Institute for Health
Metrics and Evaluation

Global Burden of Disease 1990-2021: Implications for surveillance

April 30, 2024
Christopher Murray

W UNIVERSITY *of* WASHINGTON

Outline

- **What is the GBD**
- Death registration
- Causes of Death
- Subnational burden experience

What is the GBD?

- GBD study is a systematic, scientific effort to quantify the magnitude of all major diseases, risk factors and intermediate clinical outcomes.

- **"Rules-based evidence synthesis for global health"**

- The first GBD study began in 1991 for eight regions 106 conditions and ten risk factors, 5 age groups for the year 1990.

- The GBD 2021 estimates for each year from 1990 to the present for 371 diseases and injuries, as well as 3,499 clinical outcomes (sequelae) related to those diseases and injuries, for 204 countries and territories and for subnational units in 21 countries.

Murray CJL. The global burden of disease study at 30 years. *Nature Medicine. October 2022.*

GBD collaboration

A health metrics ecosystem comprised of over **11,969 Collaborators in 163 countries and territories**

Number of collaborators based in country
- 0
- 1–5
- 6–20
- 21–60
- 61–200
- >200

AFRICA CDC
Centres for Disease Control and Prevention
Safeguarding Africa's Health

THE AGA KHAN UNIVERSITY

World Health Organization
REGIONAL OFFICE FOR Europe

ROBERT KOCH INSTITUT

KNOWLEDGE TO ACTION
phfi
PUBLIC HEALTH FOUNDATION OF INDIA

MINISTRY OF HEALTH
SINGAPORE

UK Health Security Agency

NTNU

GOVERNMENT OF NEPAL
NEPAL HEALTH RESEARCH COUNCIL

Pan American Health Organization

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Global Health Data Exchange (GHDx)

GHDx data source evolution:

NID is a unique identifier for a source of data e.g. FAO Food Balance Sheets would have a unique NID.

Some NIDs cover more than one country and thus produce many data points

GBD Compare: on-line tools providing access to detailed results, www.healthdata.org
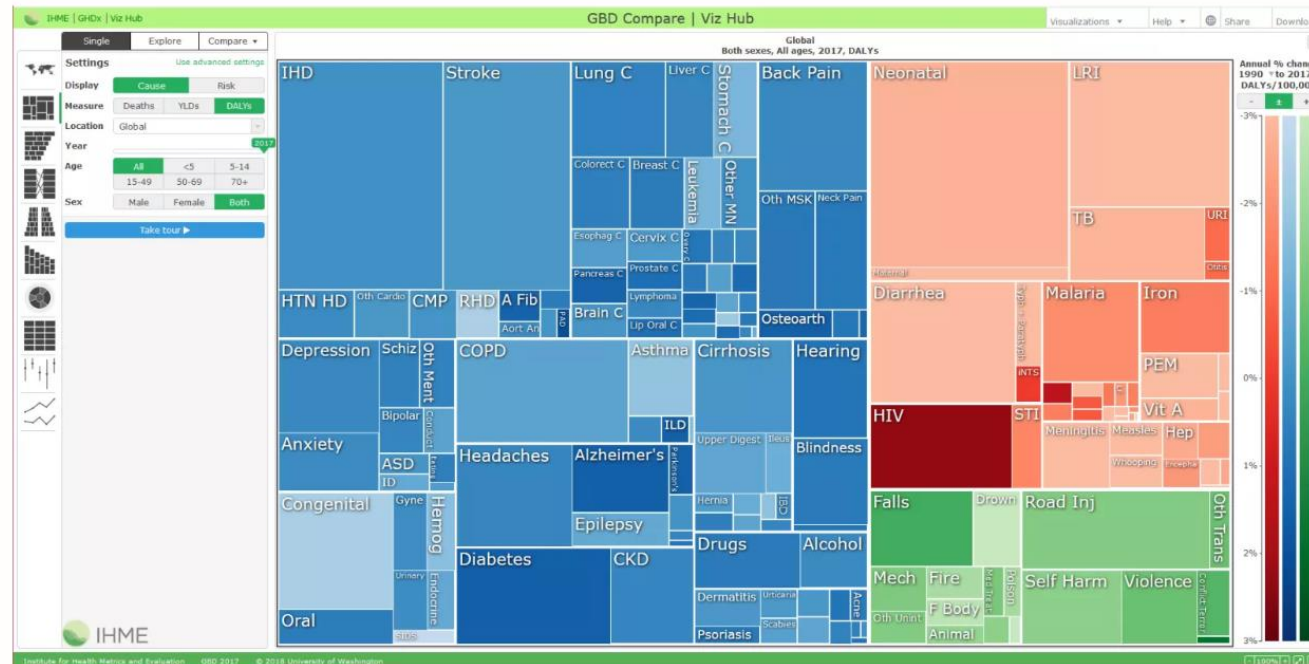
Completeness of VR systems in GBD super-regions, 1975–2021
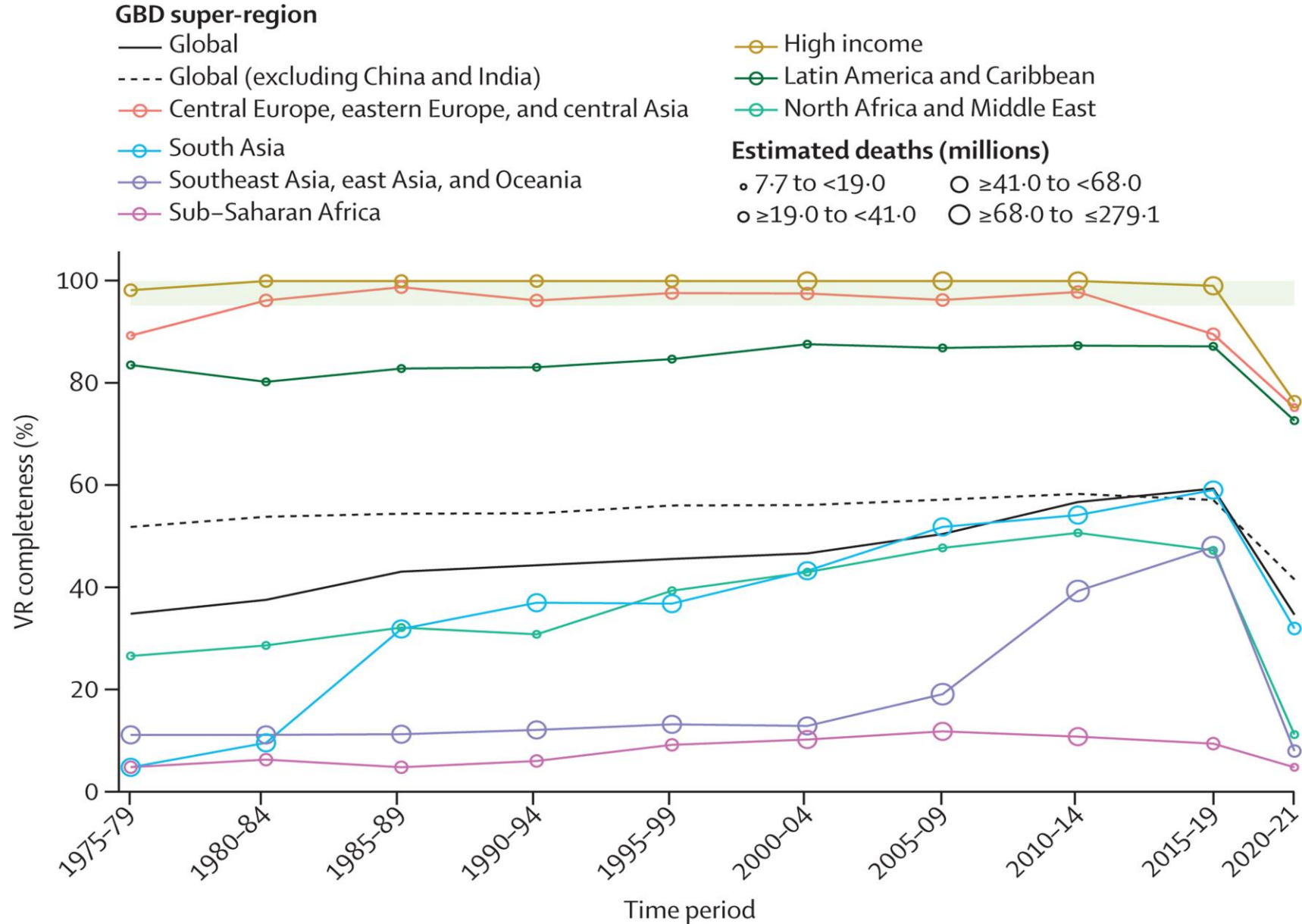
Global distribution of age-standardised excess mortality rates due to the COVID-19 pandemic, 2020 and 2021 combined

