



Institute for Health
Metrics and Evaluation

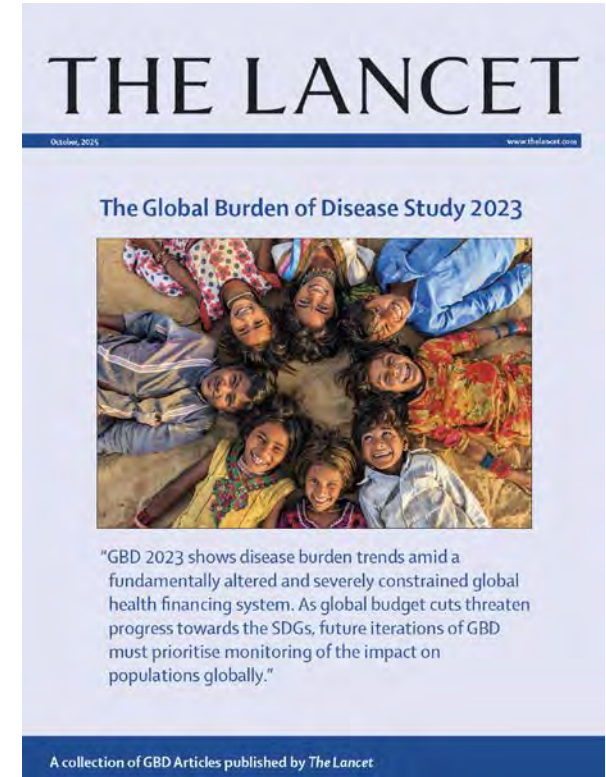
Where are we headed? Demographic transitions in a time of global upheaval

Chris Murray

Director, Institute for Health Metrics and Evaluation

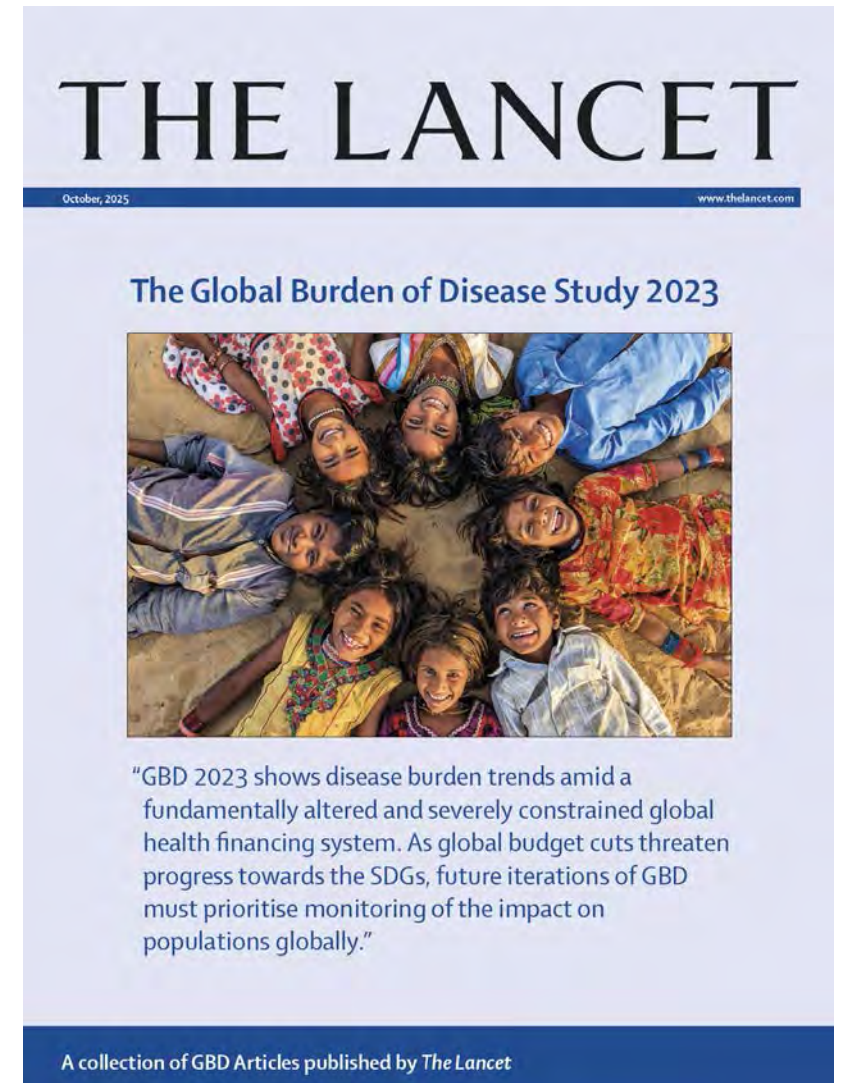
Outline

- **What is the GBD?**
- Building forecast models from the GBD
- Key drivers of future health and population
- Fertility, migration and population
- Future burden of disease and risks
- Threats and opportunities for action
- The big picture

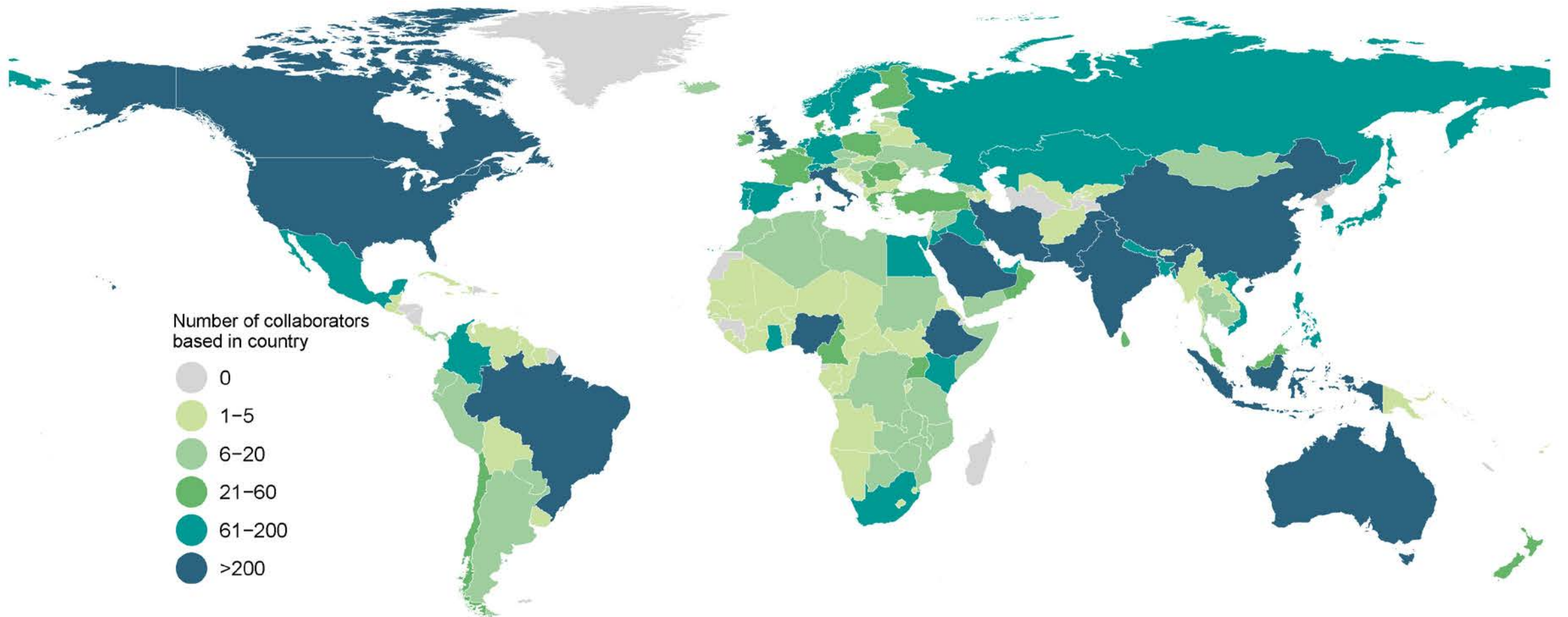


GBD 2023

- GBD 2023 is a **systematic, scientific** effort to quantify the magnitude of all major diseases, risk factors and intermediate clinical outcomes 1990-2023.
- The GBD 2023 estimates for each year from 1990 to the present for **375** diseases and injuries, as well as **3,704** clinical outcomes (sequelae) related to those diseases and injuries, for **204** countries and territories and for subnational units in 20 countries.
- GBD 2023 includes quantification of **88** risk factors
- Reports disease incidence, prevalence, age-specific fertility and mortality, population, cause-specific deaths and death rates, Years of Life Lost (YLL), Years Lived with Disability (YLD), Disability Adjusted Life Years (DALYs) and Healthy Life Expectancy (HALE).



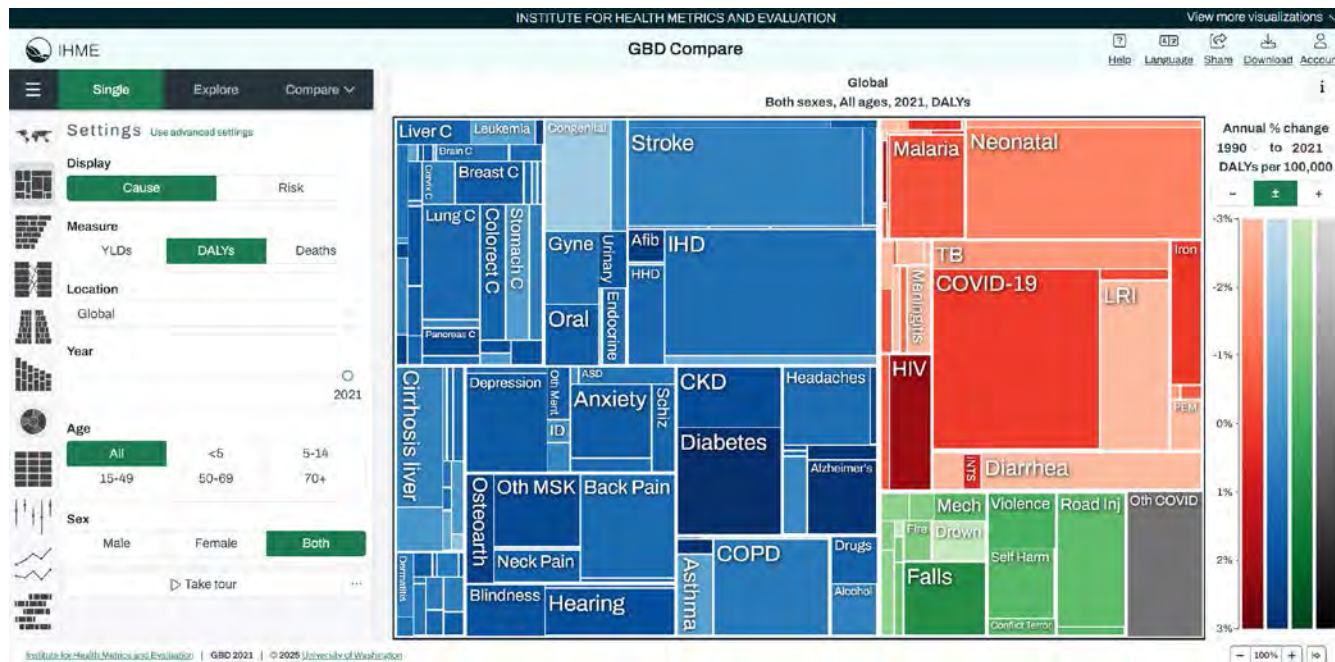
GBD is a collaborative undertaking



19,000+ collaborators in 167 countries and territories

On-line tools providing access to detailed results and data sources, www.healthdata.org

GBD COMPARE



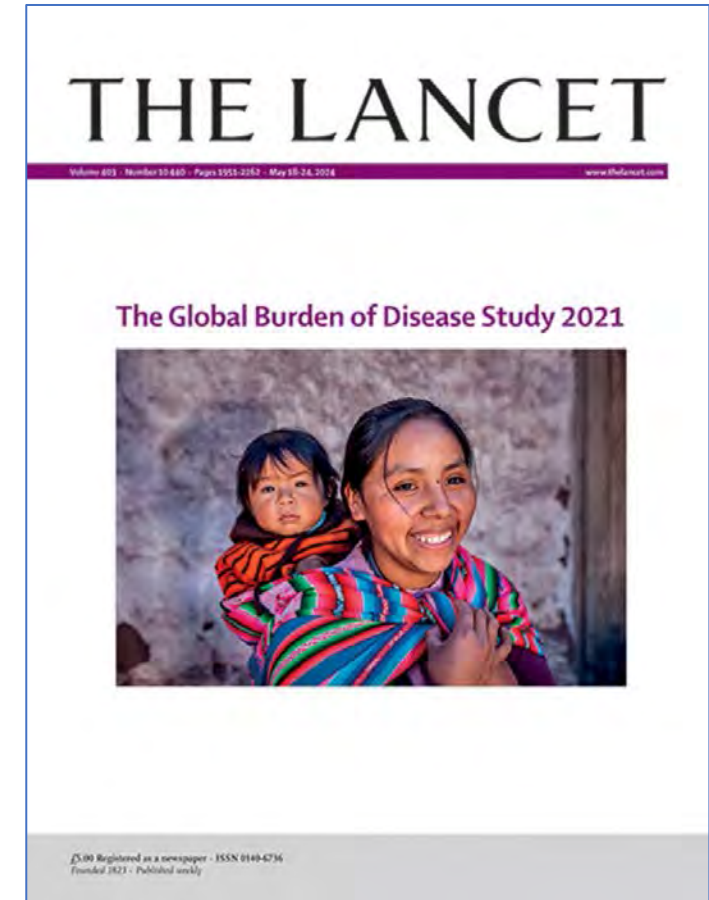
Total sources used in GBD 2023 is **317,378**

The screenshot shows the homepage of the Global Health Data Exchange (GHDx) website. The header includes the IHME | GHDx | GBD Compare logo and navigation links: Home, Countries, Series and Systems, Organizations, Keywords, Cooper, Tools, and IHME Data. The main content area features a welcome message and links to 'GBD 2021 data' and 'All IHME data'. A search bar is present with a 'Search Data' label and a 'Search' button. A 'Countries' dropdown menu is set to 'Afghanistan'. The footer contains the text 'Data made available for download by IHME can be used, shared, modified, or built upon by non-commercial users in accordance with the IHME FREE-OF-CHARGE NON-COMMERCIAL USER AGREEMENT. For more information (and inquiries about commercial use), visit IHME Terms and Conditions.'

ghdx.healthdata.org

Outline

- **What is the GBD?**
- **Building forecast models from the GBD**
- Key drivers of future health and population
- Fertility, migration and population
- Future burden of disease and risks
- Threats and opportunities for action
- The big picture



