths from NCDs annually.<sup>1</sup> Understanding the main contributors of the NCD burden supports policy makers to develop informed national plans and strategies.

In 48 countries, cancer has overtaken cardiovascular diseases as the predominant cause of mortality, partly because of successes in the prevention and management of cardiovascular diseases. In a further 65 countries undergoing major developmental transitions, cancer is the second to fourth most predominant cause of death,



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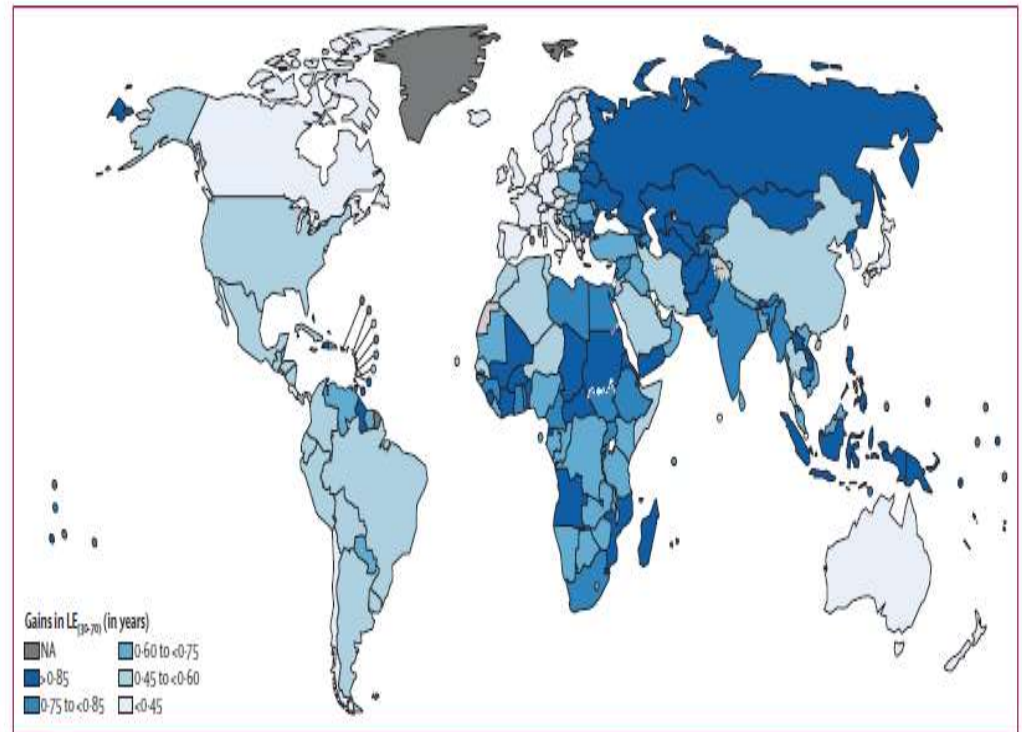


Figure 2: Global map of estimated gains in average expected years lived between 30 and 70 years in 2015–30

Estimated gains in average expected years lived if the Sustainable Development Goals target of a one-third reduction in premature mortality from the four major non-communicable diseases is attained.  $LE_{30-70}$  = average expected years lived between 30 and 70 years of age.

# Use of GHE data in assessing longevity

Series

**Ageing 1**

**Causes of International Increases in older age life expectancy**

Colin D Mathers, Gretchen A Stevens, Tim Boersma, Richard A White, Martin Tobias

**Introduction**

In high-income countries, life expectancy at age 60 years has increased in recent decades. Falling tobacco use (for men only) and cardiovascular disease mortality (for both men and women) are the main factors contributing to this rise. In high-income countries, avoidable male mortality has fallen since 1980 because of decreases in avoidable cardiovascular deaths. For men in Latin America, the Caribbean, Europe, and central Asia, and for women in all regions, avoidable mortality has changed little or increased since 1980. As yet, no evidence exists that the rate of improvement in older age mortality (60 years and older) is slowing down or that older age deaths are being compressed into a narrow age band as they approach a hypothesized upper limit to longevity.