Mortality rate (per 100 000 population)
- <0
- ≥0 to <25
- ≥25 to <50
- ≥50 to <75
- ≥75 to <100
- ≥100 to <150
- ≥150 to <200
- ≥200 to <250
- ≥250 to <300
- ≥300
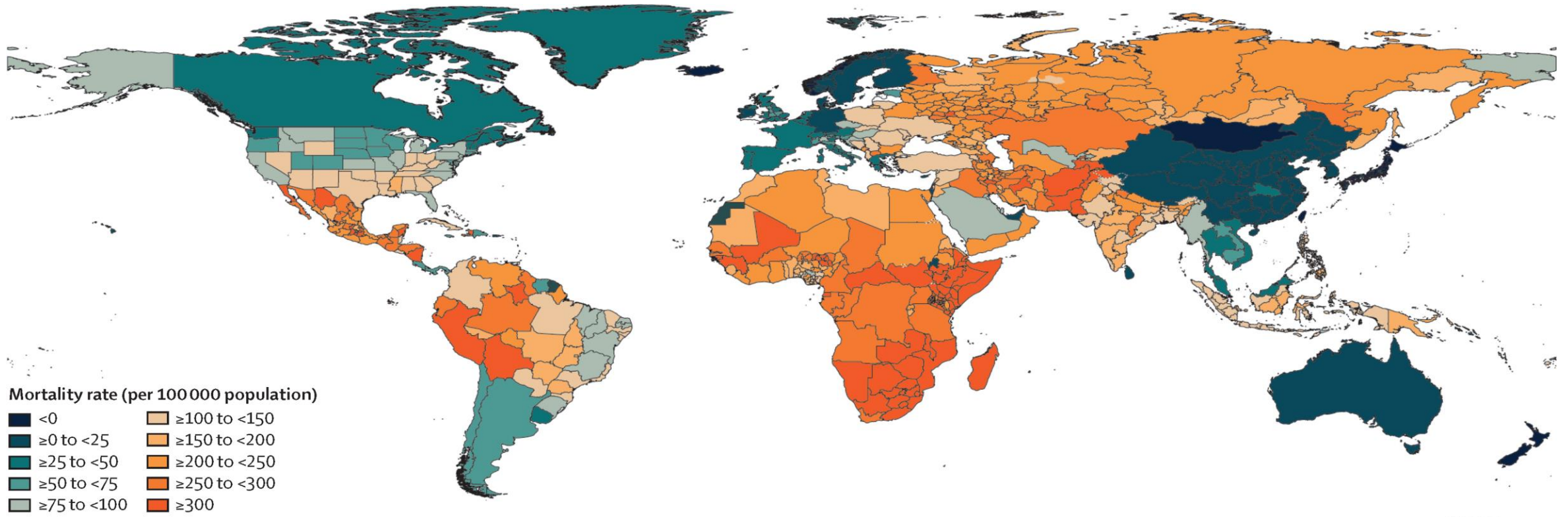
Caribbean and central America
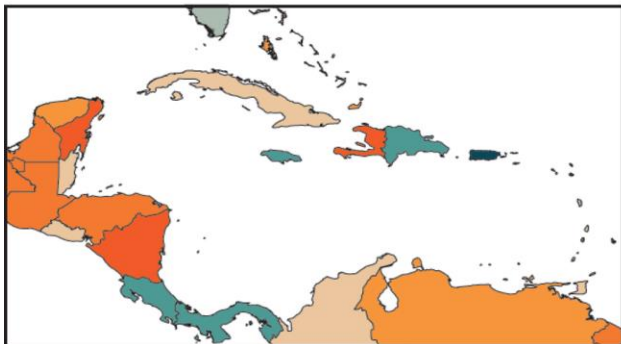
Persian Gulf
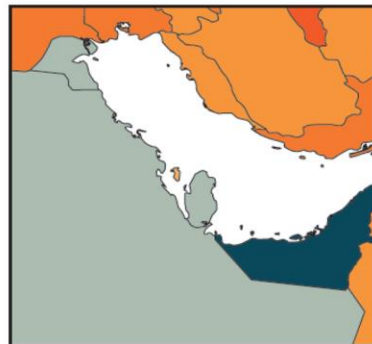
The Balkans