Global Burden of Disease Study (GBD)

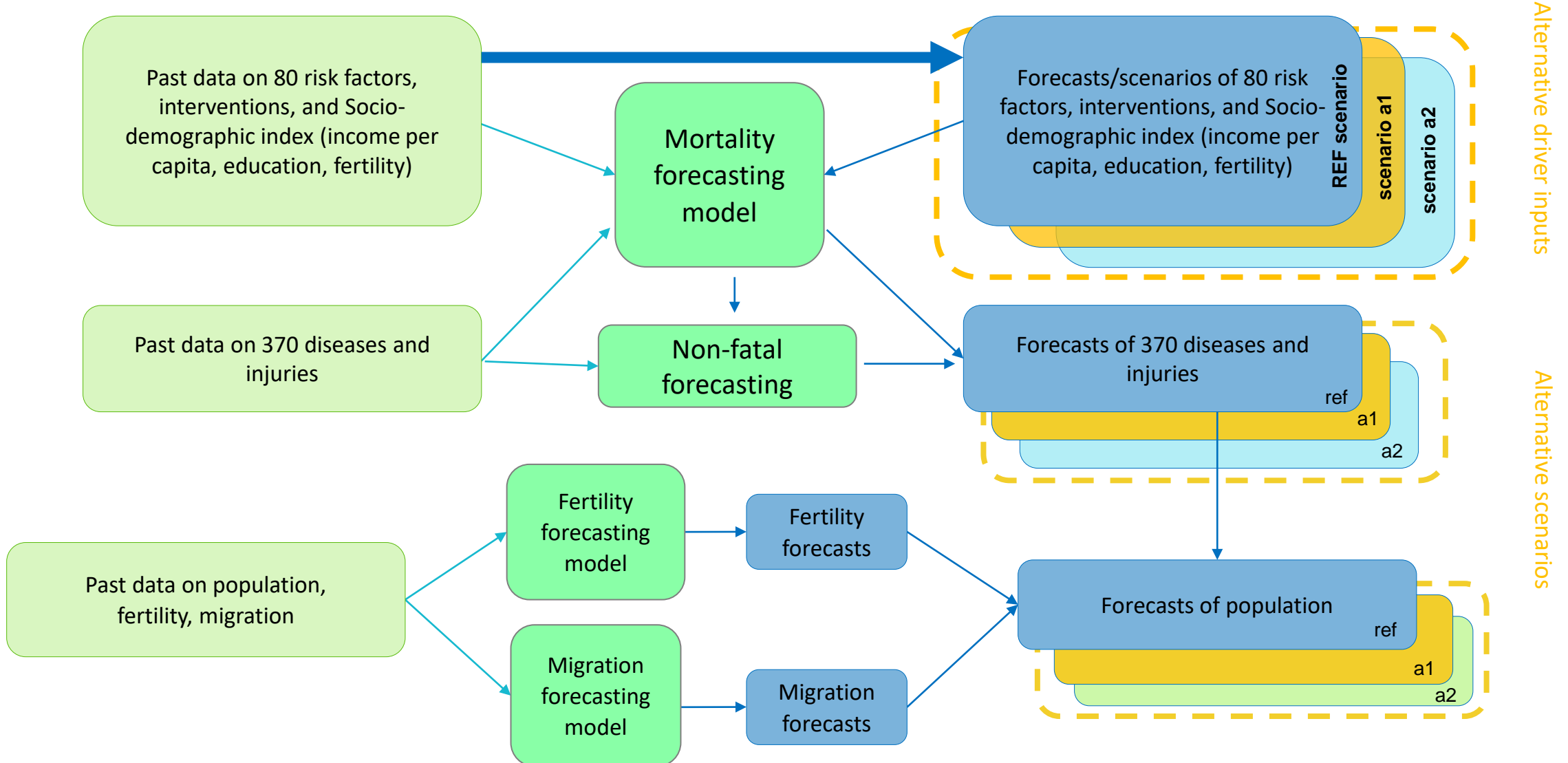
204 countries plus 811 subnational locations
23 age groups/males/females

GBD Future Health Scenarios

204 countries plus 142 subnational locations
23 age groups/males/females

1950 1980 1990 2021

2022 2050 2100



Forecasting framework

Three component model:

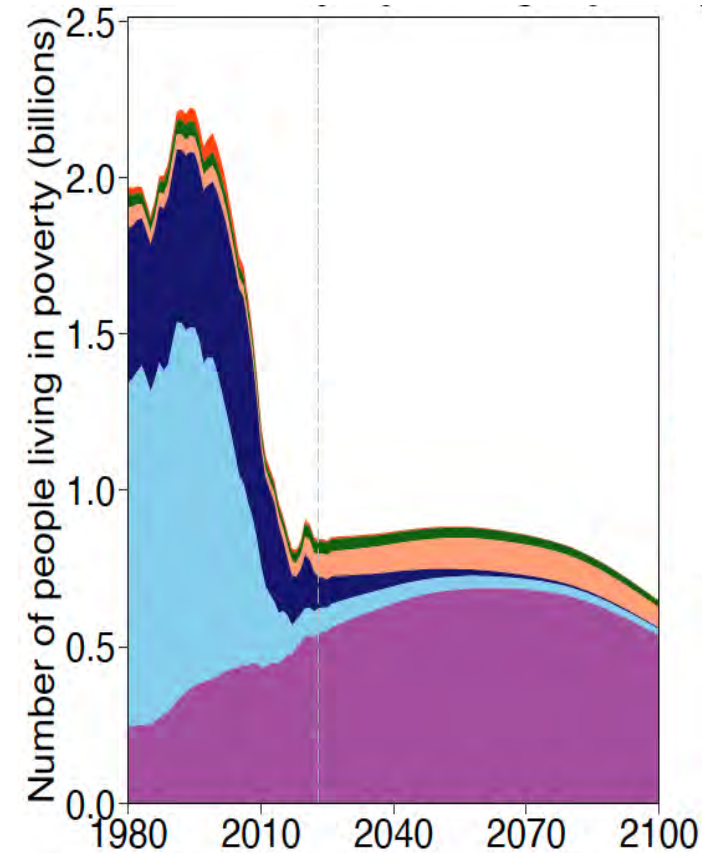
- 1) Forecast all risk factors using ensemble models
- 2) Model past risk-deleted mortality as a function of SDI, time, and additional covariates depending on the cause
- 3) Model unexplained residual mortality for cause-specific and all-cause mortality as a cascading ARIMA

$$\ln(m_{ilast}^T) \sim \mathcal{N}(\hat{y}, \sigma)$$

$$\ln(m_{ilast}^T) = \underbrace{\lambda_{is} + \alpha_{ias} + \delta_{ils} + \beta_{is}SDI_{lt} + \gamma_{is}t + \theta_{ias}t}_{2} + \underbrace{\ln(S_{ilast})}_{1} + \underbrace{\epsilon_{ilast}}_{3}$$

Outline

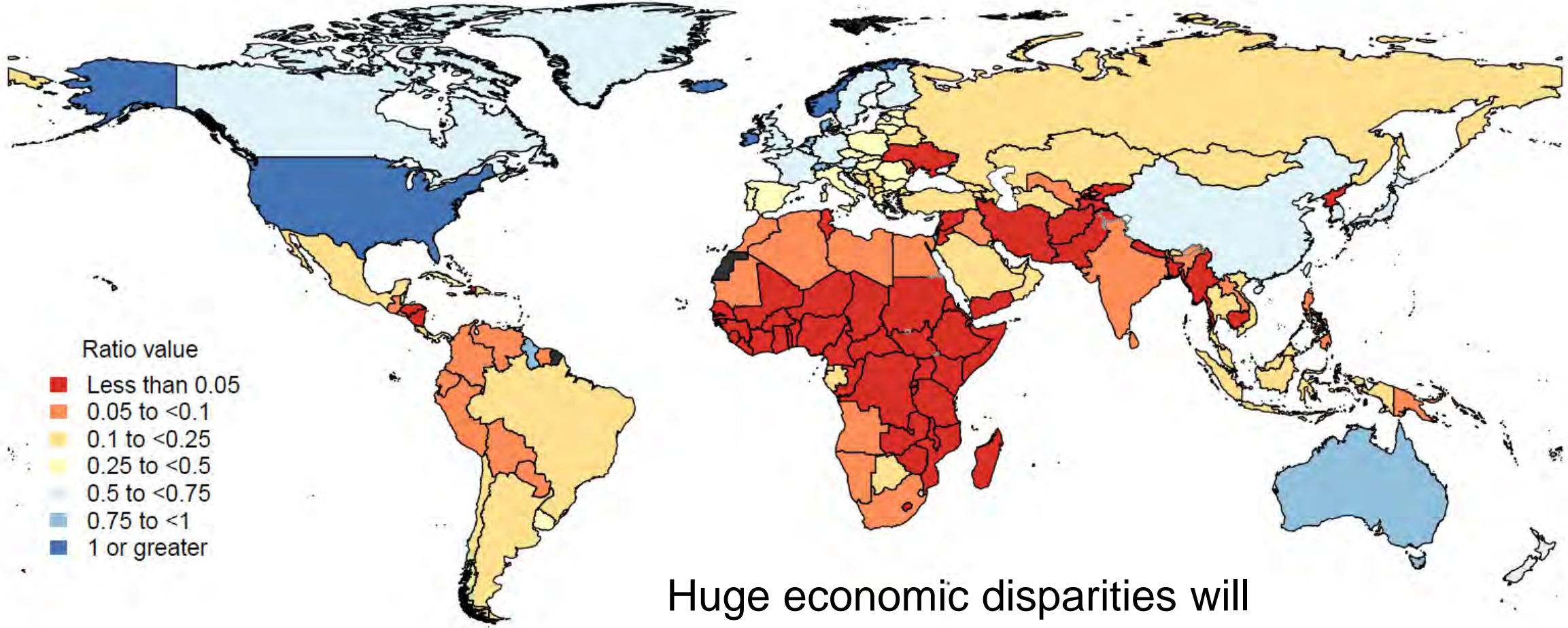
- **What is the GBD?**
- **Building forecast models from the GBD**
- **Key drivers of future health and population**
- Fertility, migration and population
- Future burden of disease and risks
- Threats and opportunities for action
- The big picture



Economic growth is a critical driver: need to capture dynamic interaction of GDP growth, population growth and climate change

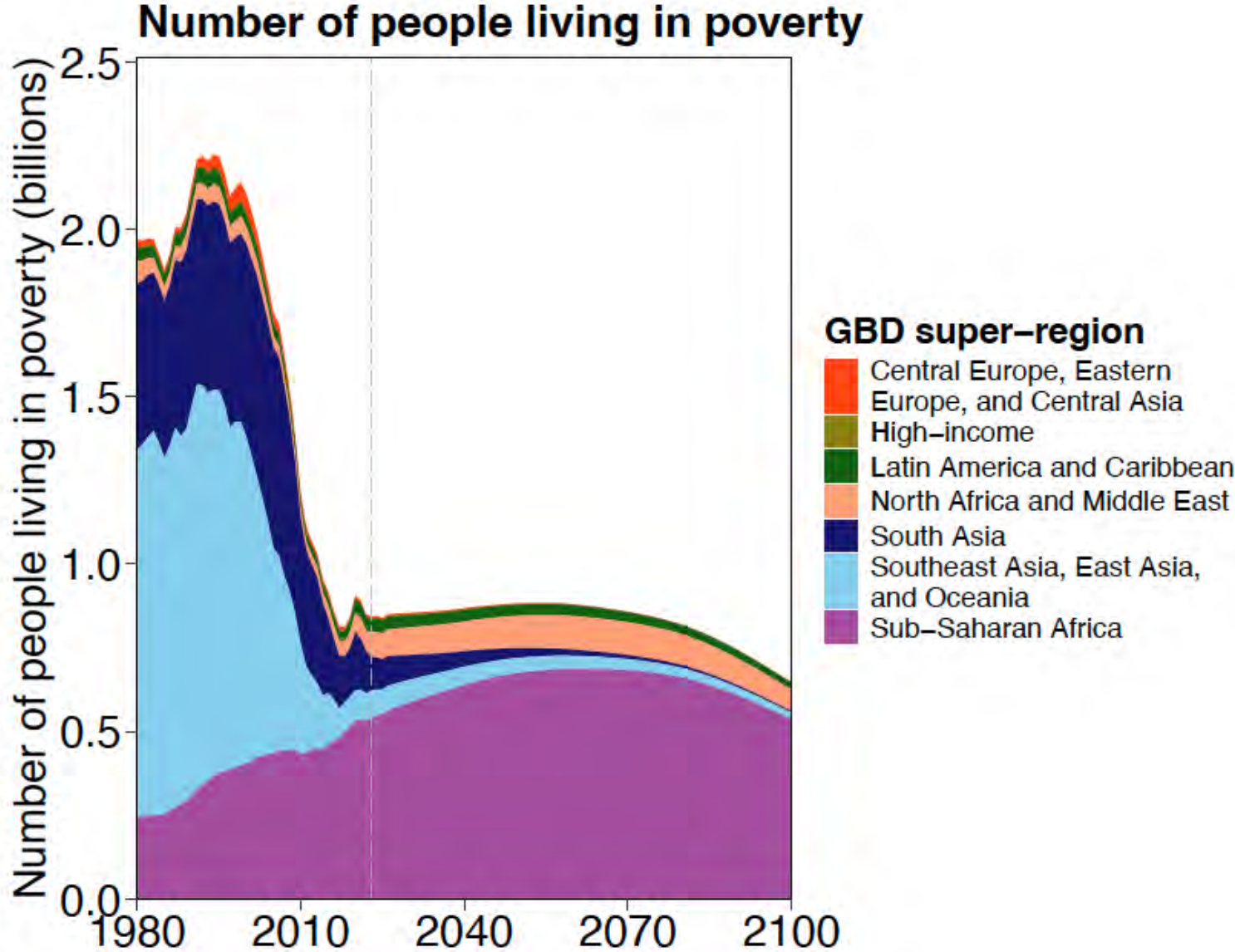
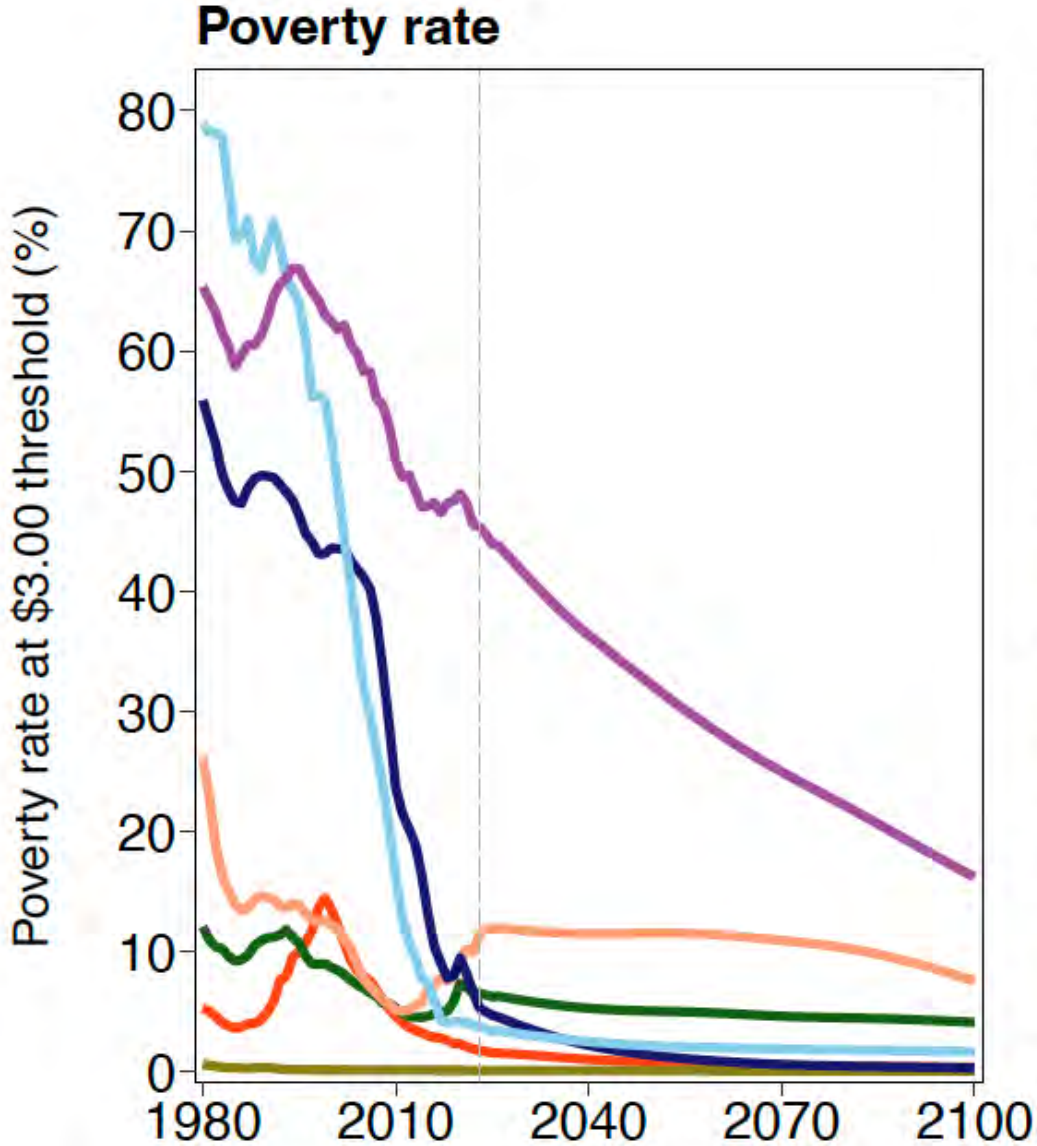
- Model GDP per working age adult so that future demographic shifts are embedded.
- To capture the dynamic interaction of climate change and agricultural and non-agricultural GDP, model GDP growth, emissions, and climate change year by year.
- For each country, an ensemble of models is developed that is a function of level of GDP per capita to capture convergence, human capital, temperature, and historic rates of growth.

