

# **Economics of Health and Education**

## **Disease Burden**

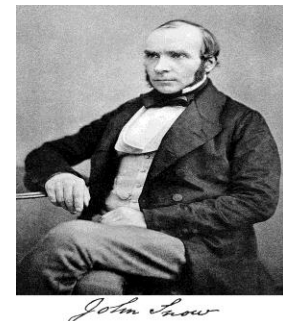


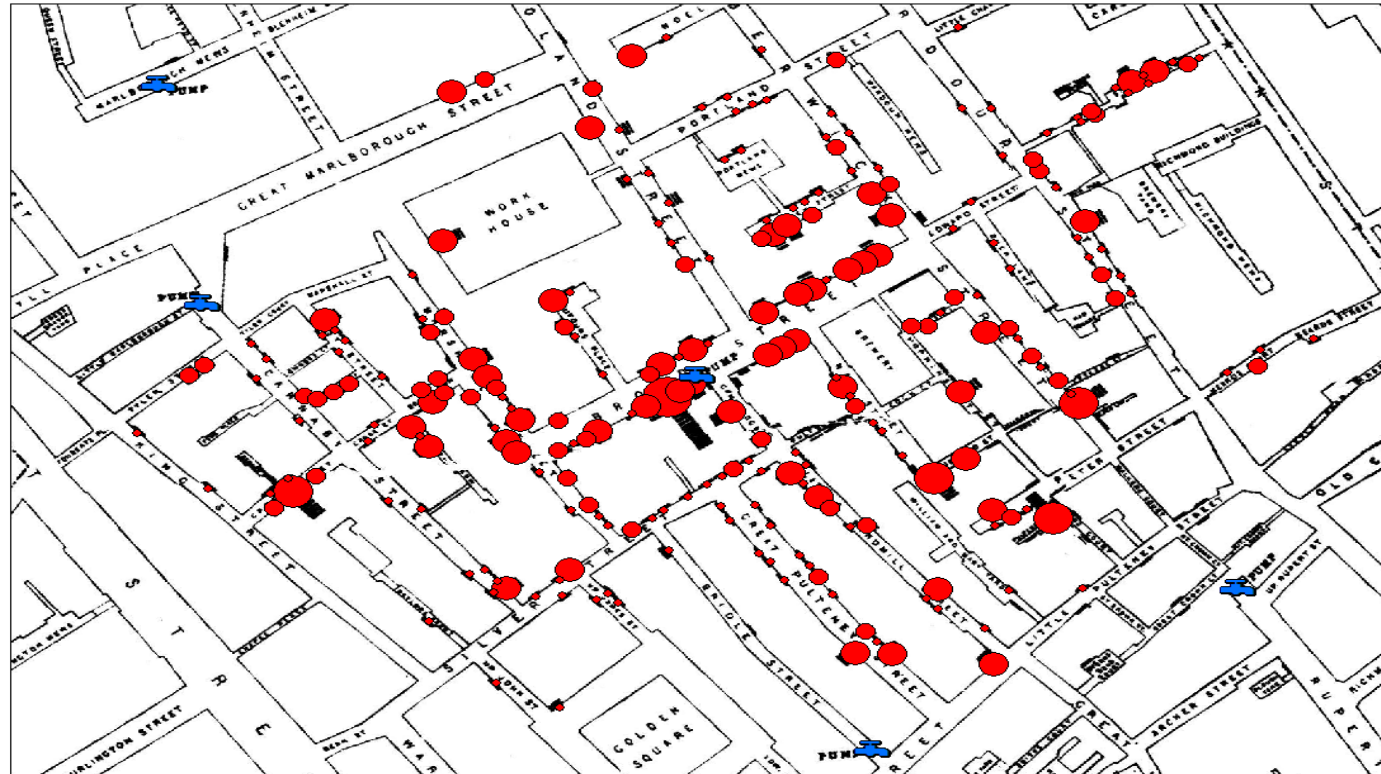
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# Why Health Data Important?

- John Snow is considered one of the fathers of modern epidemiology, in part because of his work in tracing the source of a cholera outbreak in Soho, London, in 1854
- Snow mapped the mortality in relation to the sites of different drinking water pumps by London's water supply system in Soho district in London where the September 1854 cholera outbreak was centred.
- His findings inspired fundamental changes in the water and waste systems of London, which led to similar changes in other cities, and a significant improvement in general public health around the world.
- Snow's work was possible only by the registration of births and deaths maintained by the local authorities in England from early 1880s.

John Snow (1813-1858)





# Health Status of the Population

In understanding **health status** of any population, two important indicators are:

- **Mortality**: Crude Death Rates, Infant and Child Mortality, Case Fatality-Risk of dying from diseases is very high
- **Morbidity**: Condition of illness in a population-low fatality-existing in a population for a long period.

Two important terms: **Incidence** (New Cases) and **Prevalence** (Existing +New Cases) of Diseases

- **Prevalence of Communicable Diseases**-Tuberculosis, Malaria, Cholera, Diarrhea
- **Rise in the Non-Communicable Diseases**-Cancers, Diabetes, Cardiovascular Diseases(CVDs)-Multiple Risk Factors
- **Double burden of diseases**-increased prevalence of both communicable and non-communicable diseases
- Occurrence of diseases also increases the consequences of diseases - **Impairment, disability or handicap**

# Defining Disease Burden

- “**Disease Burden** is the impact of a health problem on a given population, and can be measured using a variety of indicators such as mortality, morbidity or financial cost”. (Barratt & Kirwan, 2009)
- **Importance of Disease Burden** at Global Level:
  - Helps in **comparing the prevalence of diseases** in different regions.
  - Helps to predict future health care needs.
- Disease burden is often measured using:
  - **Quality-Adjusted Life-Years (QALY)**
  - **Disability-Adjusted Life-Years (DALY)**

# What is Global Burden of Disease (GBD)

- The **Global Burden of Diseases (GBD)**, Injuries, and Risk Factors Study (GBD) is the single largest and most detailed scientific effort ever conducted to quantify levels and trends in health.
- GBD Study carried out by the **World Health Organisation (WHO) since 1990**, is the most well-known and one of the oldest and continuing studies of the burden of disease at the global level.
- The **GBD concept was first published in 1996** which constituted the most comprehensive and consistent set of estimates of mortality and morbidity.
- WHO regularly develops GBD estimates at regional and global level for a set of more than **135 causes of disease and injury**.
- At present **GBD is led by the Institute for Health Metrics and Evaluation (IHME)** at the University of Washington.