Southeast Asia

West Africa
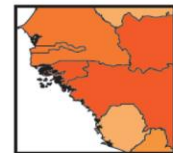
Eastern Mediterranean

Northern Europe

US life expectancy rank across 204 countries
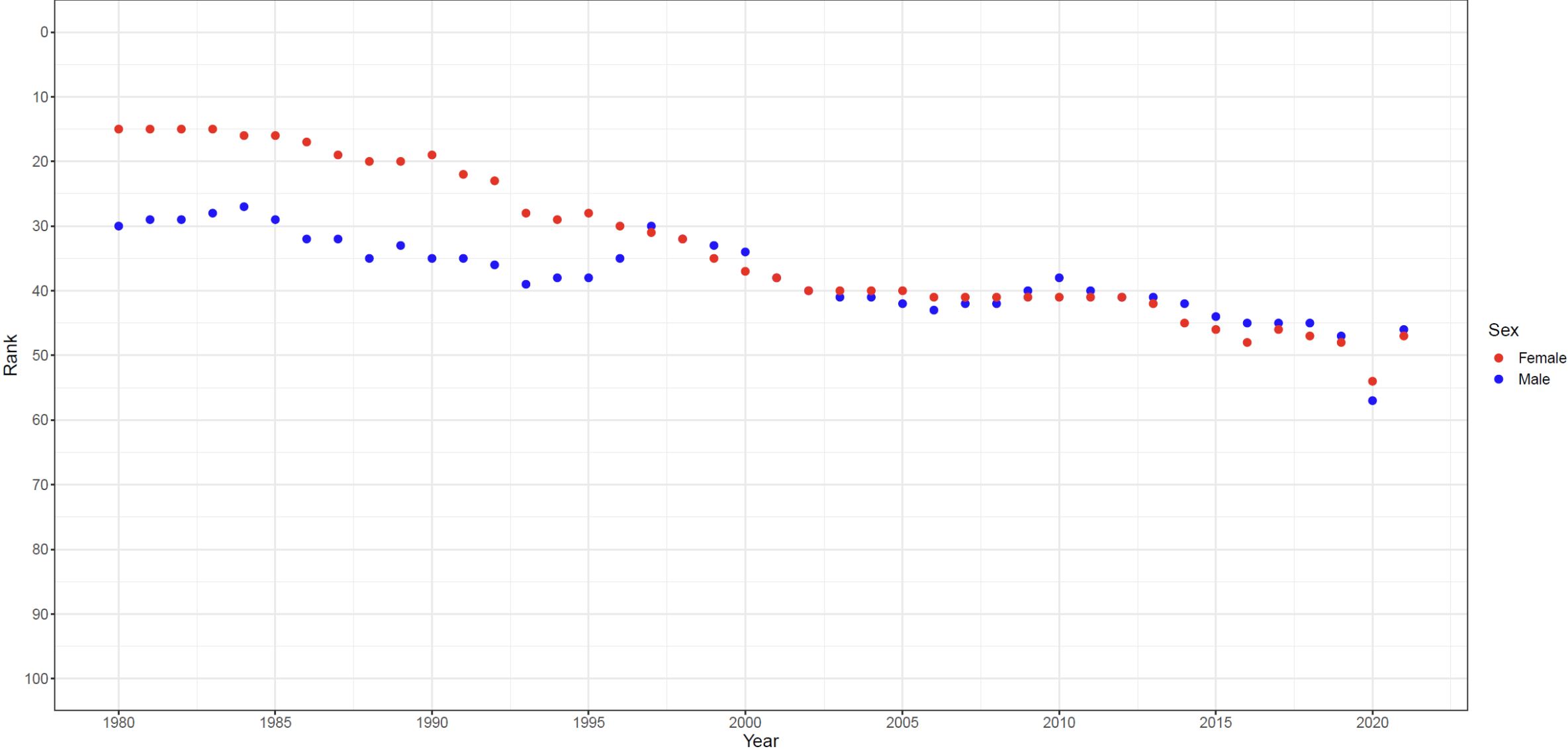
GBD 2021

Six summary capstone papers:

Causes of death and life expectancy decomposition—published online April 3

Full Lancet issue with all six capstone publications and a viewpoint will be released May 16

Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021

GBD 2021 Causes of Death Collaborators*

Summary

Background Regular, detailed reporting on population health by underlying cause of death is fundamental for public health decision making. Cause-specific estimates of mortality and the subsequent effects on life expectancy worldwide are valuable metrics to gauge progress in reducing mortality rates. These estimates are particularly important following large-scale mortality spikes, such as the COVID-19 pandemic. When systematically analysed, mortality rates and life expectancy allow comparisons of the consequences of causes of death globally and over time, providing a nuanced understanding of the effect of these causes on global populations.

Methods The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021 cause-of-death analysis estimated mortality and years of life lost (YLLs) from 288 causes of death by age-sex-location-year in 204 countries and territories and 811 subnational locations for each year from 1990 until 2021. The analysis used 56 604 data sources, including data from vital registration and verbal autopsy as well as surveys, censuses, surveillance systems, and cancer registries, among others. As with previous GBD rounds, cause-specific death rates for most causes were estimated using the Cause of Death Ensemble model—a modelling tool developed for GBD to assess the out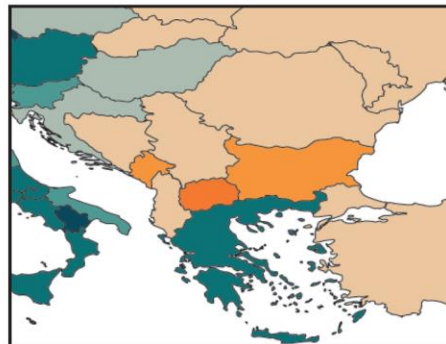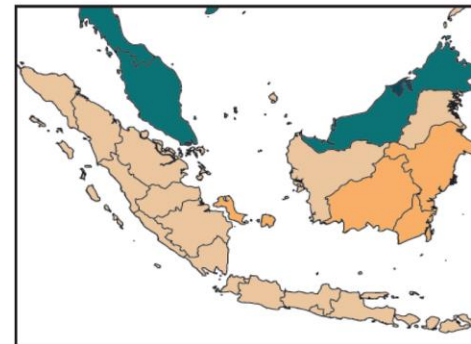-of-sample predictive validity of different statistical models and covariate permutations and combine those results to produce cause-specific mortality estimates—with alternative strategies adapted to model causes with insufficient data, substantial changes in reporting over the study period, or unusual epidemiology. YLLs were computed as the product of the number of deaths for each cause-age-sex-location-year and the standard life expectancy at each age. As part of the modelling process, uncertainty intervals (UIs) were generated using the 2·5th and 97·5th percentiles from a 1000-draw distribution for each metric. We decomposed life expectancy by cause of death, location, and year to show cause-specific effects on life expectancy from 1990 to 2021. We also used the coefficient of variation and the fraction of population affected by 90% of deaths to highlight concentrations of mortality. Findings are reported in counts and age-standardised rates. Methodological improvements for cause-of-death estimates in GBD 2021 include the expansion of under-5-years age group to include four new age groups, enhanced methods to account for stochastic variation of sparse data, and the inclusion of COVID-19 and other pandemic-related mortality—which includes excess mortality associated with the pandemic, excluding COVID-19, lower respiratory infections, measles, malaria, and pertussis. For this analysis, 199 new country-years of vital registration cause-of-death data, 5 country-years of surveillance data, 21 country-years of verbal autopsy data, and 94 country-years of other data types were added to those used in previous GBD rounds.