Ratio of countries' GDP per capita to USA GDP per capita in 2100, reference scenario

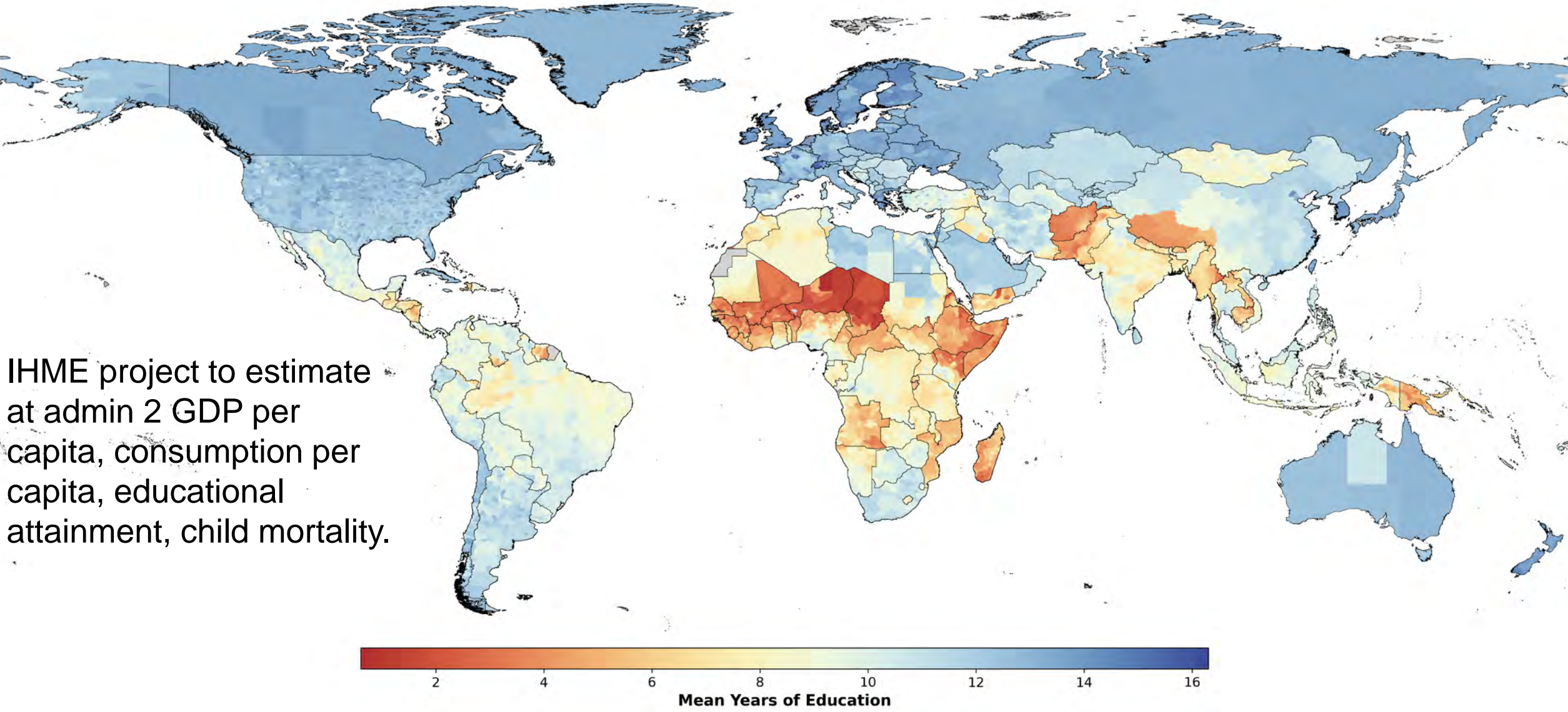


Huge economic disparities will remain without major change in growth trajectories

Extreme poverty count is a critical driver of health: it is not expected to decline



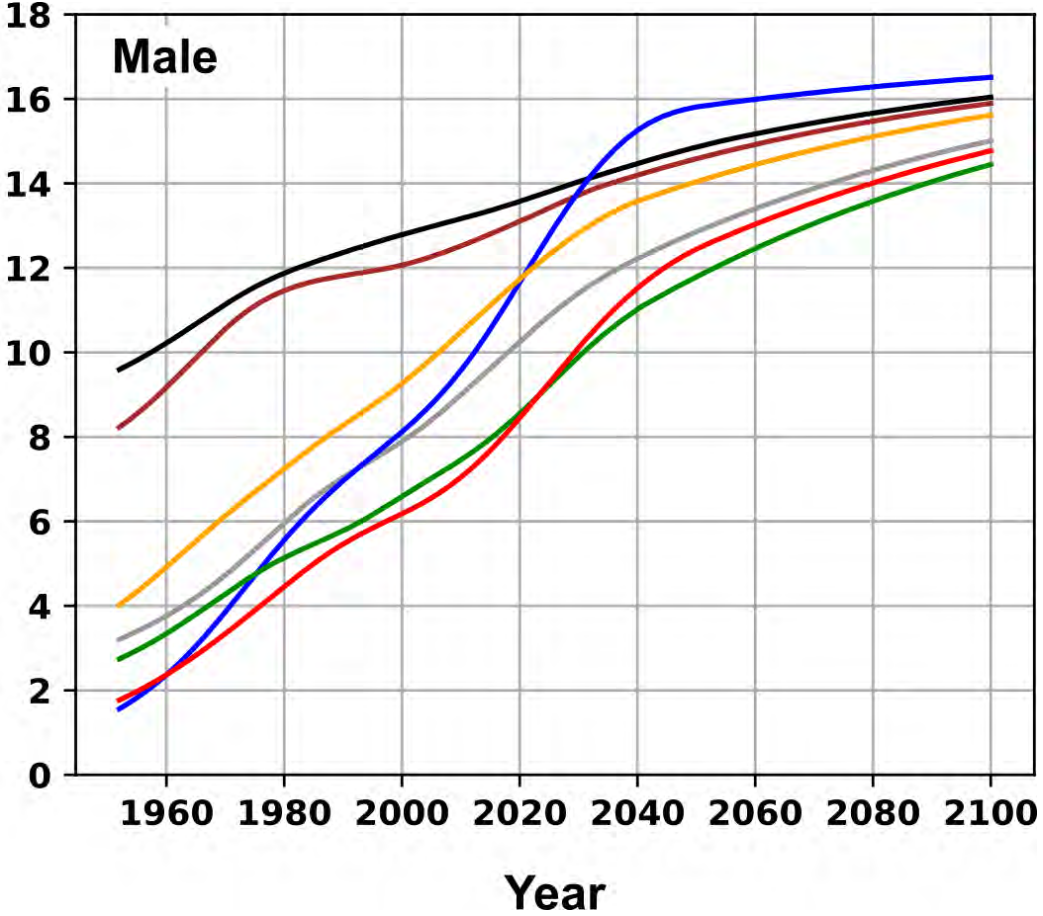
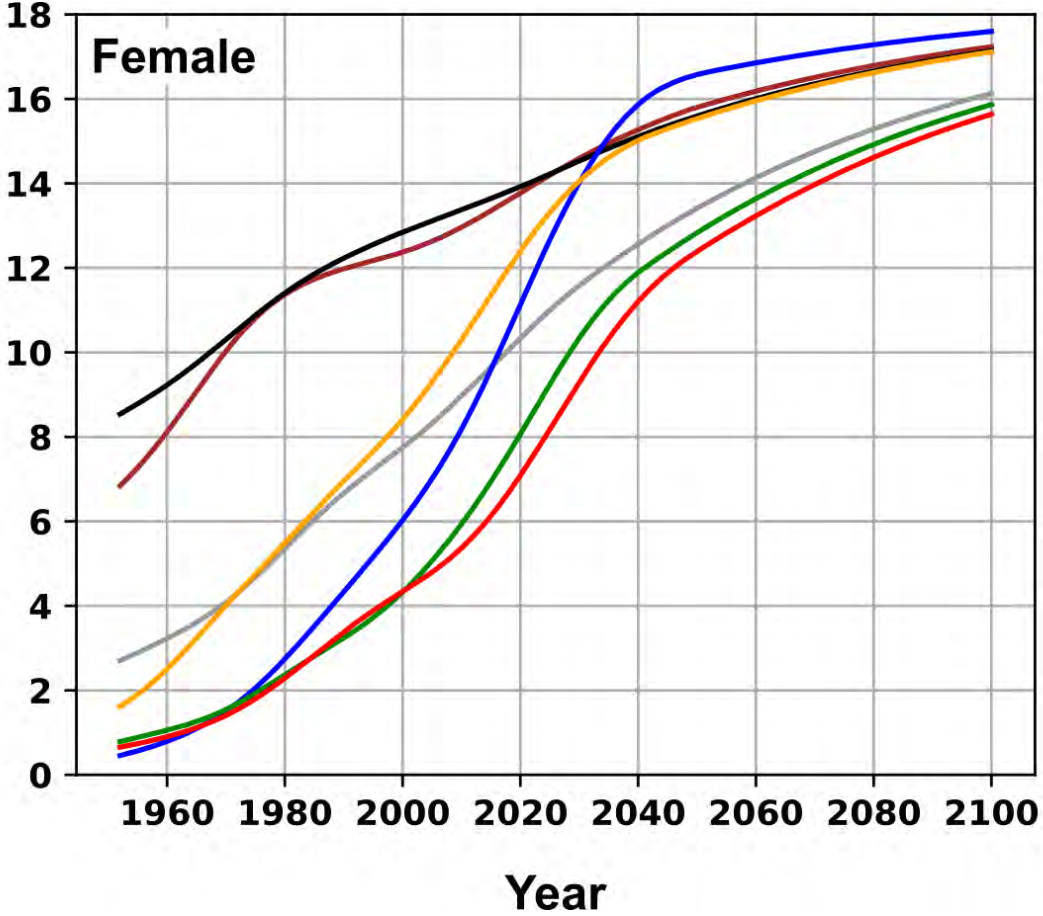
Mean years of schooling for Admin 2: both sexes, 2023



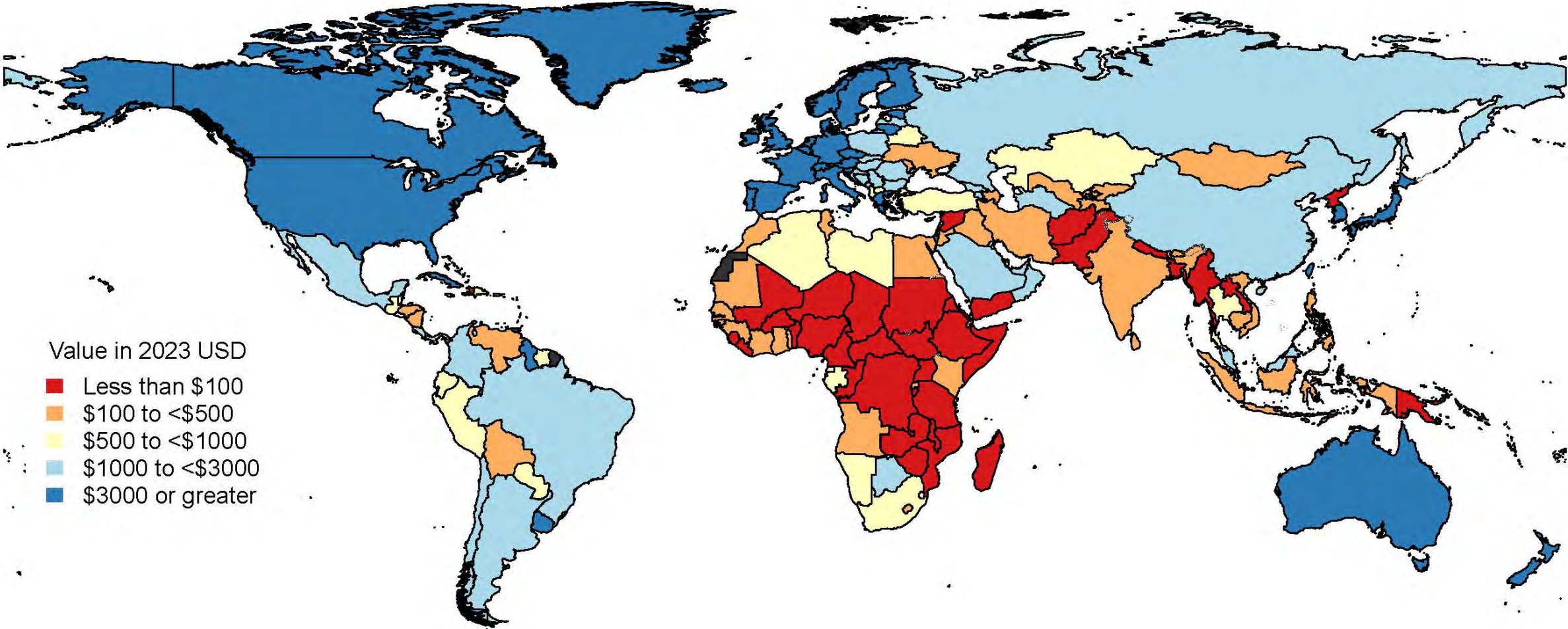
IHME project to estimate at admin 2 GDP per capita, consumption per capita, educational attainment, child mortality.