# Why is GBD Important?

- GBD creates a [unique platform](#) to [compare the magnitude](#) of [diseases, injuries, and risk factors](#) across age groups, sexes, countries, regions, and time.
- For decision-makers, health sector leaders, researchers, and informed citizens, the GBD approach provides an opportunity to [compare their countries' health progress to that of other countries](#), and to [understand the leading causes of health loss](#) that could potentially be avoided, like high blood pressure, smoking, and household air pollution.
- [IHME \(Institute of Health metrics and Evaluation\)](#) provides [GBD results](#) in [visualization tools](#), allowing people to interact with the vast amounts of data and the trends they identify. These unique tools are beneficial when trying to identify specific information for age groups, sexes, causes, risks, and comparison to other regions.

# Disability Adjusted Life Years (DALY) and GBD

- The **GBD initiative** for the first time put forward the concept of **DALY**.
- GBD study **quantified the health effects of more than 100 diseases and injuries** for eight regions of the world in 1990.
- It generated comprehensive and internally consistent **estimates of mortality and morbidity** by age, sex and region.
- GBD study aims to **quantify the burden of premature mortality and disability** for major diseases or disease groups.
- The study introduced a new metric – the **Disability-Adjusted Life Year (DALY)** – as a single measure **to quantify the burden of diseases, injuries and risk factors**.
- **DALY** is based on, **combine estimates** of the **years of life lost from premature death** and **years lived with disabilities** (or years of life lived in less than full health). The data are also broken down by age, sex and region.



# Calculating DALY

- DALYs for a disease or health condition are calculated as the sum of the **Years of Life Lost (YLL)** due to premature mortality in the population and the **Years Lost due to Disability (YLD)** for people living with the health condition or its consequences.
- DALY can be thought of as **one lost year of ‘healthy’ life** and the measured disease burden is the gap between a population’s health status and that of a normative reference population.
- The DALY measures health gaps as opposed to health expectancies. It measures the **difference between a current situation and an ideal situation where everyone lives up to the age of the standard life expectancy, and in perfect health.**
- DALYs for a specific cause are calculated as the sum of the YLLs from that cause and the YLDs for people living in states of less than good health resulting from the specific cause:

$$\text{DALY}(c,s,a,t) = \text{YLL}(c,s,a,t) + \text{YLD}(c,s,a,t)$$

*Where,*

for given cause c; age a,; sex s ; year t

# Calculating DALY

- The YLLs for a cause are essentially calculated as the number of cause-specific deaths multiplied by a loss function specifying the years lost for deaths as a function of the age at which death occurs. The basic formula for YLLs is the following for a given cause  $c$ , age  $a$ , sex  $s$  and year  $t$ :

$$YLL(c,s,a,t) = N(c,s,a,t) \times L(s,a)$$

where:

$N(c,s,a,t)$  is the number of deaths due to the cause  $c$  for the given age  $a$  and sex  $s$  in year  $t$

$L(s,a)$  is a standard loss function specifying years of life lost for a death at age  $a$  for sex  $s$

# Calculating DALY

- The GBD 1990 and subsequent WHO updates used an incidence perspective for the calculation of YLDs.
- To estimate YLDs for a particular cause in a particular time period, the number of incident cases in that period is multiplied by the average duration of the disease and a weight factor that reflects the severity of the disease on a scale from 0 (perfect health) to 1 (dead):

$$\text{YLD}(c,s,a,t) = I(c,s,a,t) \times \text{DW}(c,s,a) \times L(c,s,a,t)$$

where:

$I(c,s,a,t)$  = number of incident cases for cause  $c$ , age  $a$  and sex  $s$

$\text{DW}(c,s,a)$  = disability weight for cause  $c$ , age  $a$  and sex  $s$

$L(c,s,a,t)$  = average duration of the case until remission or death (years)

The ‘valuation’ of time lived in non-fatal health states formalizes and quantifies the loss of health for different states of health as *disability weights*.

# Incidence Rate and Prevalence Rate

- The incidence rate & prevalence rate, recommended by the [Expert Committee on Health Statistics of the World Health Organization \(WHO\)](#), is defined as:
- **Incidence Rate:** “the measurement of the frequency of illness commencing during a defined period.”
- **Prevalence Rate:** “the measurement of the frequency of illness in existence at any time during a defined period (that is, a year, a month, a week).”

# Prevalence verses Incidence Approach of YLDs

The incidence-based YLD approach has three major disadvantages :

- **First**, it does not reflect the current prevalent burden of disabling sequelae for a condition for which incidence has been substantially reduced.
- **Secondly**, the YLD calculation requires estimates of both incidence and average duration of disease sequelae, whereas for many health conditions it is primarily prevalence data that are collected.
- **Third**, in an incidence perspective, all YLDs for a condition are assigned to the age-groups at which the condition is incident, whereas the policy-maker is often more interested in the ages at which the loss of health is experienced.

Given these advantages of a incidence approach, both the GBD 2010 and WHO have decided to switch to a prevalence-based approach to calculation of YLDs.

## Calculating Prevalence based YLDs

- **Prevalence of YLD:** which can also be described as years lived in less than ideal health.

**Fore example:** This includes conditions such as influenza, which may last for only a few days, or epilepsy, which can last a lifetime.

- Therefore, it is measured by taking the **prevalence of the condition multiplied by the disability weight for that condition.**
- **Disability weights** reflect the severity of different conditions and are developed through surveys of the general public.

The prevalence based YLD calculation :