Findings The leading causes of age-standardised deaths globally were the same in 2019 as they were in 1990; in descending order, these were, ischaemic heart disease, stroke, chronic obstructive pulmonary disease, and lower respiratory infections. In 2021, however, COVID-19 replaced stroke as the second-leading age-standardised cause of death, with 94·0 deaths (95% UI 89·2–100·0) per 100 000 population. The COVID-19 pandemic shifted the rankings of the leading five causes, lowering stroke to the third-leading and chronic obstructive pulmonary disease to the fourth-leading position. In 2021, the highest age-standardised death rates from COVID-19 occurred in sub-Saharan Africa (271·0 deaths [250·1–290·7] per 100 000 population) and Latin America and the Caribbean (195·4 deaths [182·1–211·4] per 100 000 population). The lowest age-standardised death rates from COVID-19 were in the high-income super-region (48·1 deaths [47·4–48·8] per 100 000 population) and southeast Asia, east Asia, and Oceania (23·2 deaths [16·3–37·2] per 100 000 population). Globally, life expectancy steadily improved between 1990 and 2019 for 18 of the 22 investigated causes. Decomposition of global and regional life expectancy showed the positive effect that reductions in deaths from enteric infections, lower respiratory infections, stroke, and neonatal deaths, among others have contributed to improved survival over the study period. However, a net reduction of 1·6 years occurred in global life expectancy between 2019 and 2021, primarily due to increased death rates from COVID-19 and other pandemic-related mortality. Life expectancy was highly variable between super-regions over the study period, with southeast Asia, east Asia, and Oceania gaining 8·3 years (6·7–9·9) overall, while having the smallest reduction in life expectancy due to COVID-19 (0·4 years). The largest reduction in life expectancy due to COVID-19 occurred in Latin America and the Caribbean (3·6 years). Additionally, 53 of the 288 causes of death were highly concentrated in locations with less than 50% of the global population as of 2021,

Star Rating of causes of death data from 1980-2021 based quality of assignment of death and completeness
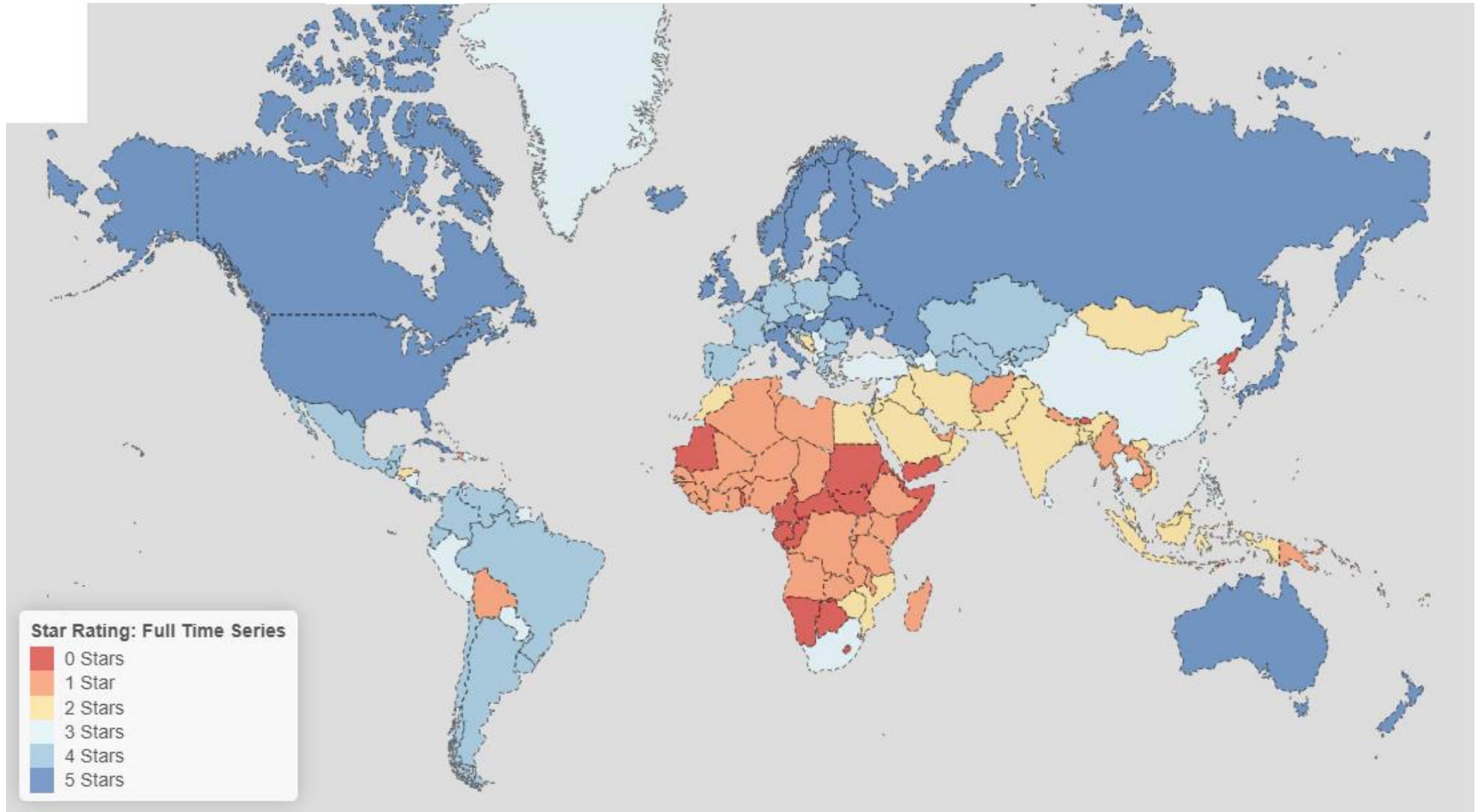
Change in life expectancy attributable to leading causes of death among super-regions, 1990–2021
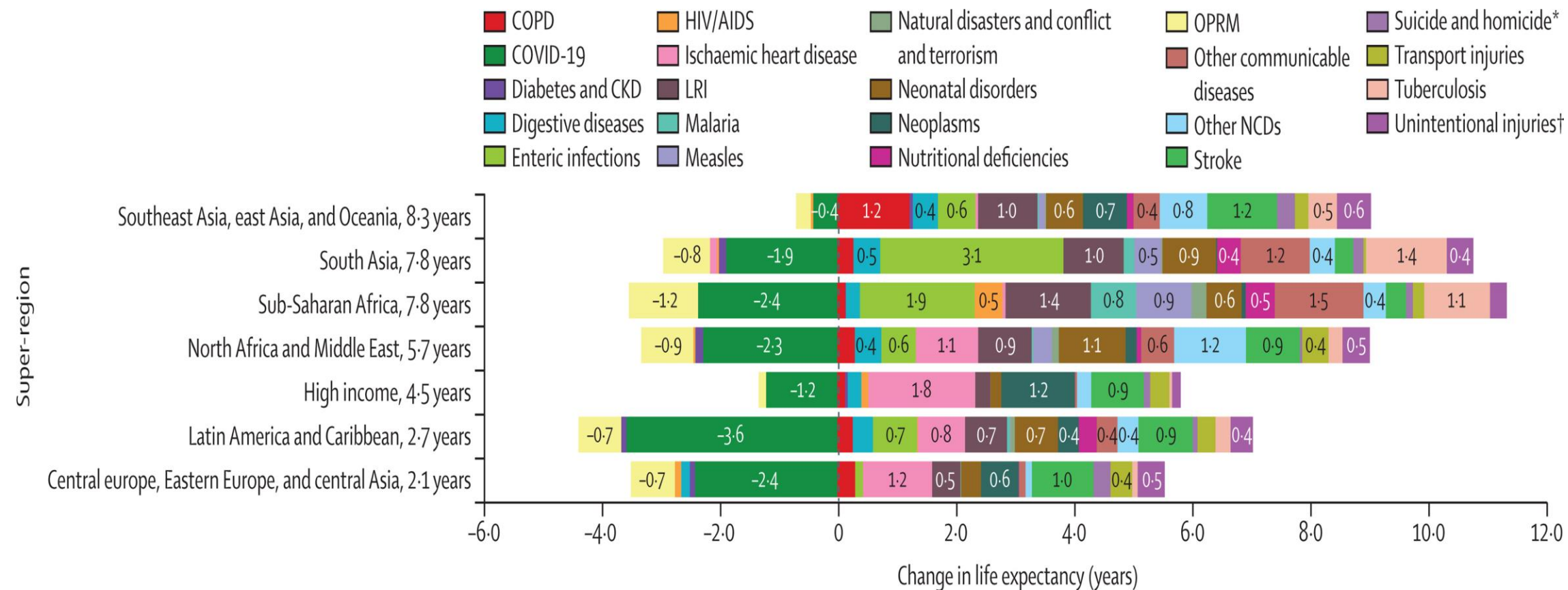
US Burden of Disease and Health Disparities Project