Forecasts of educational attainment, age 25-29: trends are mostly a function of level of education

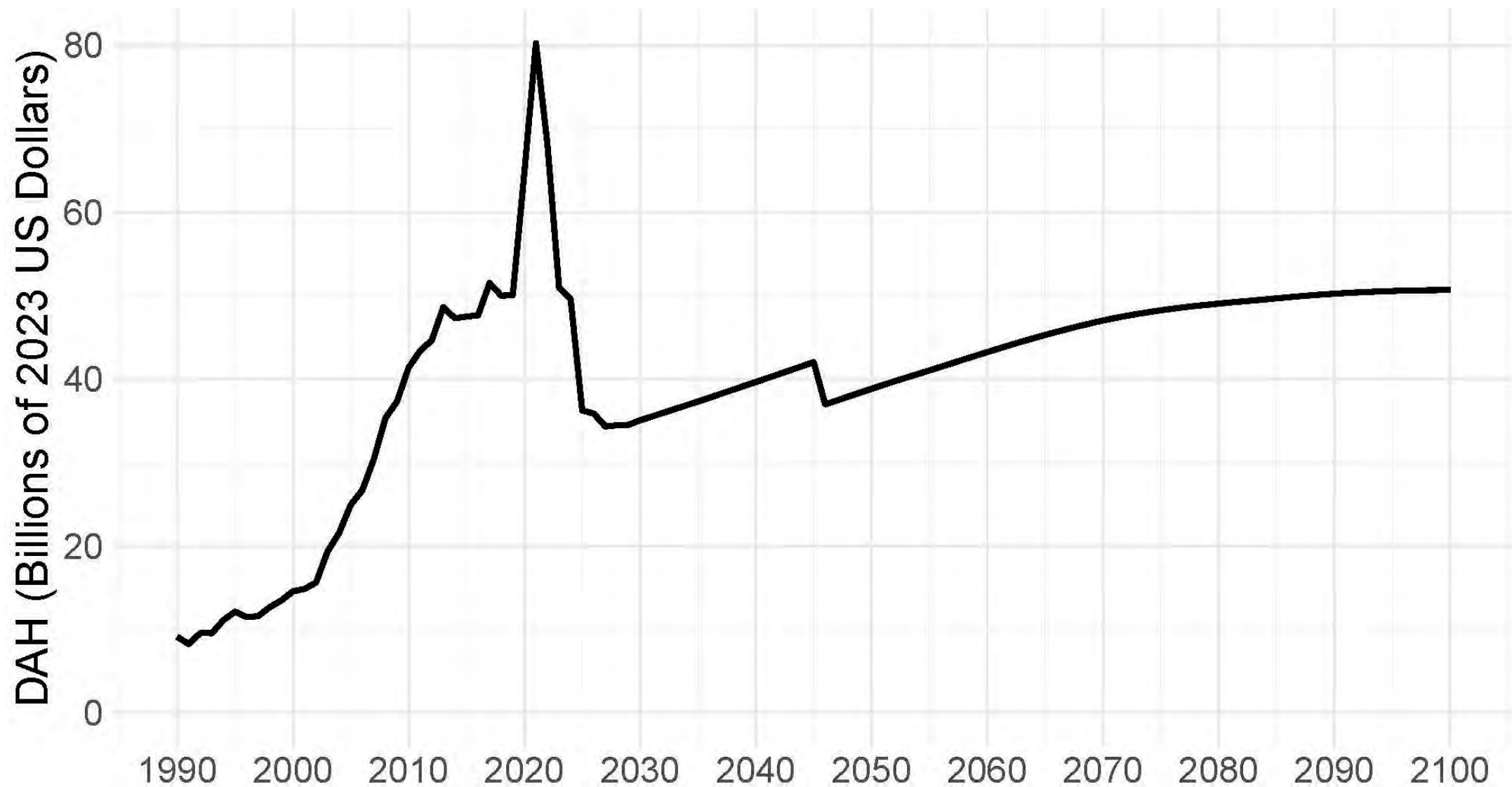
- Central Europe, Eastern Europe, and Central Asia
- High-income
- Latin America and Caribbean
- North Africa and Middle East
- South Asia
- Southeast Asia, East Asia, and Oceania
- Sub-Saharan Africa



Total health spending per capita, 2100

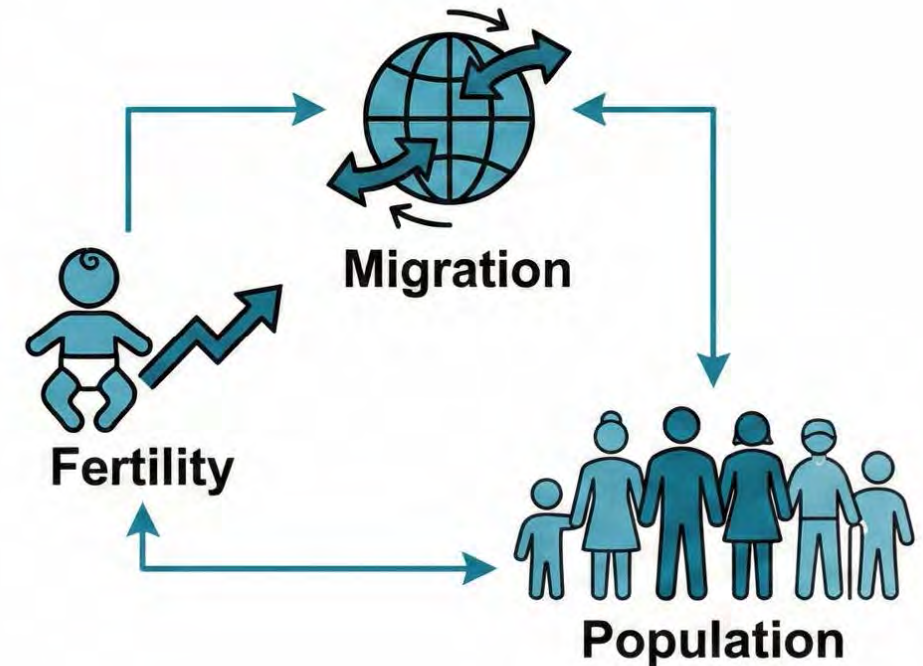


Reference scenario for Development Assistance for Health



Outline

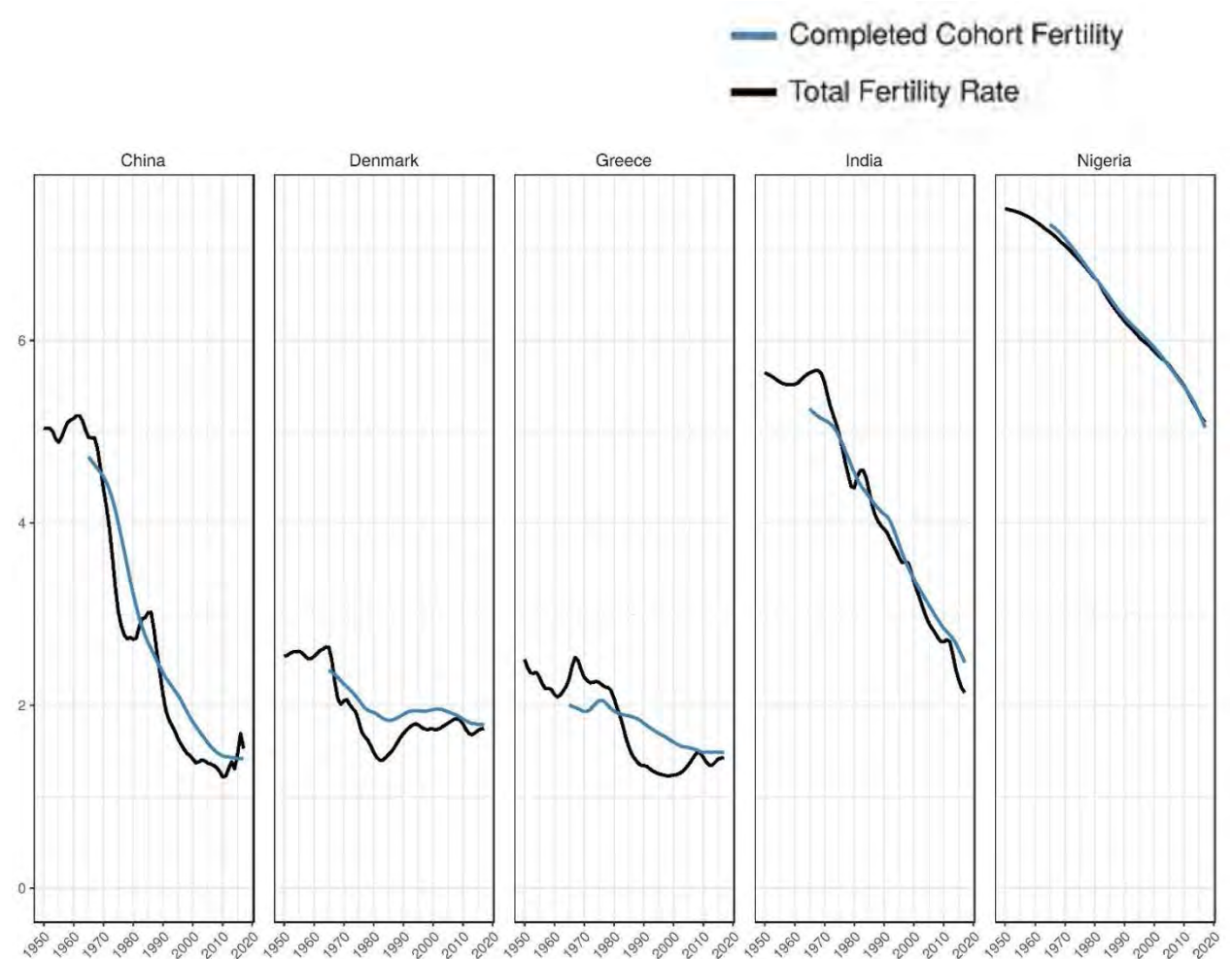
- **What is the GBD?**
- **Building forecast models from the GBD**
- **Key drivers of future health and population**
- **Fertility, migration and population**
- Future burden of disease and risks
- Threats and opportunities for action
- The big picture



Forecasting fertility

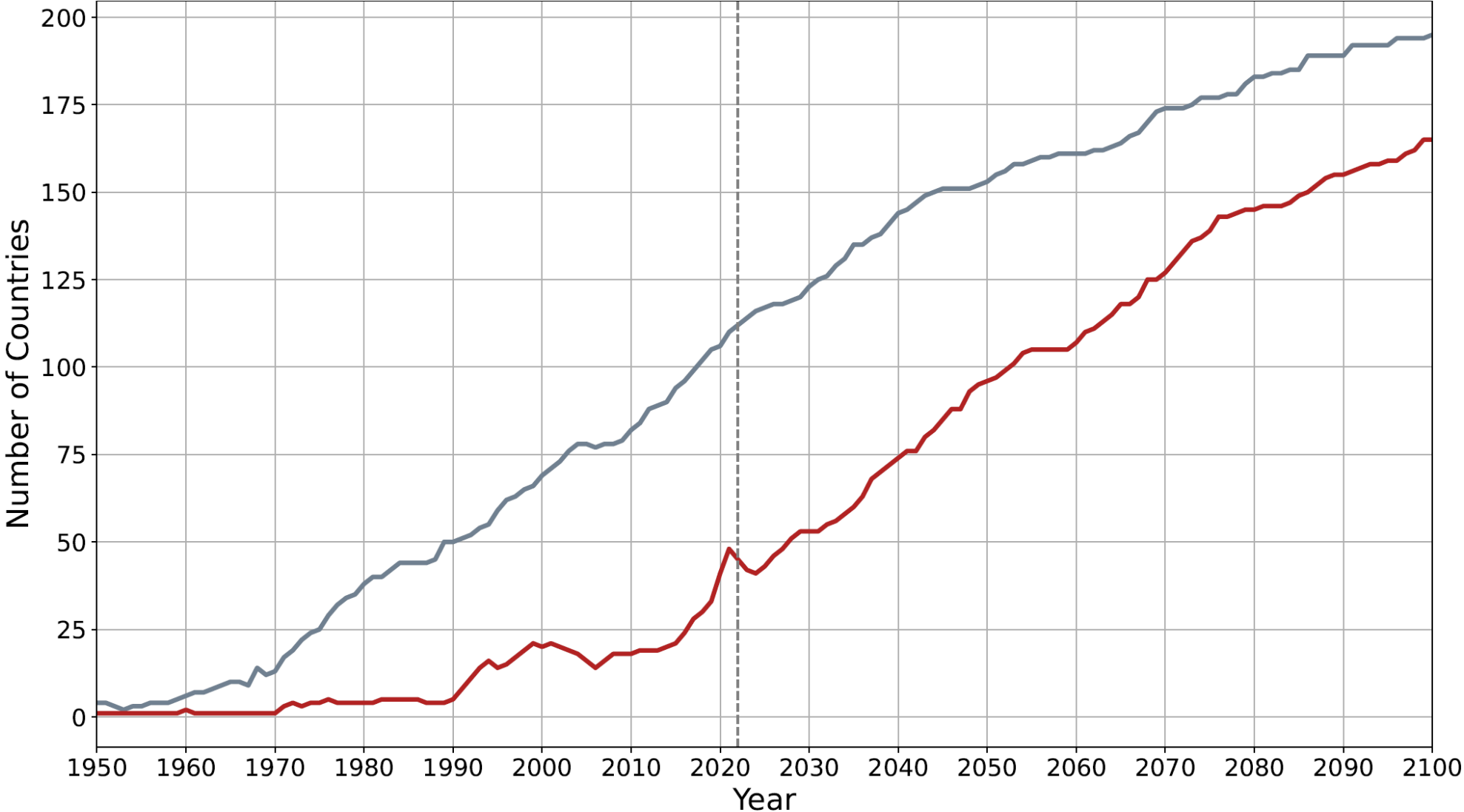
KEY FEATURES (DISTINCT FR)