$$\text{YLD} = P \times DW$$

*Where:*

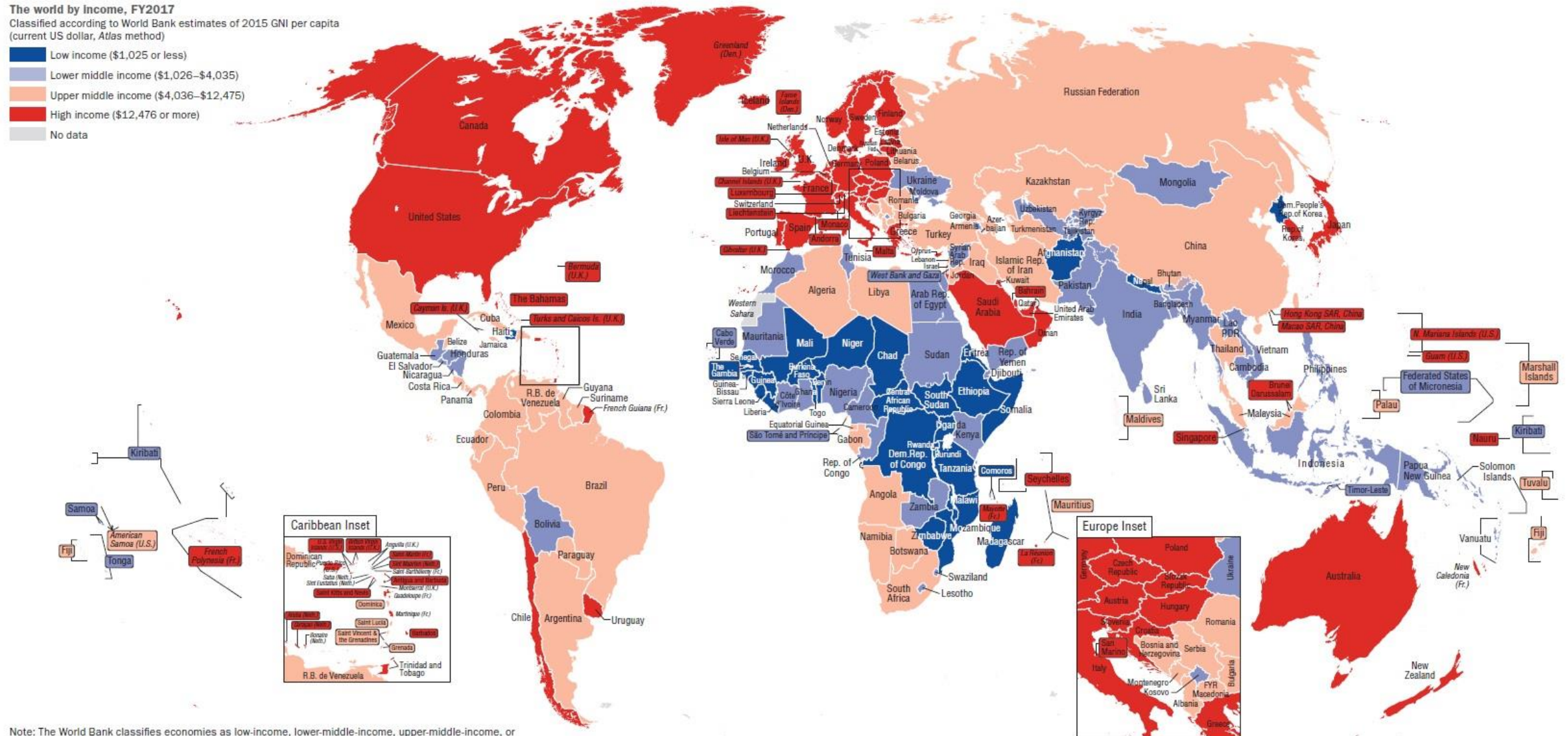
*P = number of prevalent cases*

*DW = disability weight*

## **World Bank's country classification in 2017 by income (GNI estimates as per 2015 data)**

- **Low income economies** are those with a GNI per capita of USD 1,025 or less
- **Lower-middle-income economies** are those with a GNI per capita of USD 1026-4035.
- **Upper-middle-income economies** are those with a GNI per capita of USD 4036-12,475.
- **High-income economies** are those with a GNI per capita of USD 12,476 or more.

Classified according to World Bank estimates of 2015 GNI per capita (current US dollar, Atlas method)



Note: The World Bank classifies economies as low-income, lower-middle-income, upper-middle-income, or high-income based on gross national income (GNI) per capita. For more information see <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.



# What is meant by “developing countries”?

- The terms North, rich countries, industrialized countries, or Triad all refer to the countries of Western Europe, North America, Japan, South Korea, Australia, New Zealand, and a number of other high income countries.
- However debatable, all countries outside the Triad are referred to as *developing countries*.
- Within the category of developing countries, for historical reasons, there is a distinction between the groups of countries designated as Central and Eastern Europe, Turkey, and Central Asia, and the others – Latin America and the Caribbean, Middle East and North Africa, Sub-Saharan Africa, South Asia, East Asia, and the Pacific – classified as the *Third World* or the *South*.

## Comparing Disease Burden – Poorest Billion and High-Income Regions: Based on GBD 2017

- The health of populations living in extreme poverty has been a long-standing focus of global development efforts, and continues to be a priority during the [Sustainable Development Goal](#).
- The paper estimated disease rates by cause for the [world's poorest billion and compared these rates to those in high-income populations](#). (Paper titled: “Burden of disease among the world’s poorest billion people: An expert-informed secondary analysis of Global Burden of Disease estimates”)
- The study uses national-level disease burden estimates from the [2017 Global Burden of Disease Study](#) data source.
- The disease burden among the poorest people globally compared to that in high income countries is highly influenced by [demographics as well as large disparities in burden from many conditions](#).
- The comparisons show that the [largest disparities remain in communicable, maternal, neonatal, and nutritional diseases](#), though NCDs and injuries are an important part of the “unfinished agenda” of poor health among those living in extreme poverty.

## Comparing Disease Burden – Poorest Billion and High-Income Regions: Based on GBD 2017

- The disease burden in **low- and lower-middle-income countries** (LLMICs) has often been characterized as primarily due to **communicable diseases as well as maternal and child illness**.
- **Non-communicable diseases** (NCDs) in the LLMIC context are often described in the context of **transitions involving population aging, urbanization, and higher-income lifestyles**.
- The composition of disease burden among the poorest billion, as measured by disability adjusted life years (DALYs), was:
  - 65% communicable, maternal, neonatal, and nutritional (CMNN) diseases,
  - 29% non-communicable diseases (NCDs)
  - 6% injuries. Age-standardized
  - NCDs were 44% higher in the poorest billion (23,583 DALYs per 100,000) compared to high-income regions (16,344 DALYs per 100,000).
  - DALY rates were 2,147% higher for CMNN conditions (32,334 DALYs per 100,000) and
  - 86% higher for injuries (4,182 DALYs per 100,000) in the poorest billion, compared to high income regions.