Goal: Estimate burden of disease and health disparities in the US at the county level, stratified by racial and ethnic population.

Using the same conceptual approach as the Global Burden of Disease (GBD) Study:

- Focus on all aspects of health loss, and various metrics:
  - *Traditional measures*: mortality, incidence, and prevalence rates
  - *Impact measures*: years of life lost (YLLs), years lived with disability (YLDs)
  - *Summary measures*: disability adjusted life years (DALYs), healthy life expectancy (HALE)
- Consider a wide range of health conditions
- Estimate both exposure to and burden attributable to selected risk factors

This project is funded by NIH, and undertaken in collaboration with the NIH US Burden of Health Disparities Working Group

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County Life Expectancy, 2019
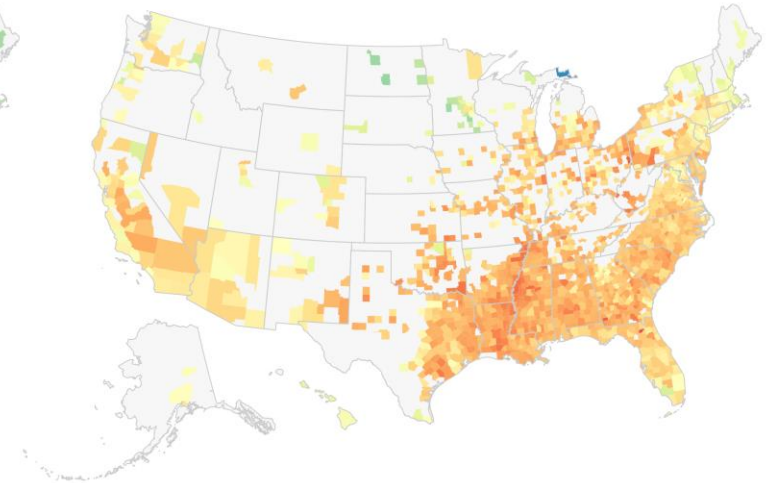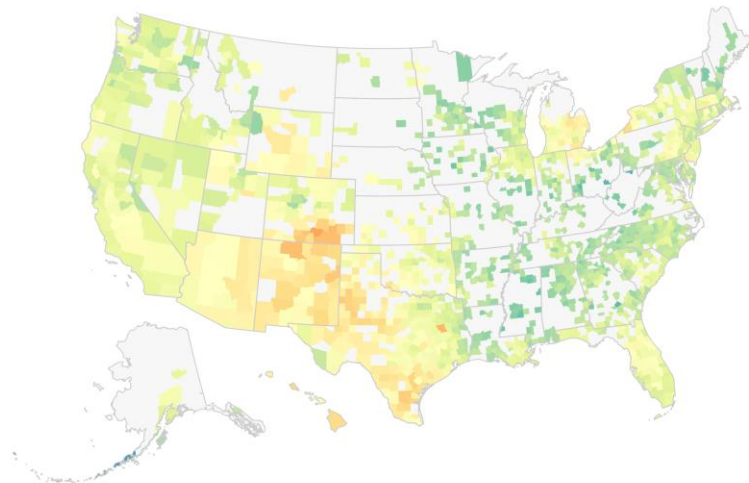