1. We model **completed cohort fertility at age 50 (CCF50)**
2. **Why:** CCF50 measures the experience of a cohort of women followed over time - TFR is a period measure. It can be distorted by shifts in women's age-at-giving-birth distribution and does not represent life-course experience of women
3. **Covariates:** female education, met need for modern contraceptives, urbanicity, under-5 mortality



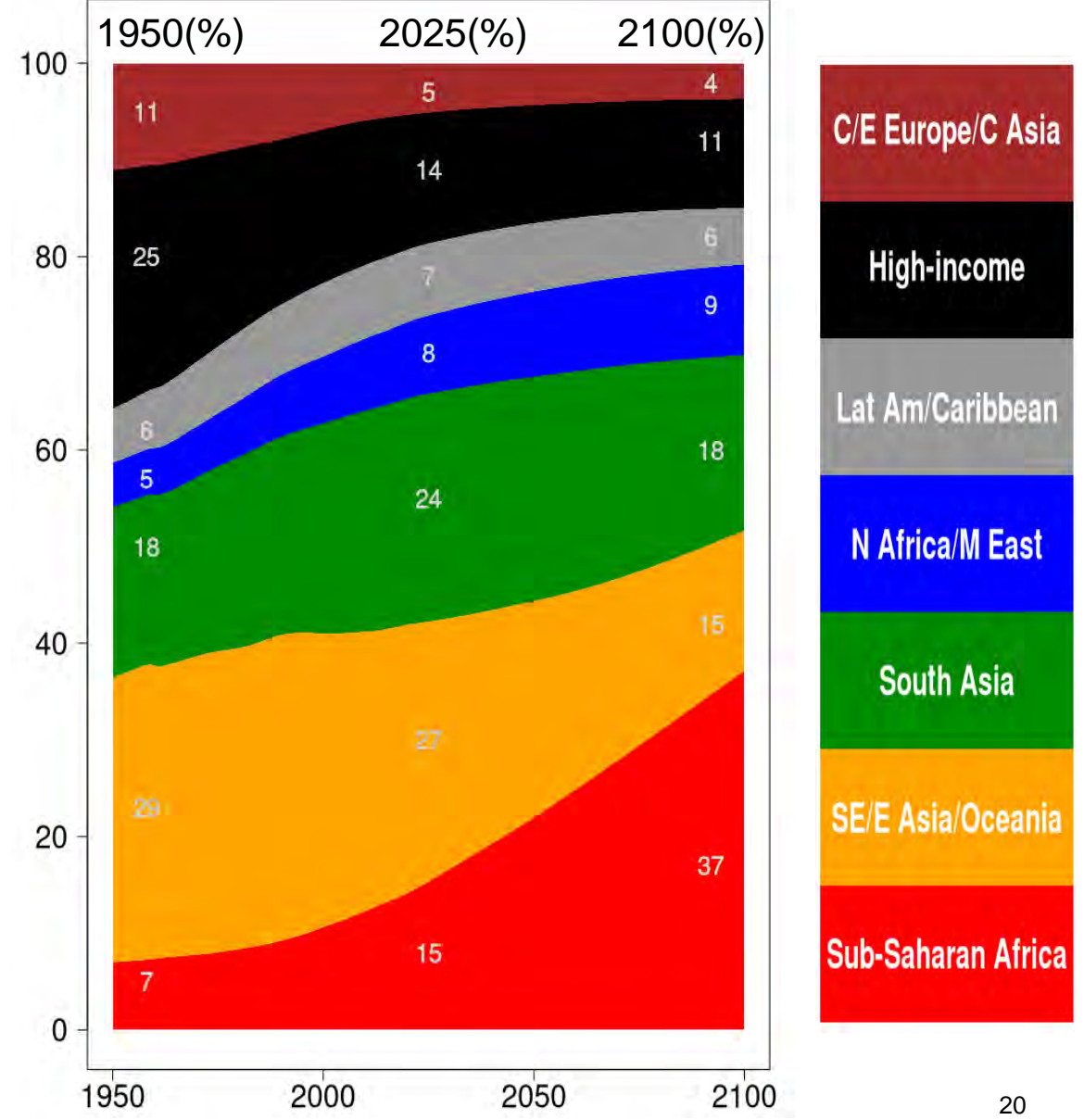
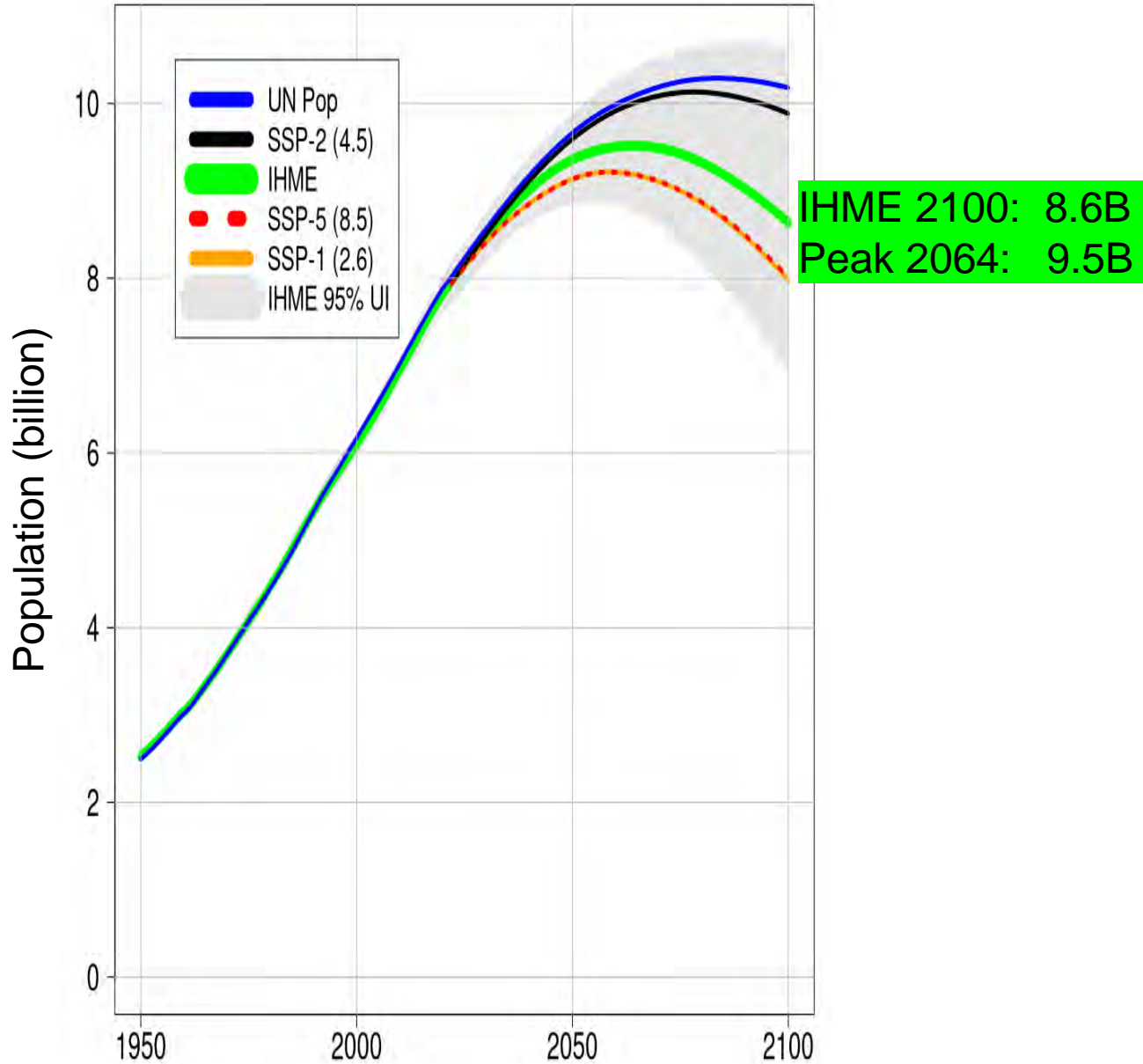
CCF50 regression model explains 84% of past variation in fertility rates

Number of countries and territories with TFR <2.1 (grey) and with negative rate of natural increase (red) 1950-2100



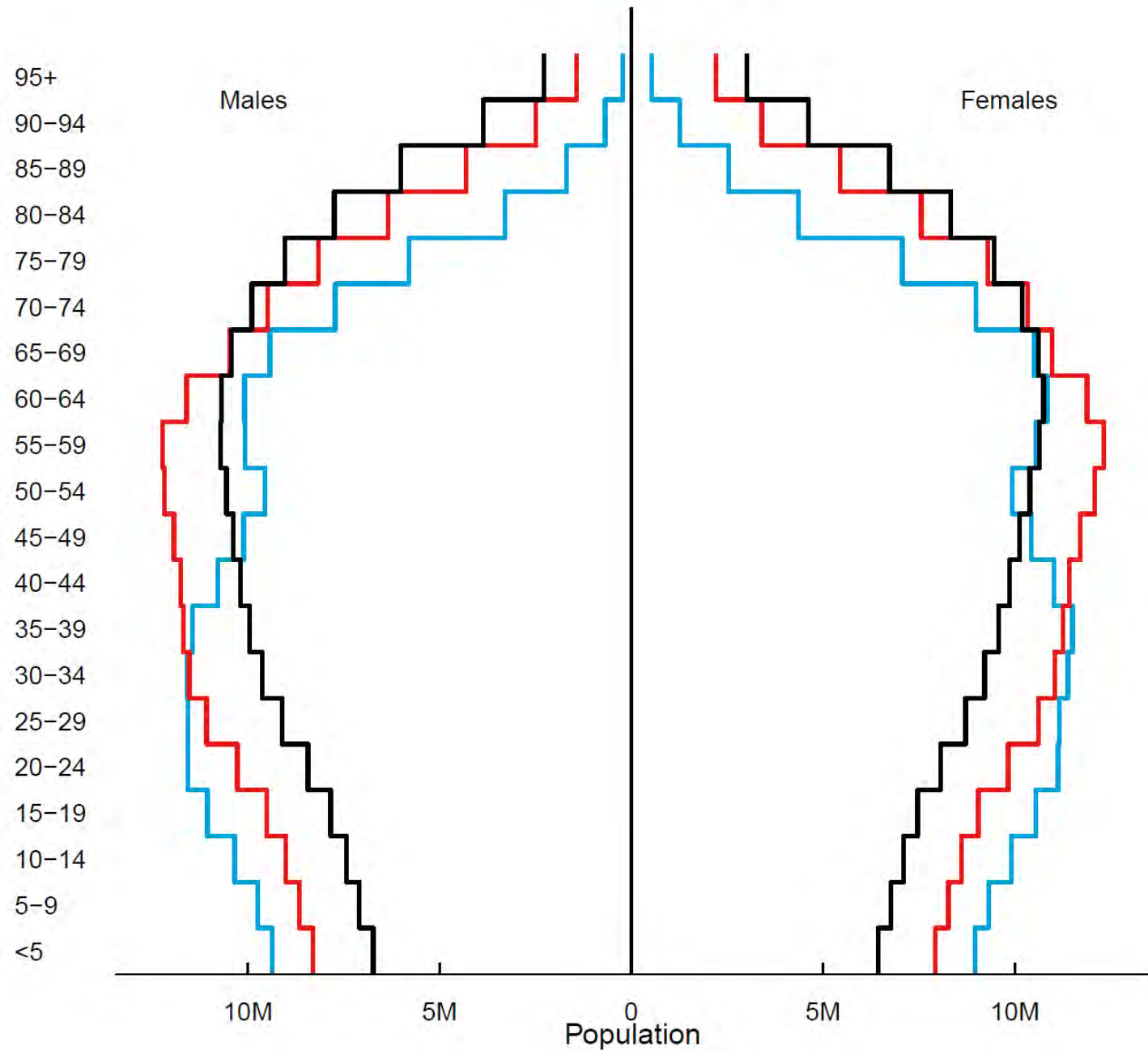
— Below Replacement Fertility Rate — Negative Rate of Natural Increase