# Comparing Disease Burden – Poorest Billion and High-Income Regions: Based on GBD 2017

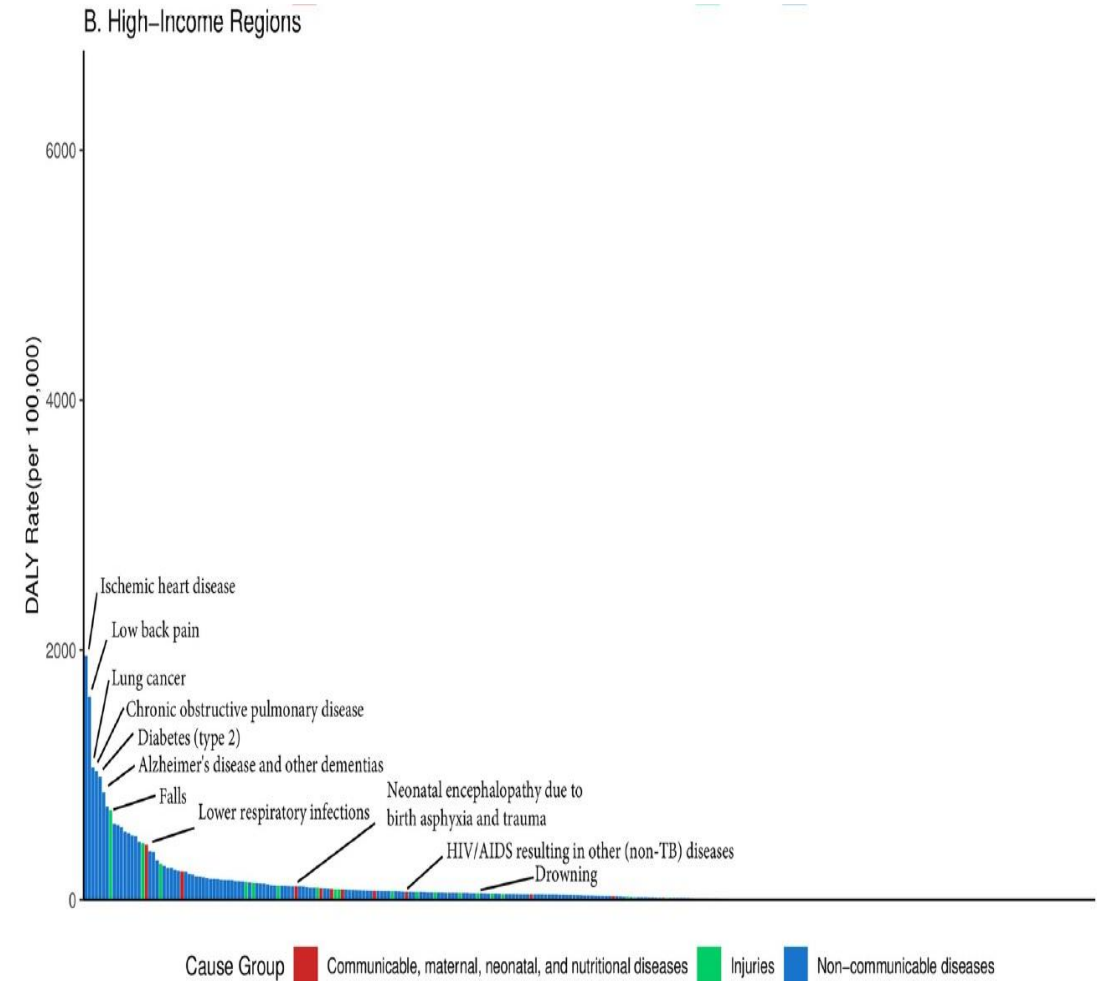