**WHO has estimated life average expectancy at age 60 years for all Member States during the years 1990–2012.<sup>1</sup> Most countries in the Middle East, north Africa, and sub-Saharan Africa do not have usable death registration data, and estimates of mortality at older age rely on the use of model life tables to extrapolate from younger adult mortality and, in some countries, from other sources of mortality data (genat). WHO has estimated that worldwide average life expectancy for women at age 60 years was 21.5 years in 2011, ranging from 17.1 years in sub-Saharan Africa to 26.1 years in high-income countries (table). For men, the worldwide life expectancy at age 60 years was 18.5 years, ranging from 15.7 years in sub-Saharan Africa to 22.3 years in high-income countries. During the past two decades, life expectancy at age 60 years for men and women has risen by 0.9 years for men and 0.8 years for women per decade. The gap in life expectancies between high-income and low-income and middle-income countries has increased by 1.4 for men and 1.4 years for women per decade compared with 0.7 years for men and 0.8 years for women in low-income and middle-income countries.**

**We explored these trends in more detail using high quality death registration data. We addressed the following questions: how do recent gains in older adult life expectancy vary by country and region? Is a fixed upper limit for the human life span approaching, with the consequent compression of mortality into a narrowing band of older ages, as proposed by Frisvold?<sup>2</sup> What are the causes of the recent decreases in death rates in older people? Is there potential for further reductions in mortality at older ages, from which causes, and in which countries and regions? We decided that reliable information on cause-specific mortality and their trends could be calculated from death registration data in the WHO mortality database<sup>3</sup> if the proportion of all deaths (recorded and unrecorded) for which cause-of-death information could be obtained exceeded 80% for at least 80% of two-year intervals between 1980 and 2011. The appendix describes selection criteria for countries and**

**Key messages**

- High-quality data for levels of and trends in older age (>60 years) mortality are unavailable for all low-income and many middle-income countries.
- Life expectancy at age 60 years has improved steadily in the past three decades, with no deceleration in life expectancy improvement or consistent compression in age at death.
- For men in high-income countries, the risk of dying between ages 60 years and 80 years has been decreasing at 1.5% a year on average during the past three decades, the same as the average rate of decrease of 1.5% per year for the risk of dying between ages 15 years and 60 years.
- For women, the risk of dying between ages 60 years and 80 years has been decreasing at an average annual rate of 1.7%, faster than the risk of dying between ages 15 years and 60 years (1.2% per year).
- The annual average rate of increase in life expectancy at age 80 years was slightly higher for both men and women than that of age 60 years.
- Improvements in older age mortality were mainly attributed to decreases in tobacco use (for men) and in cardiovascular disease mortality (for both men and women).
- Older age mortality can be assessed by comparison with mortality in best-performing so-called frontier countries. Wherever mortality rates are higher than those in the frontier countries, the difference in mortality can be judged avoidable.
- Male avoidable mortality has fallen in high-income countries during the past three decades. However, both female avoidable mortality in all regions and male avoidable mortality in middle-income countries have changed little or risen since 1980. Particularly, avoidable mortality in middle-income European countries has increased, showing that these countries are falling behind the best-performing ones.