Global population (billion) 1950-2100 and share (%) by GBD super region

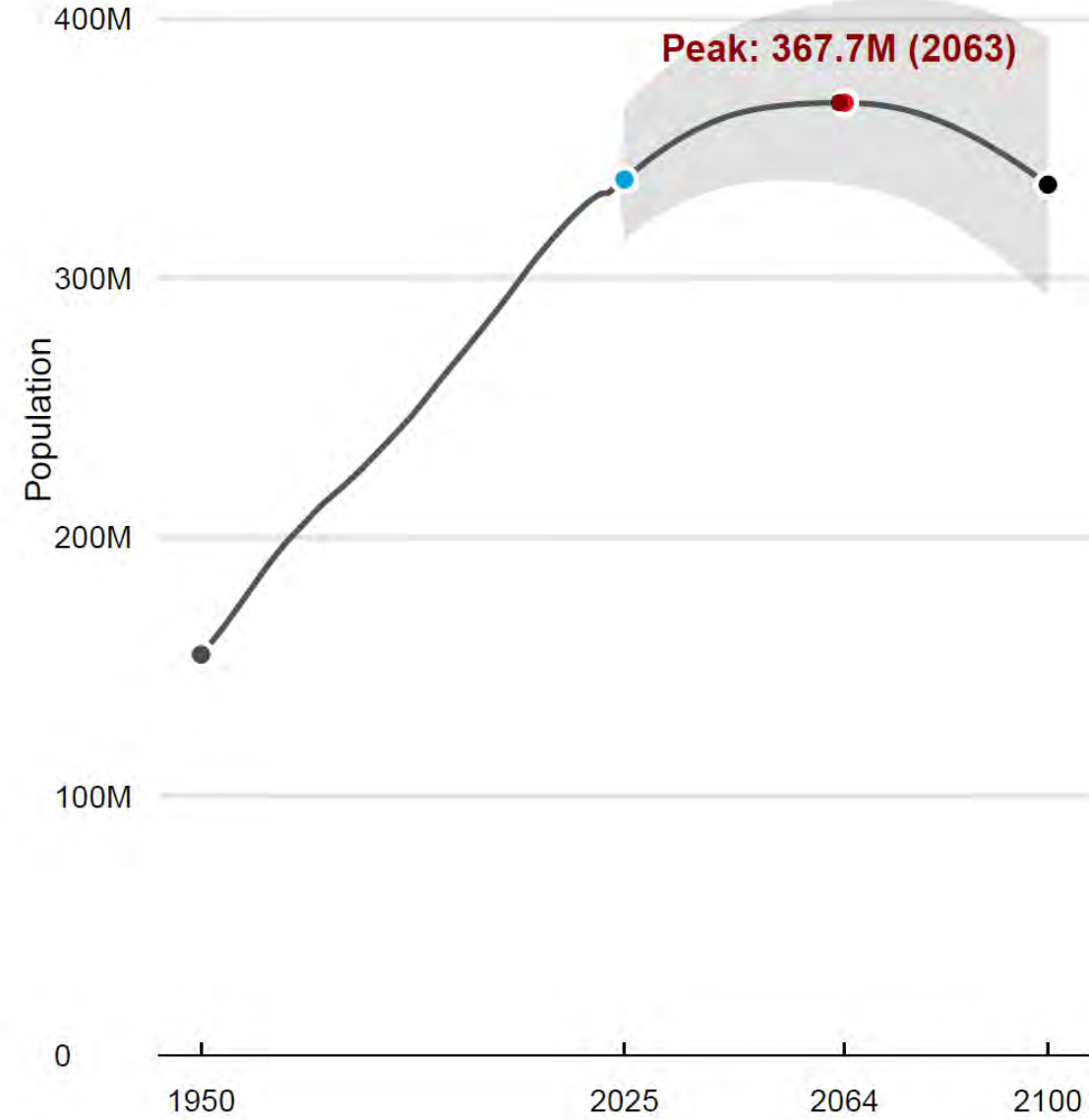


United States of America

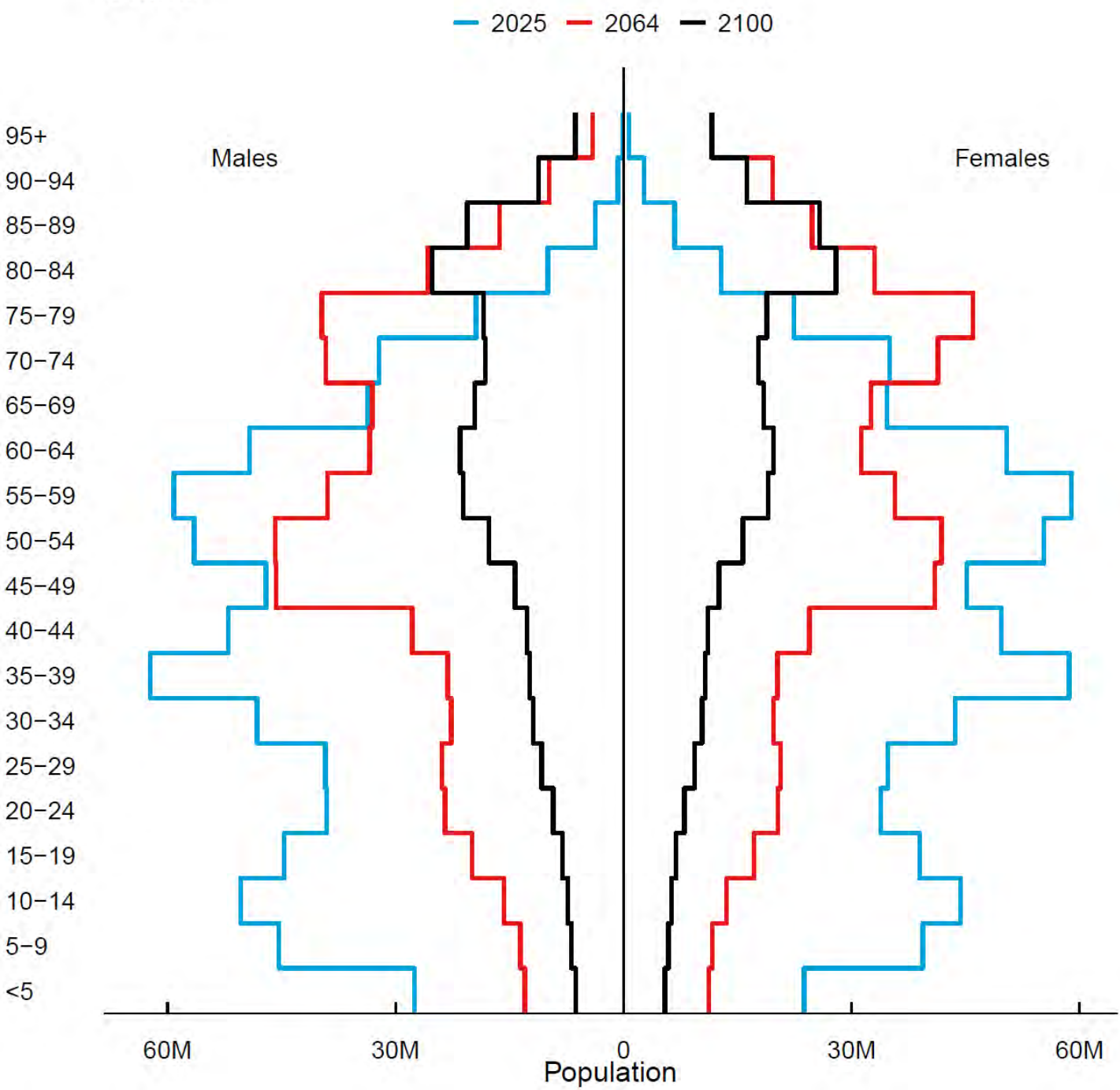
— 2025 — 2064 — 2100



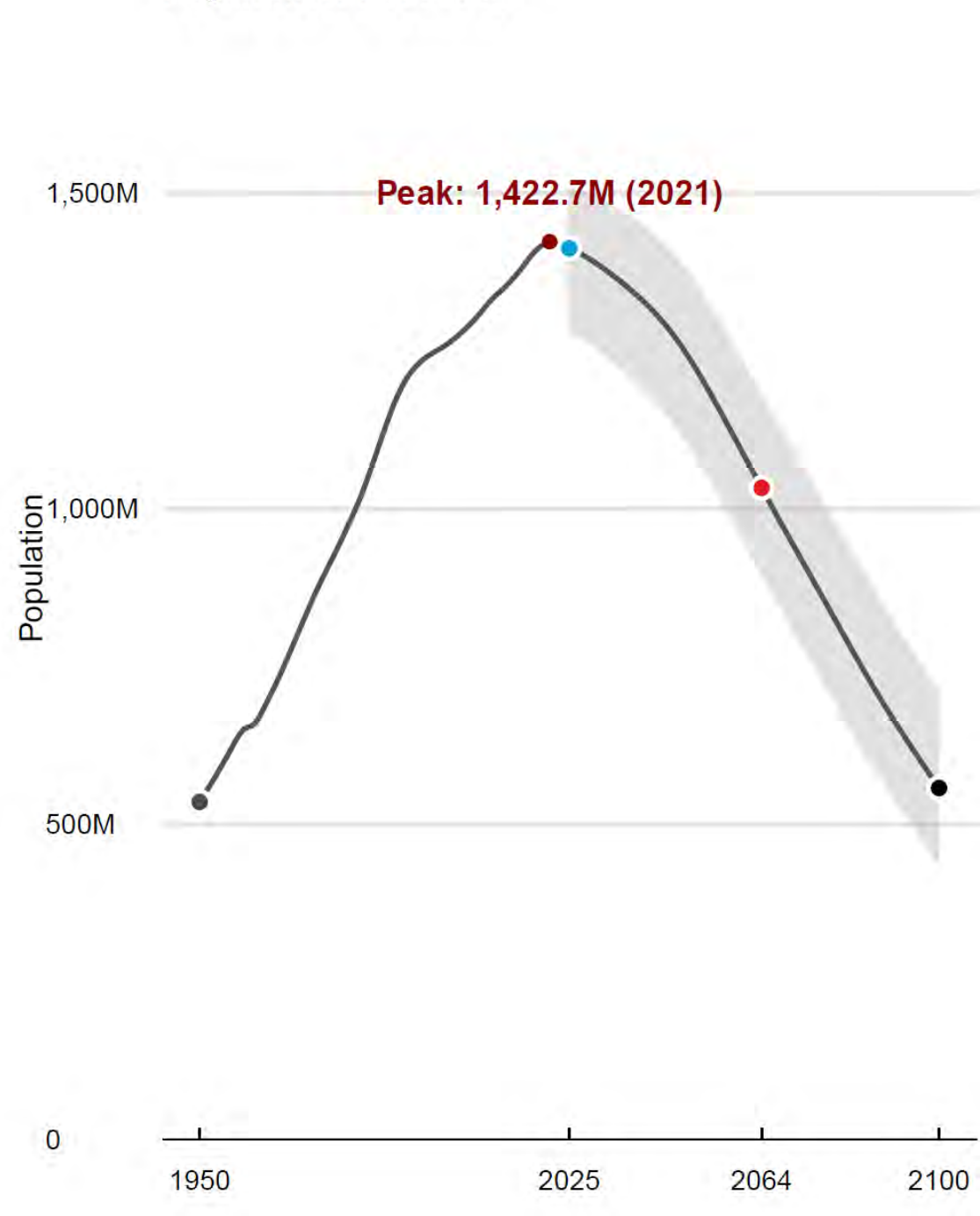
Population Forecast



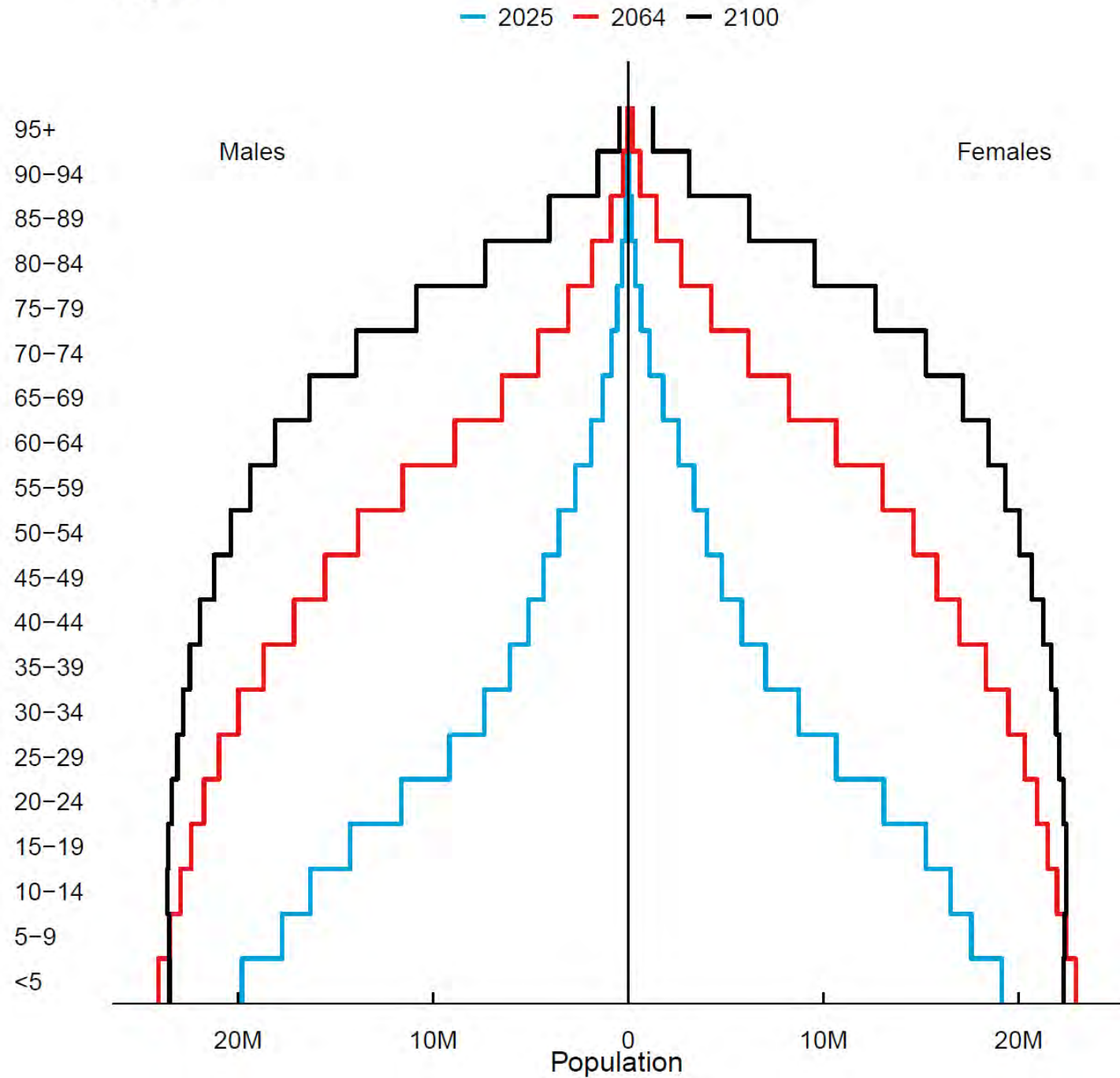
China



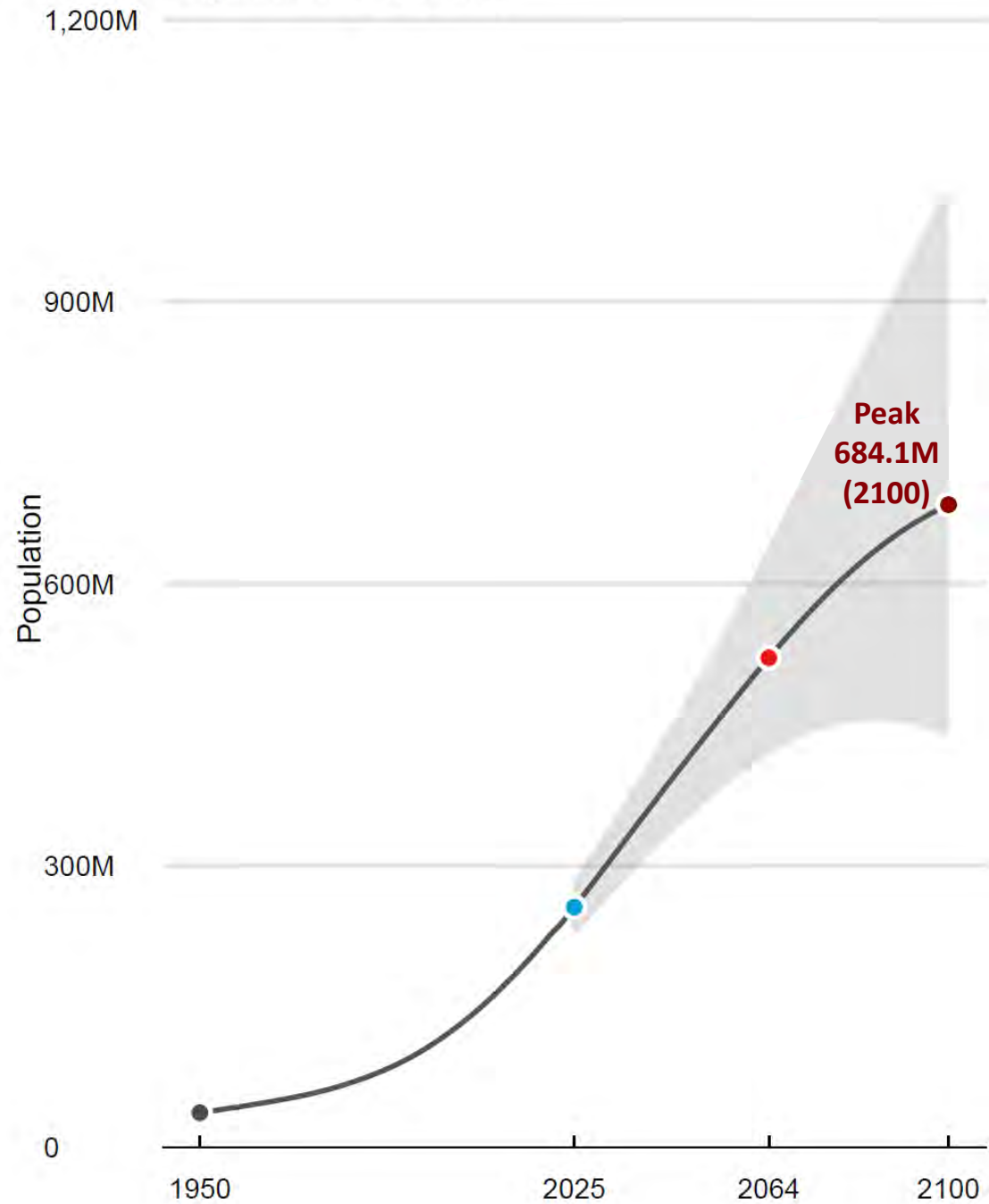
Population Forecast



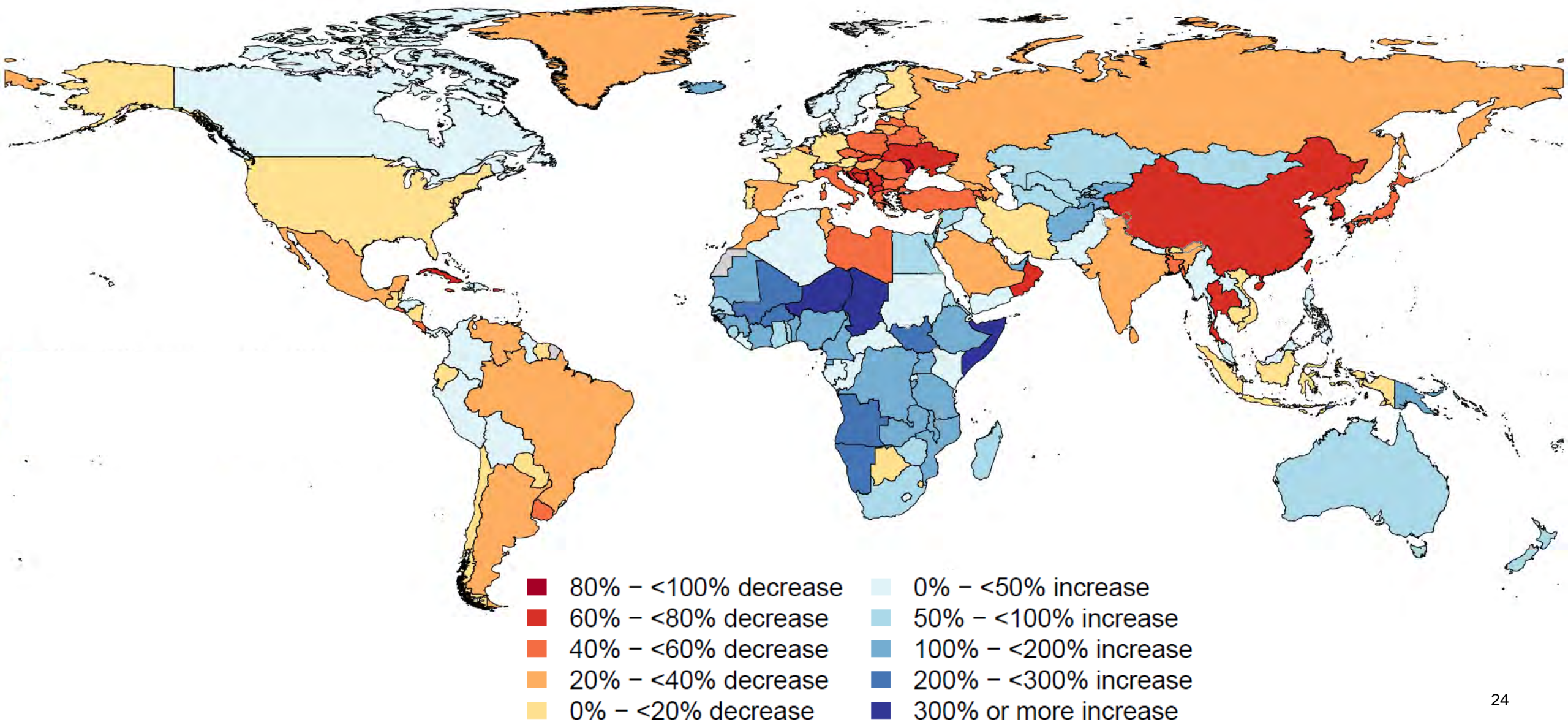
Nigeria



Population Forecast

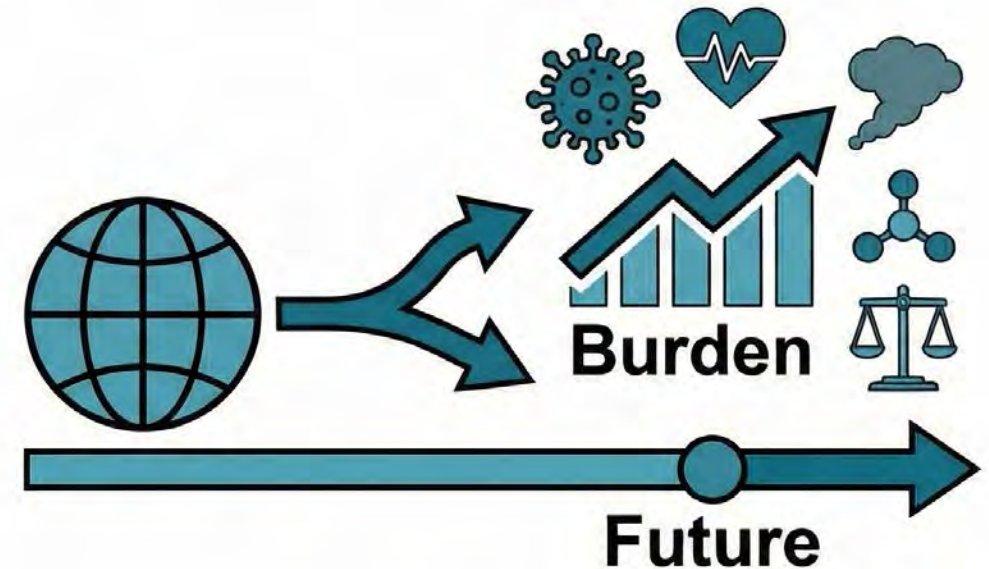