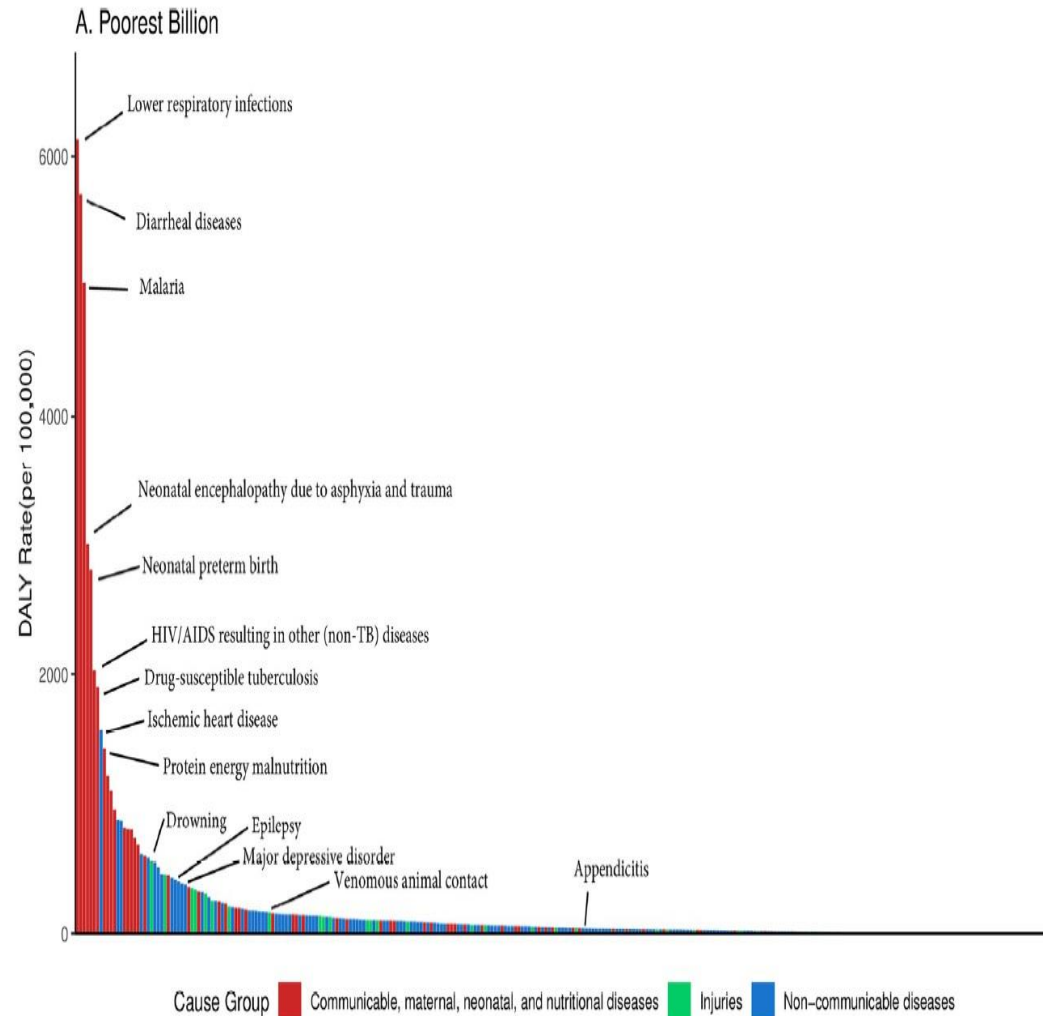
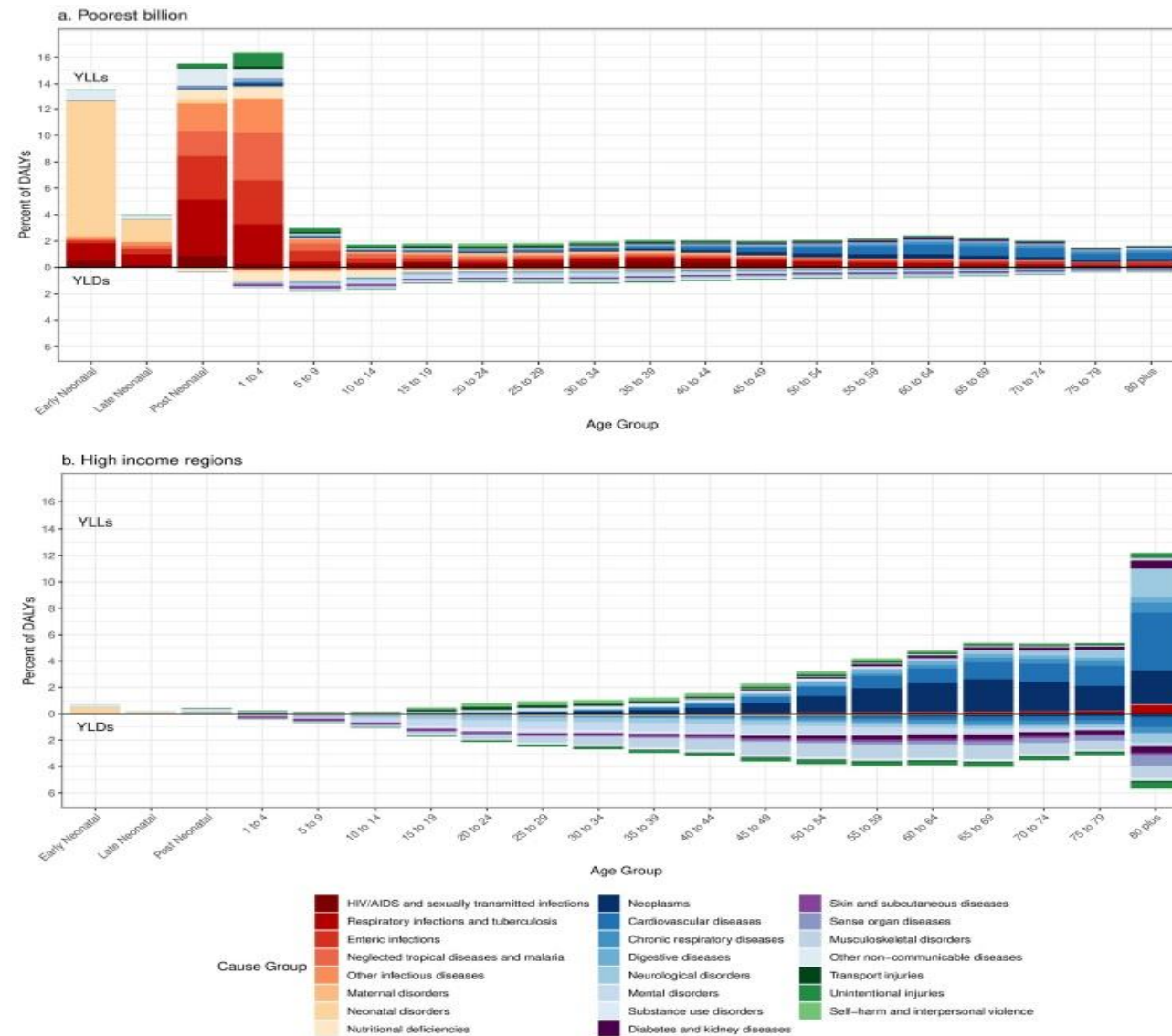
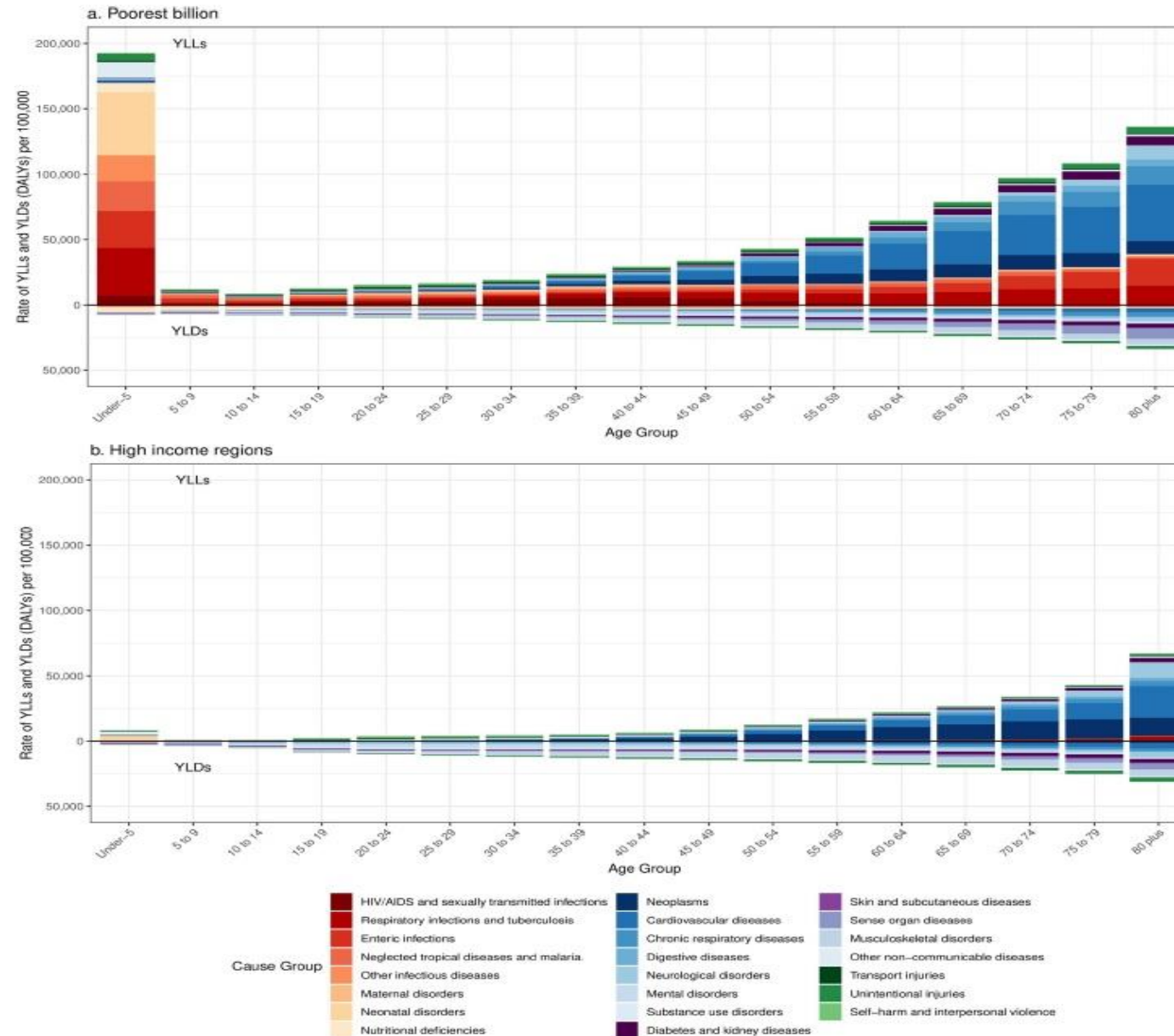