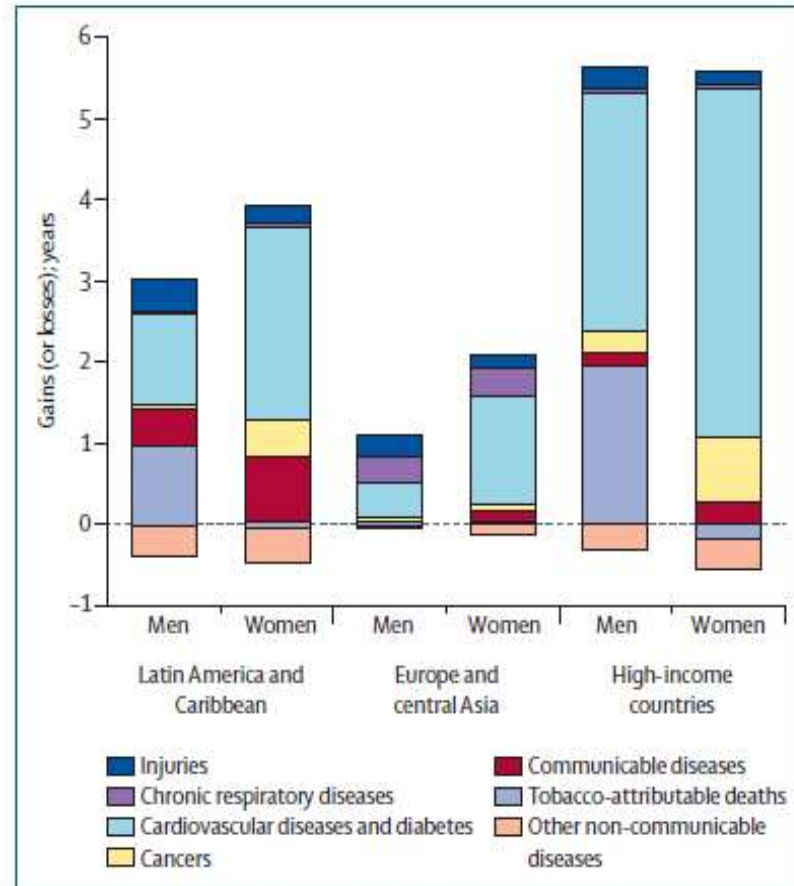
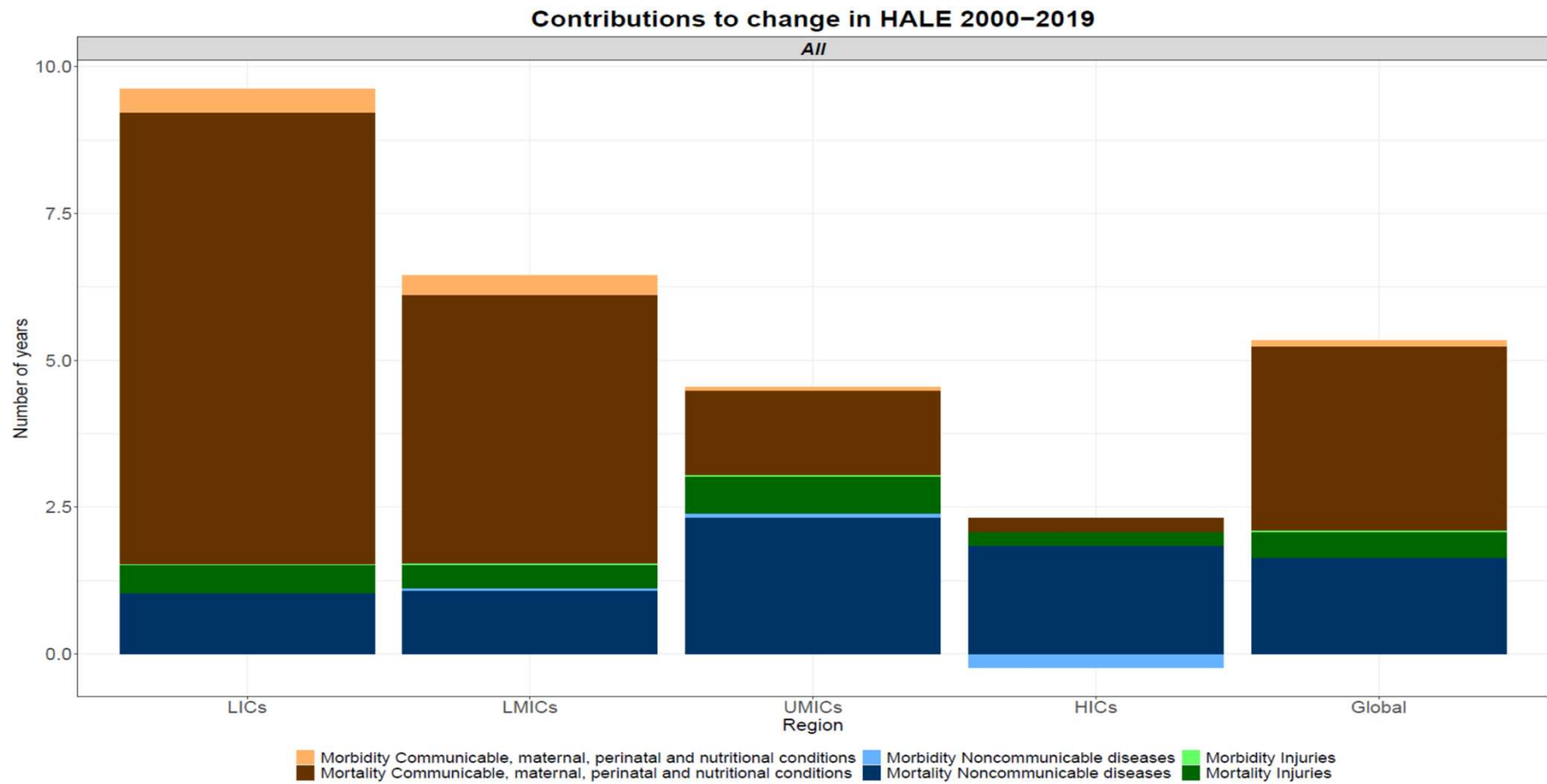