Life expectancy, 2019 (years)
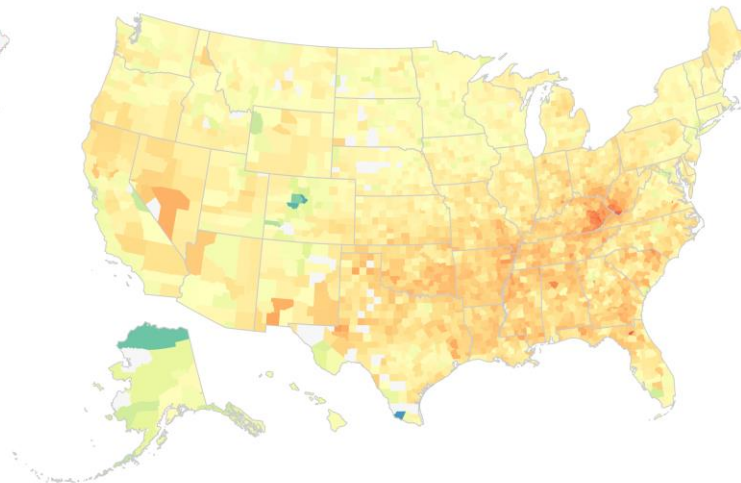
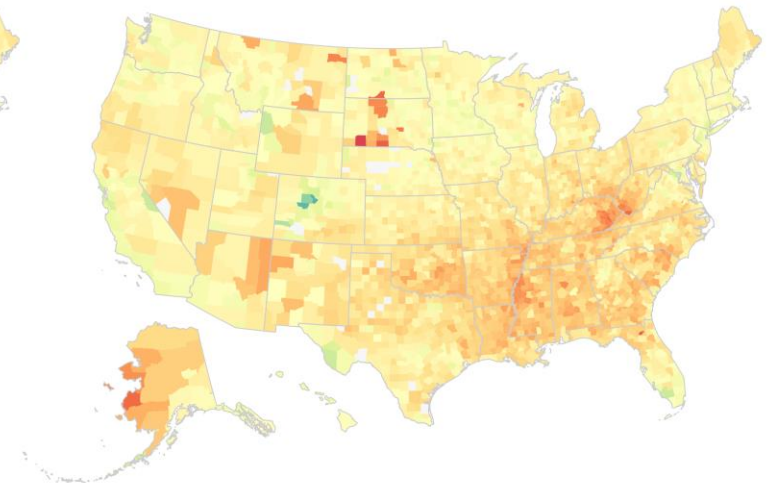59–65   70   75   80   85   90   95
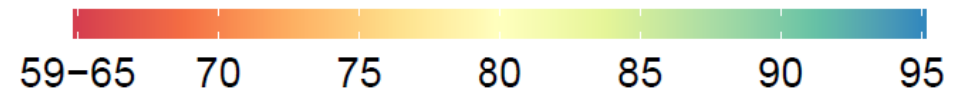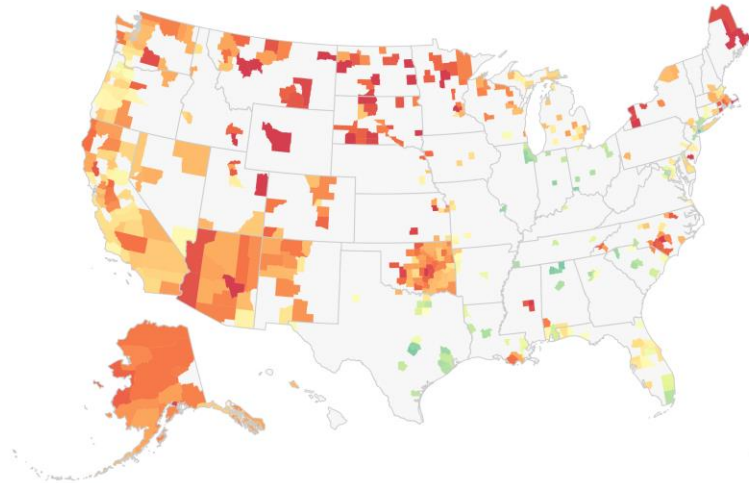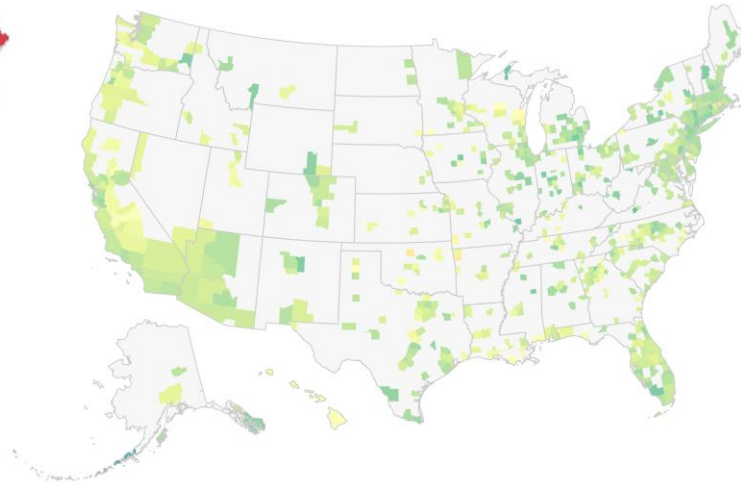
AIAN

Asian

Black

Latino

White

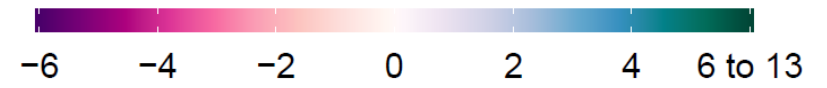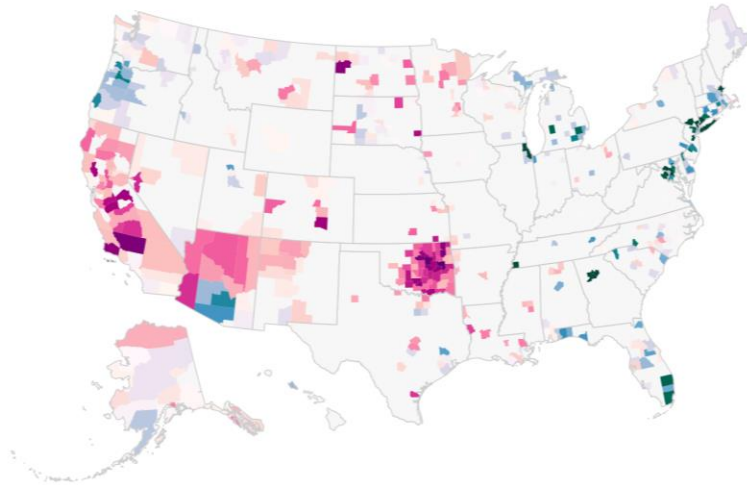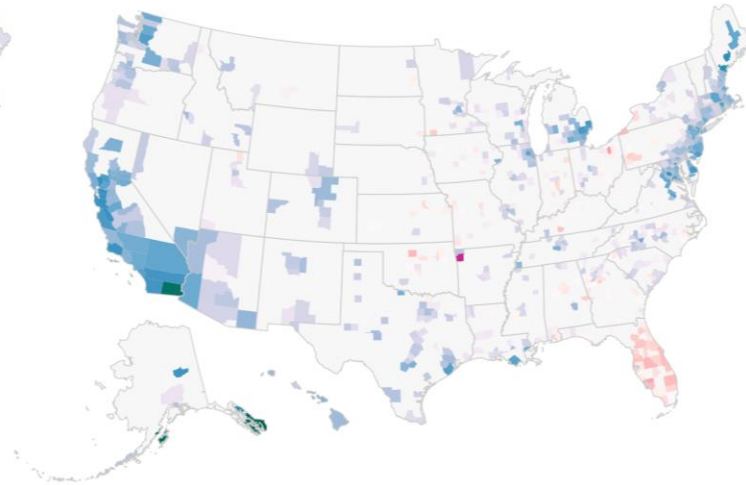Total