Fig 3. Crude DALY rate by condition in the poorest billion (a) and in high-income regions (b). High-income regions defined as Western Europe, high-income North America, high-income Asia-Pacific, Australia, and New Zealand from the GBD 2017.

# Comparing DALY Percent– Poorest Billion and High-Income Regions: Based on GBD 2017

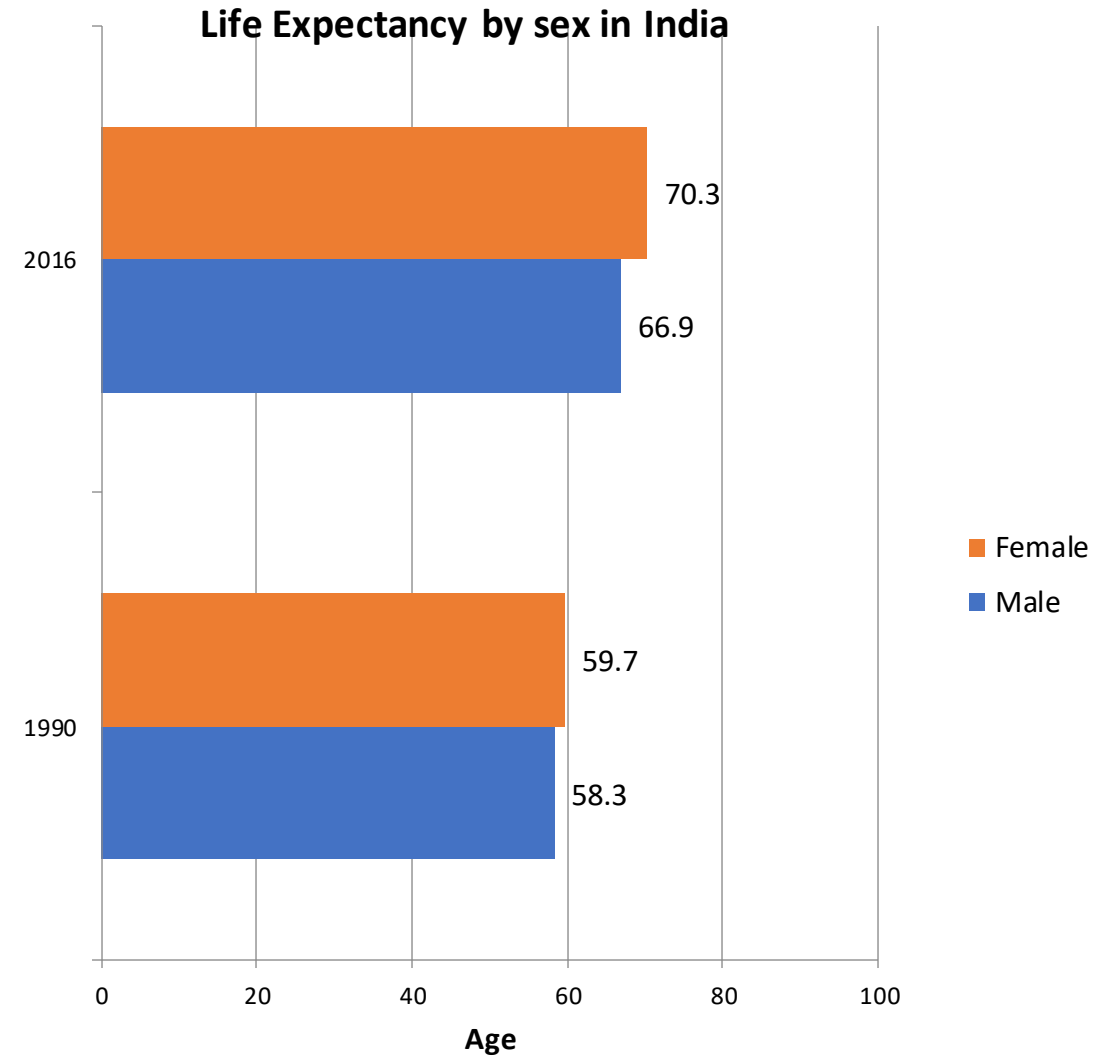


# Comparing DALY per 100,000– Poorest Billion and High-Income Regions: Based on GBD 2017

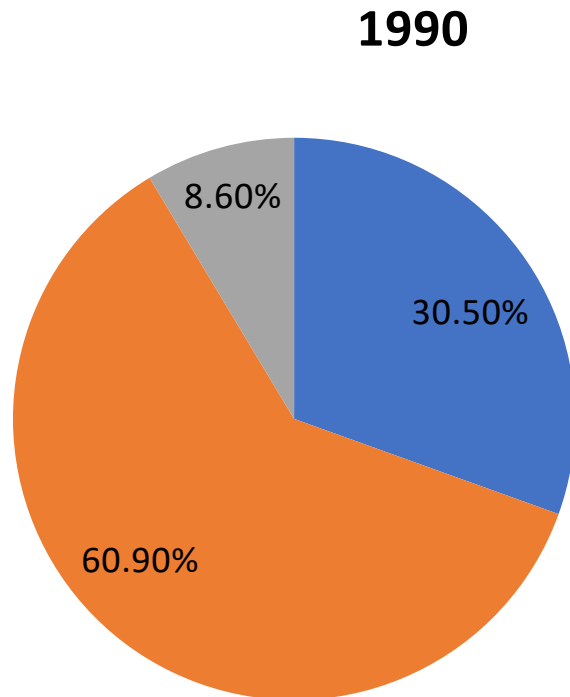


# Burden of Disease: India

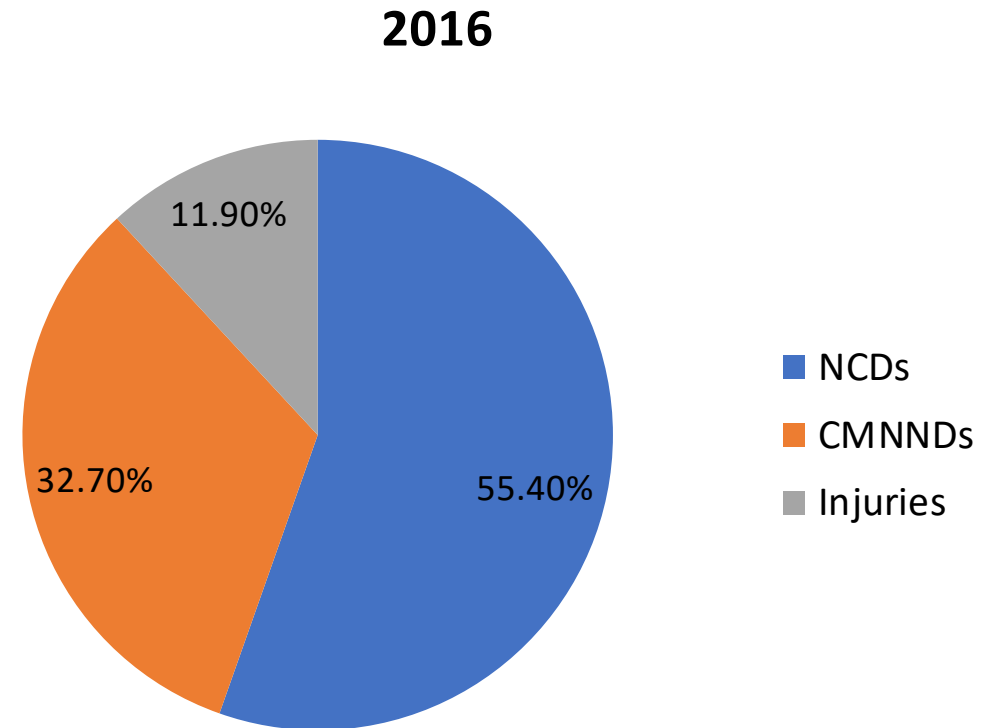
- Inequality in [Life Expectancy](#)
- States with higher [incidence of NCDs](#): Punjab, Tamil Nadu, Kerala, Andhra Pradesh, and Maharashtra.
- [Three](#) of the five [leading](#) individual [causes of disease burden](#) in India were: Ischemic heart disease, chronic obstructive pulmonary disease and stroke.
- States with higher [incidence of infectious](#) and related disease: [Empowered Action Group\(EAG\)](#) states and [North-Eastern states](#).