Figure 2: Cause contributions\* to gains in life expectancy at age 60 years from 1980 to 2011

# Use of GHE data in assessing longevity



Cao et al.(2022) under review

# Use of GHE data in assessing longevity

## Top 10 contributors to the gains in HALE in 2000-2019



Cao et al.(2022) under review



## Use of GHE data in attributable risk assessment

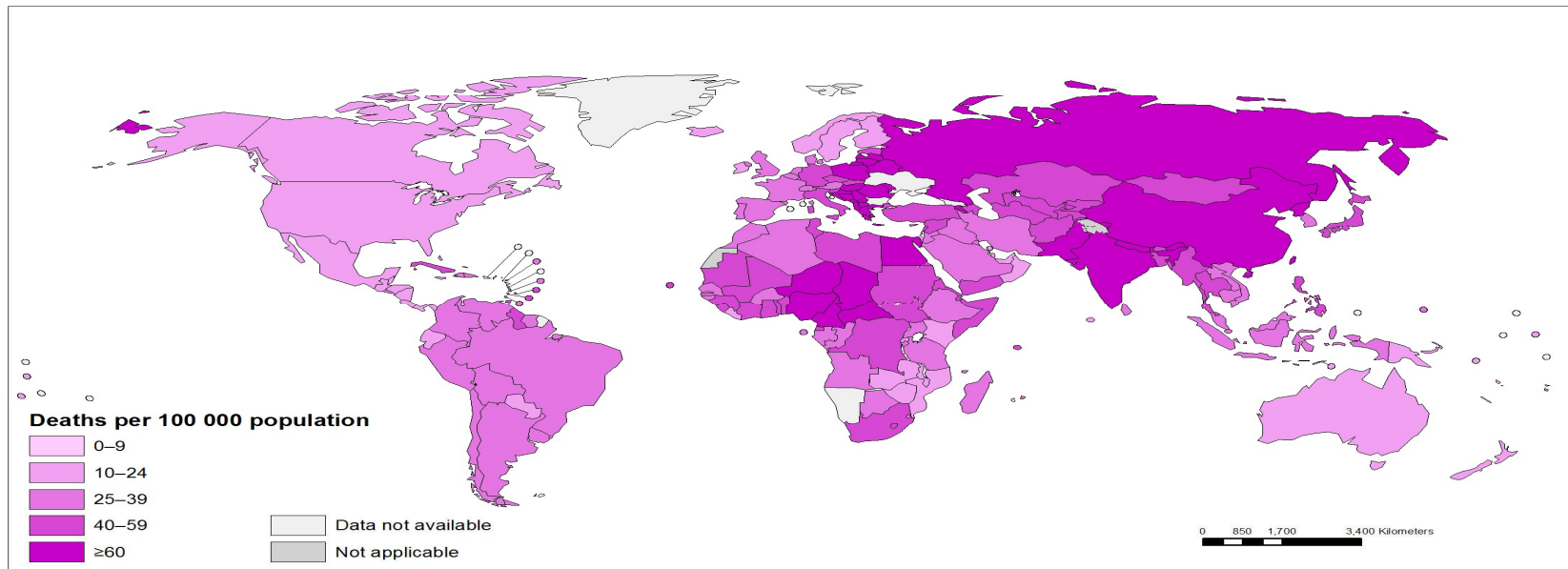
- Link risk factors and health outcome
- Assess the impact of risk factor on population health

WHO currently have estimates available for the burden of diseases attributable to a few risk factors, including

- tobacco smoking
- alcohol use
- air pollution
- occupational risks
- food-borne diseases
- unsafe water and sanitation

# Use of GHE data in attributable risk assessment

Deaths attributable to ambient air pollution (age-standardized, per 100 000 population), 2016



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization  
Map Production: Information Evidence and Research (IER)  
World Health Organization



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# | Questions & Discussion

**Thank You!**