Percent change in population from 2025 to 2100



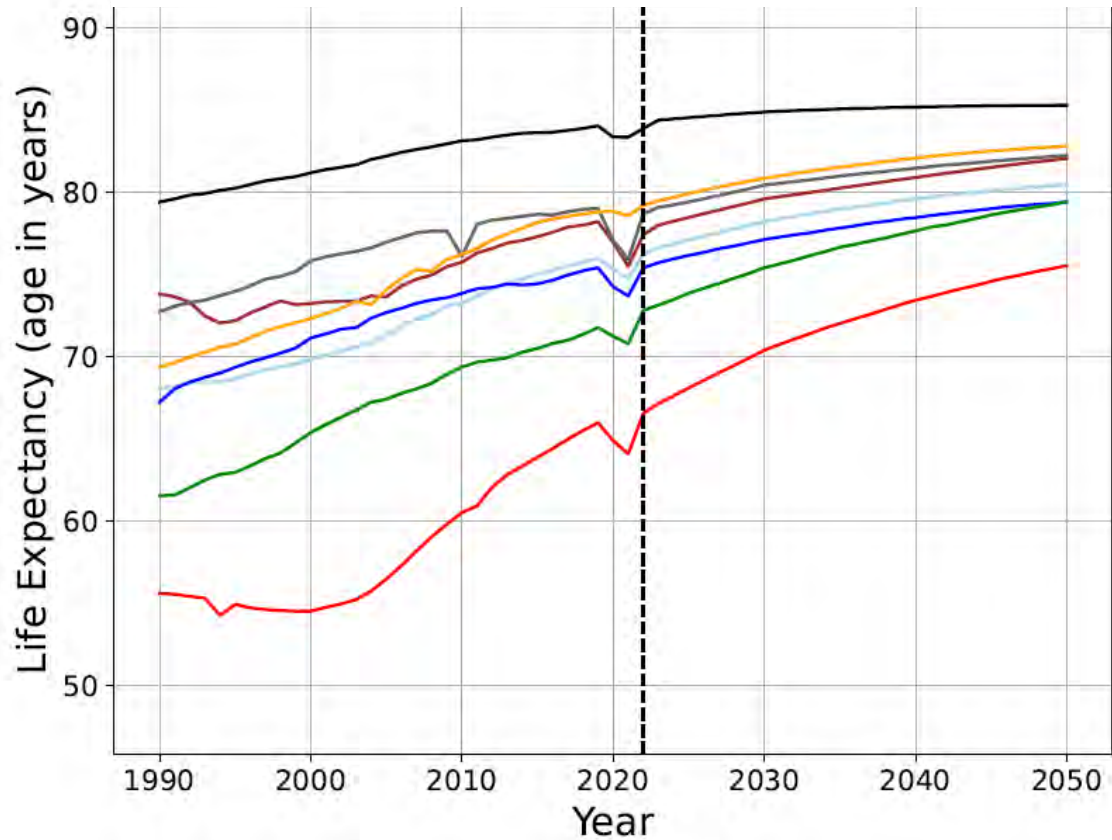
Outline

- **What is the GBD?**
- **Building forecast models from the GBD**
- **Key drivers of future health and population**
- **Fertility, migration and population**
- **Future burden of disease and risks**
- Opportunities for action
- The big picture

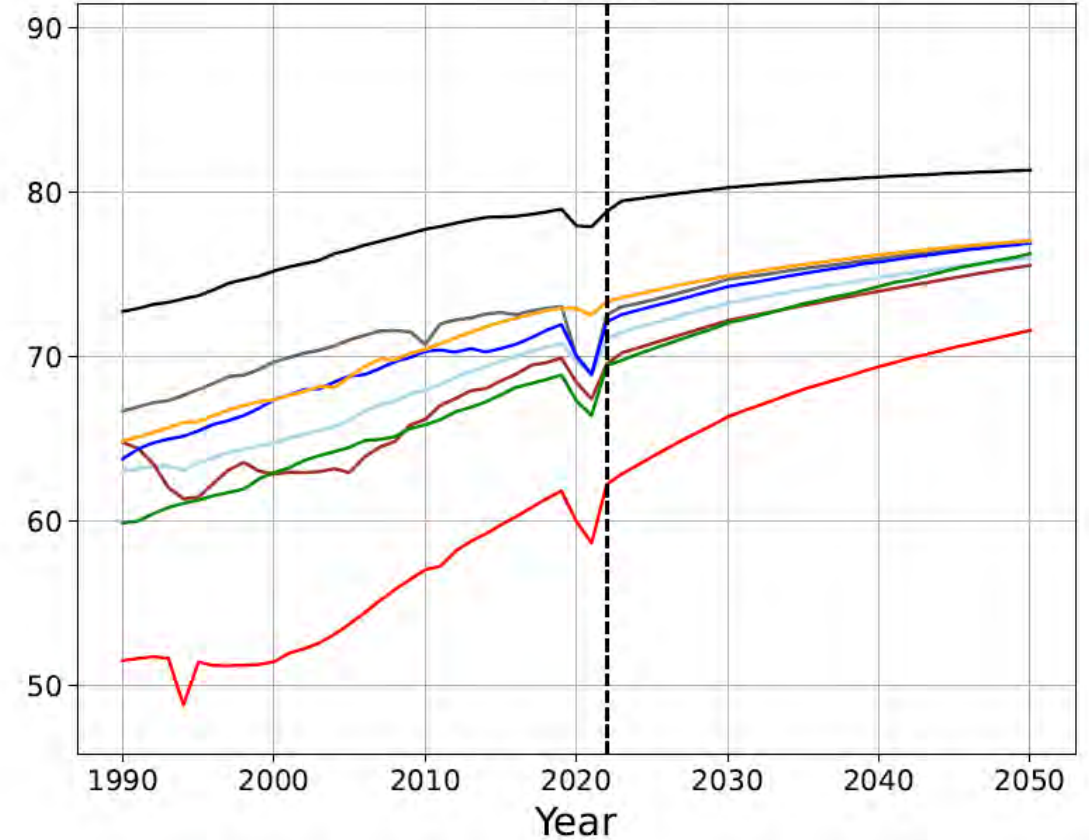


Despite climate change, obesity epidemic, global and super-region life expectancy expected to increase