- [The top five leading causes of disease burden for Males](#): Ischemic heart disease, COPD, Road injuries, Lower respiratory infection, Diarrhoeal diseases
- [The top five leading causes of disease burden for Females](#): Ischemic heart diseases, Diarrhoeal diseases, Iron deficiency anaemia, Lower respiratory infection, COPD



## Comparing Disease Burden in India



■ NCDs  
■ CMNNDs  
■ Injuries



■ NCDs  
■ CMNNDs  
■ Injuries

Source: India: Health of the Nation's States  
The India State-Level Disease Burden Initiative (2017)  
Ministry of Health & Family Welfare



# Classification of Indian States

## Empowered Action Group (EAG) states

- A group of eight states that receive special development effort attention from the Government of India.
- Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand, and Uttar Pradesh.

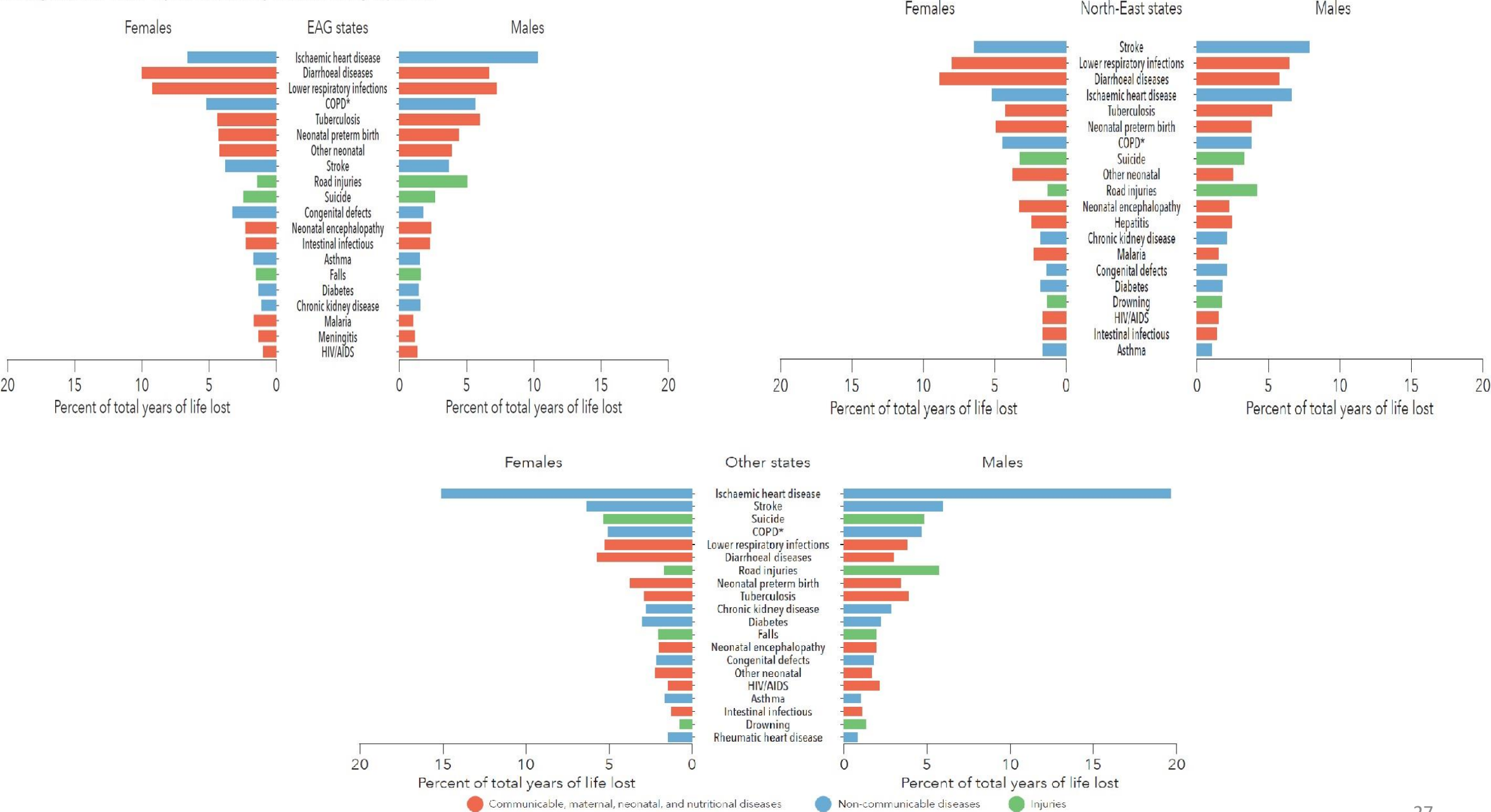
## North-East states

- Eight states in the hilly northeastern region of India:
- Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura.