Change, 2000–19

Change in life expectancy, 2000 to 2019 (years)
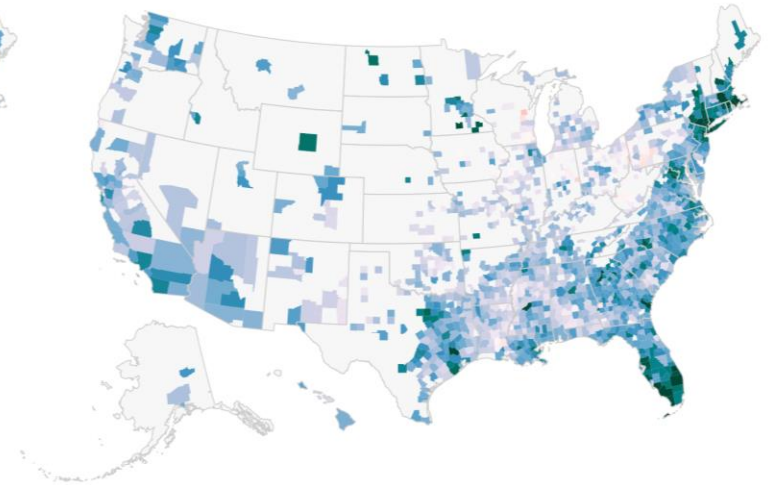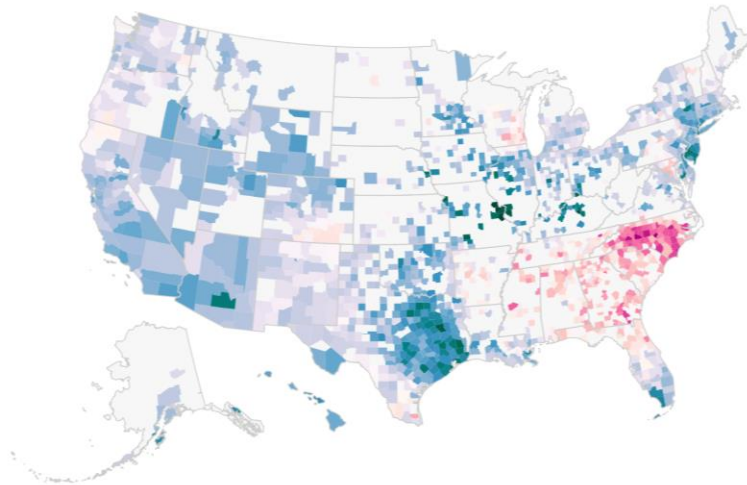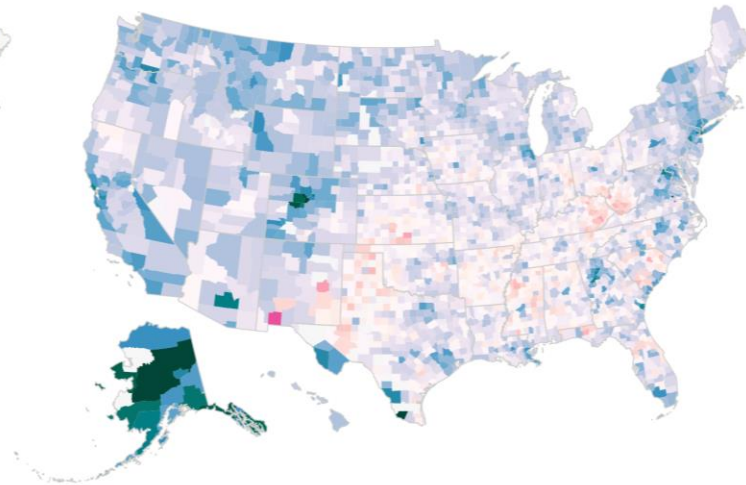
−6 −4 −2 0 2 4 6 to 13

AIAN Asian Black

Latino White Total
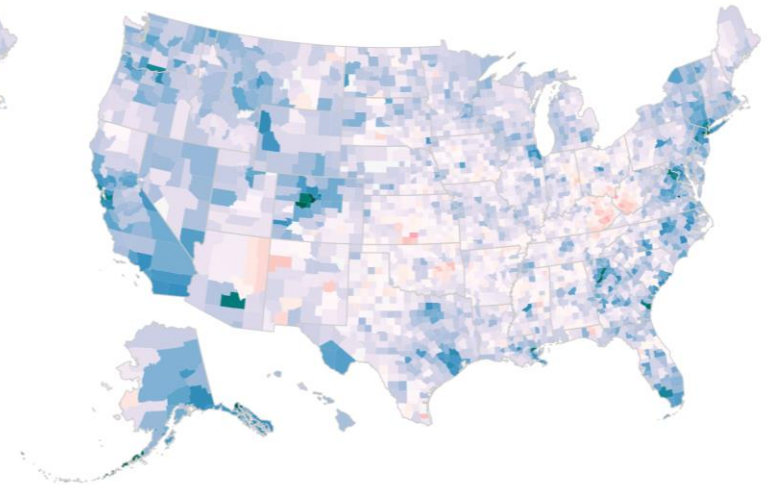
Comparison to Other Countries
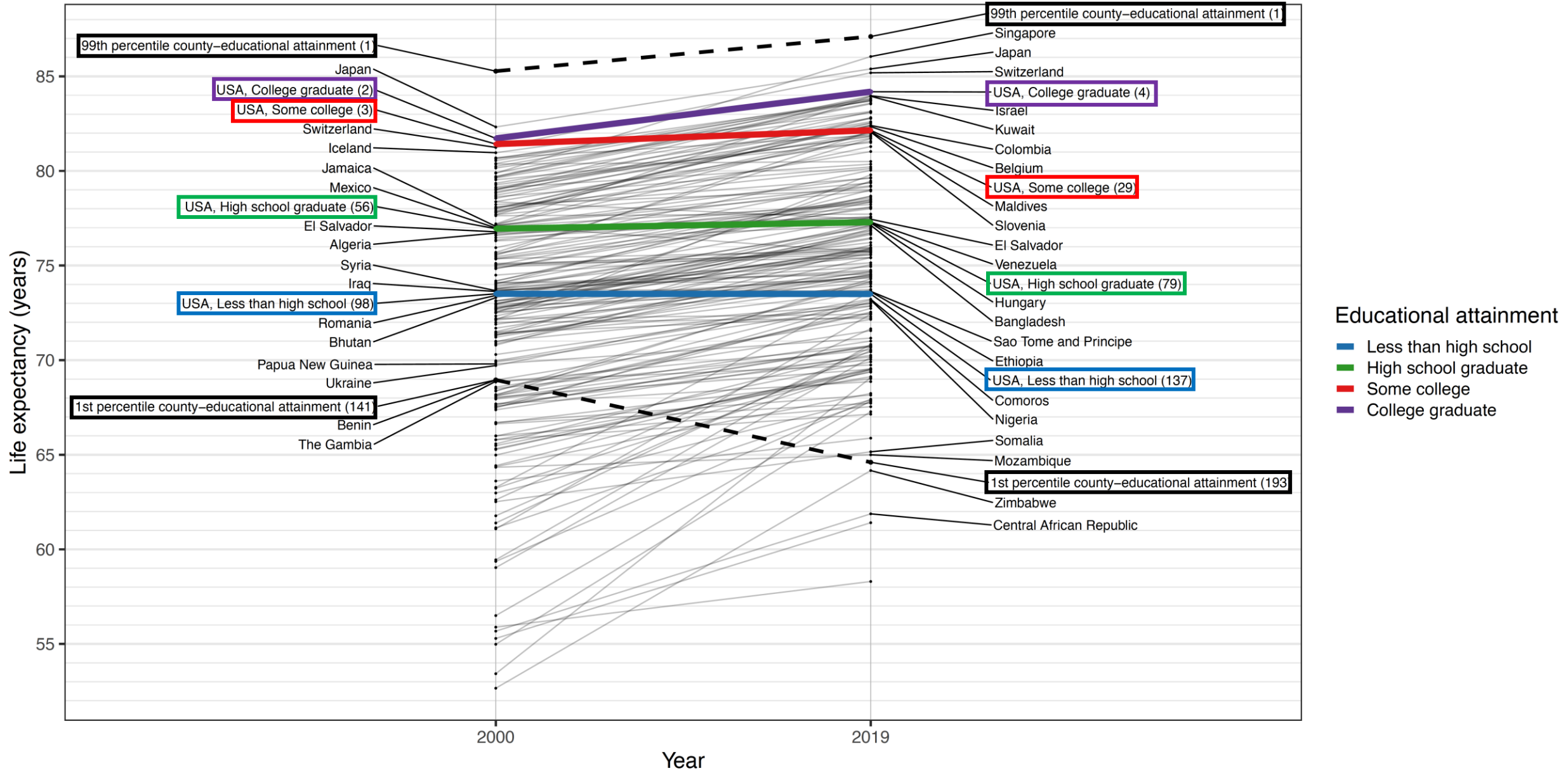
County Mortality Patterns, 2019

Ratio of county mortality to national mortality:

0.10 - 0.33   0.50   0.67   1.00   1.50   2.00   3.00 - 10.55

US Health Map

https://vizhub.healthdata.org/subnational/usa
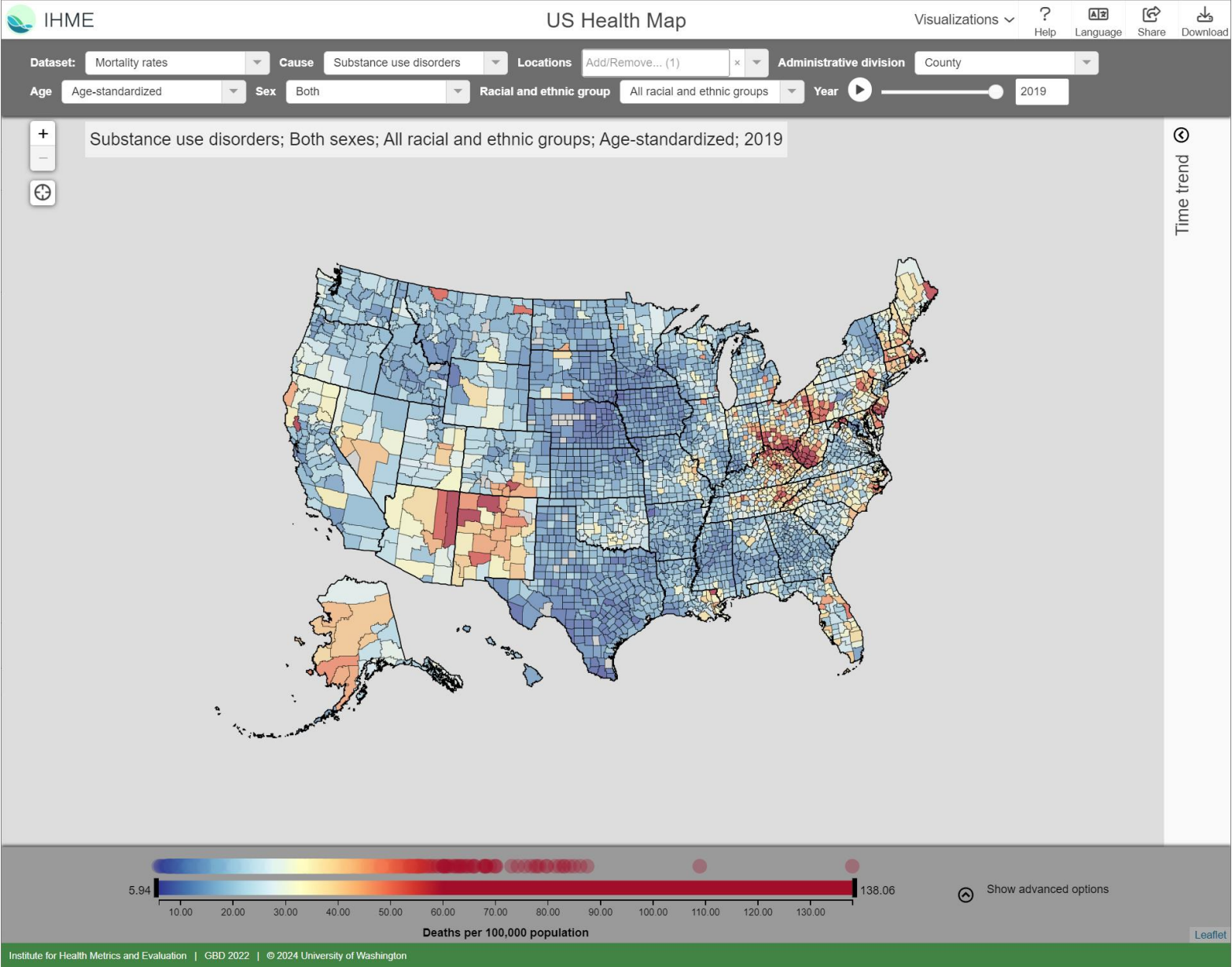
County Obesity Prevalence (age 20+), 2019

Obesity prevalence (%)
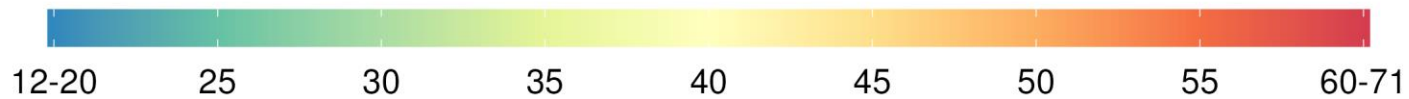
12-20 · 25 · 30 · 35 · 40 · 45 · 50 · 55 · 60-71