# Comparing Disease Burden: India and Assam

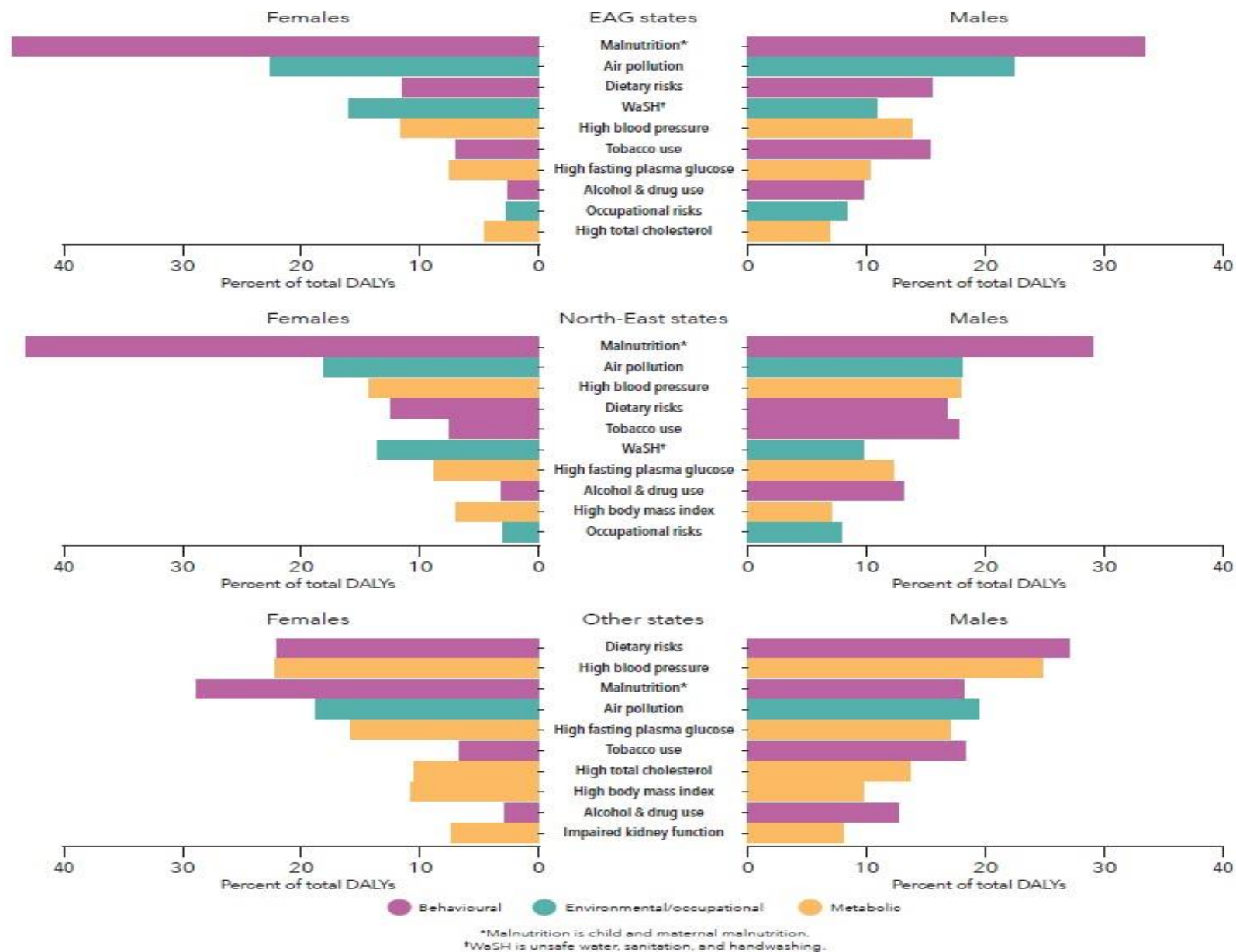
India	Assam
<p>Top five <b>Risk Factors</b> contributing to DALY:</p> <ul style="list-style-type: none"> <li>➤ <b>Malnutrition</b> (especially child &amp; maternal malnutrition)</li> <li>➤ Air Pollution</li> <li>➤ Dietary Risk</li> <li>➤ High Blood Pressure</li> <li>➤ High fasting plasma glucose</li> </ul>	<p>Top five <b>Risk Factors</b> contributing to DALY:</p> <ul style="list-style-type: none"> <li>➤ <b>Malnutrition</b> (especially child &amp; maternal malnutrition)</li> <li>➤ Air Pollution</li> <li>➤ High blood pressure</li> <li>➤ Dietary Risk</li> <li>➤ High Blood Pressure</li> </ul>
<p>The top five leading causes of <b>DALYs for Males</b>:</p> <ul style="list-style-type: none"> <li>➤ <b>Ischemic heart disease</b></li> <li>➤ COPD</li> <li>➤ Road injuries</li> <li>➤ Lower respiratory infection</li> <li>➤ Diarrhoeal diseases</li> </ul>	<p>The top five leading causes of <b>DALYs combined</b> for both the sexes, :</p> <ul style="list-style-type: none"> <li>➤ <b>Diarrhoeal diseases</b></li> <li>➤ Stroke</li> <li>➤ Lower respiratory infection</li> <li>➤ Chronic obstructive pulmonary disease (COPD)</li> <li>➤ Ischemic heart disease.</li> </ul>
<p>The top five leading causes of <b>DALYs for Females</b>:</p> <ul style="list-style-type: none"> <li>➤ <b>Ischemic heart diseases</b></li> <li>➤ Diarrhoeal diseases</li> <li>➤ Iron deficiency anaemia</li> <li>➤ Lower respiratory infection</li> <li>➤ COPD</li> </ul>	<p>Source: India Health of Nation's State The India State Level Disease Burden Initiative (2017) Ministry Of Health &amp; Family Welfare.</p>

Leading individual causes of years of life lost by sex in the state groups, 2016



\*COPD is chronic obstructive pulmonary disease.

Percent DALYs attributable to leading risk factors by sex in the state groups, 2016



Source: India: Health of the Nation's States  
 The India State-Level Disease Burden Initiative(2017)  
 Ministry of Health & Family Welfare

# Importance of Health Data as Indicators of health status of a population

- Age at death and cause provide an instant depiction of health status
- In high mortality settings, information on trends of death (by causes) substantiate the progress of health programs
- As survival improves with modernization and populations age, mortality measures do not give an adequate picture of a population's health status
- Indicators of morbidity such as the prevalence of chronic diseases and disabilities become more important
- Morbidity refers to the diseases and illnesses, injuries, and disabilities in a population.
- Data on frequency and distribution of an illness can aid in controlling its spread and, in some cases, may lead to the identification of its causes.
- It helps us to correlate various health indicators with various socioeconomic variables which have a significant impact on the health status of an individual.
- These findings can eventually help in making various interventions at policy level.

# References

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