Female

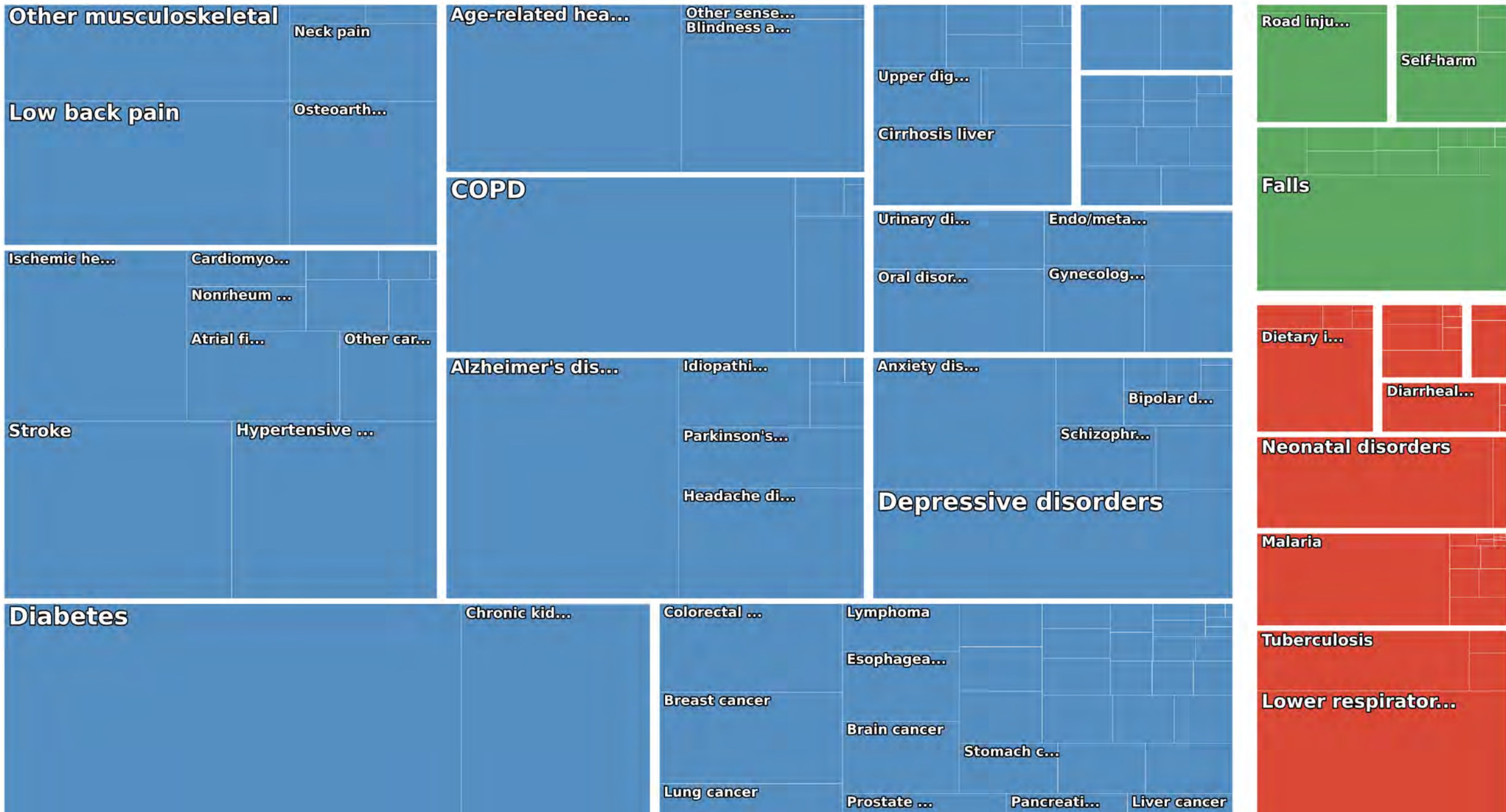


Male



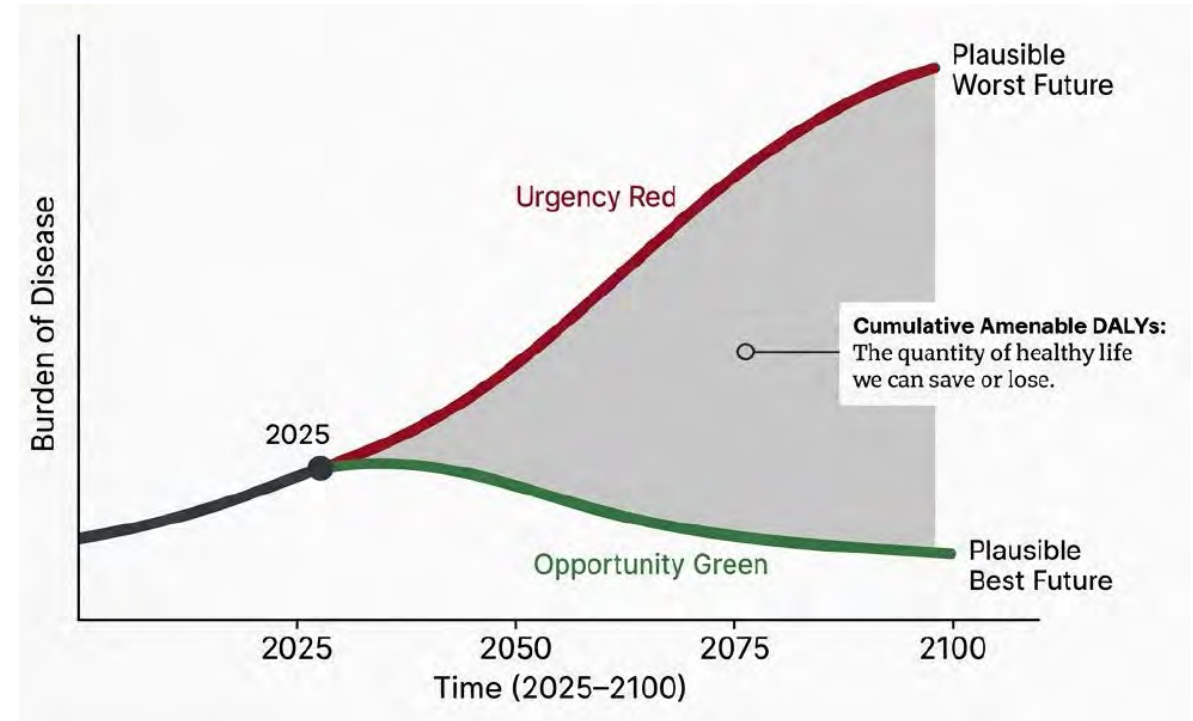
- Global
- Central Europe, Eastern Europe, Central Asia
- High-income
- Latin America & Caribbean
- North Africa & Middle East
- South Asia
- Southeast Asia, East Asia, Oceania
- Sub-Saharan Africa

Global DALYs by Cause (2100)



Outline

- **What is the GBD?**
- **Building forecast models from the GBD**
- **Key drivers of future health and population**
- **Fertility, migration and population**
- **Future burden of disease and risks**
- **Opportunities for action**
- **The big picture**



The Lancet Commission on 21st Century Global Threats to Health

- The Commission is an independent expert body, established December 2022, to create a unified voice on critical global threats TO health.
- The Commission is meant to look across threats, integrating the diverse set of analyses on threats and adding new data-driven analysis.
- The initial Commission report (expected 2026 publication) will provide analysis of 17 of the most pressing threats to health at the global, regional and national level.
- Commission of Commissions...

Our commissioners bring deep expertise and broad perspective.



Dr. Natalia Kanem, co-chair
Former Executive Director, UNFPA



Dr. Christopher Murray, co-chair
Director of the Institute for Health Metrics and Evaluation (IHME)



Dr. Richard Horton
Editor-in-Chief of The Lancet



Mr. Shameran Abed
Executive Director of BRAC International



Professor Ibrahim Abubakar
Dean of the UCL Faculty of Population Health Sciences



Dr. Ifedayo Adetifa
*Former Director General, Nigeria CDC
Chief Transformation Officer/CEO, FIND*



Dr. Samira Asma
Director of Evaluation & Learning, Susan Thompson Buffett Foundation



Dr. Ximena Aguilera
Minister of Health, Chile



Professor Ilaria Capua
Senior Fellow for Global Health at Johns Hopkins -SAIS Europe



Mr. Martin Chungong
Secretary General of the Inter-Parliamentary Union (IPU)



Dame Sally Davies
40th Master of Trinity College



Dr. Senait Fisseha
VP of Global Programs, Susan Thompson Buffett Foundation and Chief Advisor to the Director General of the World Health Organization



Dr. Julio Frenk
Chancellor, University of California, Los Angeles



Dr. Luiz Augusto Galvão
Area lead, Oswaldo Cruz Foundation Center for Global Health



Professor Jane Halton
Chair of Coalition for Epidemic Preparedness Innovations



Mr. Trevor Houser
Partner at Rhodium Group, Energy & Climate practice



Ms. Lorence Kabasele
*East and Southern Africa Chairperson of AfriYAN.
Deputy Director, DRC Ministry of EDU-NC*



Dr. Catherine Kyobutungi *Executive Director, Africa Population and Health Research Center*



Dr. Hechmi Louzir

Former Director General of the Institut Pasteur de Tunis, Tunisia



Mario Monti

Former Prime Minister of Italy



Dr. Camilla Stoltenberg

Former Director-General of the Norwegian Institute of Public Health



Dr. Roberto Tapia

CEO of the Carlos Slim Foundation



Dr. Juan Pablo Uribe

Global Director for Health, Nutrition & Population at the World Bank



Professor Lan Xue

Cheung Kong Chair Distinguished Professor and Dean, Schwarzman College, Tsinghua University



Ms. Maziko Matemvu

President and founder of Uwale



Professor Baron Peter Piot

Handa Professor of Global Health at London School of Hygiene & Tropical Medicine



Dr. Gunhild Stordalen

Founder and Executive Chair of EAT



Professor Yik-Ying Teo

Dean, Saw Swee Hock School of Public Health at National University of Singapore (NUS)



Professor Dr. Lothar Wieler

Speaker of Digital Health Cluster and Head of Global Public Health, Hasso-Plattner-Institute



Dr. Anita Zaidi

President of Gates Foundation's Gender Equality Division



Dr. Nicolas Meda

Former Director-General of Centre MURAZ



Dr. Izukanji Sikazwe

HIV Lead, Global Fund



Dr. Soumya Swaminathan

Former WHO Chief Scientist & Dep. Director-General for Programmes



Dr. Nisia Trindade Lima

Former Minister of Health, Brazil



Dr. John Eu-Li Wong

Executive Director, Centre for Population Health at the National University of Singapore (NUS)

From 500 potential threats to 17 Major Global Threats



Malicious use of AI



Inequality



Pandemics



Collapse of DAH



Nuclear war



Conventional war



Climate Change



Obesity



Unhealthy ageing



Antimicrobial resistance



Air pollution



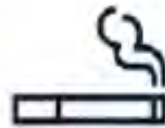
Low educational attainment



Poor mental health



High alcohol use



Tobacco



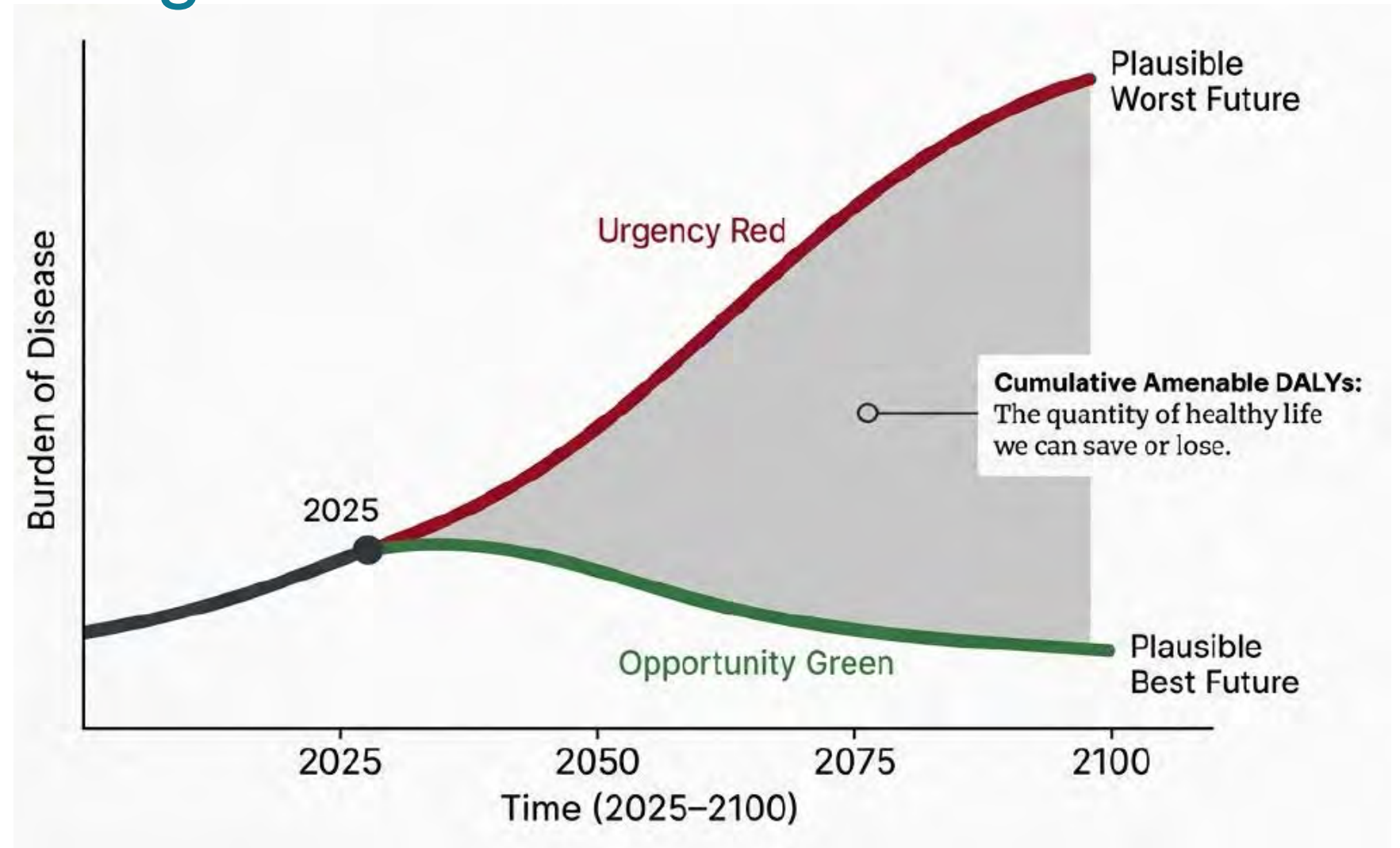
Childhood malnutrition



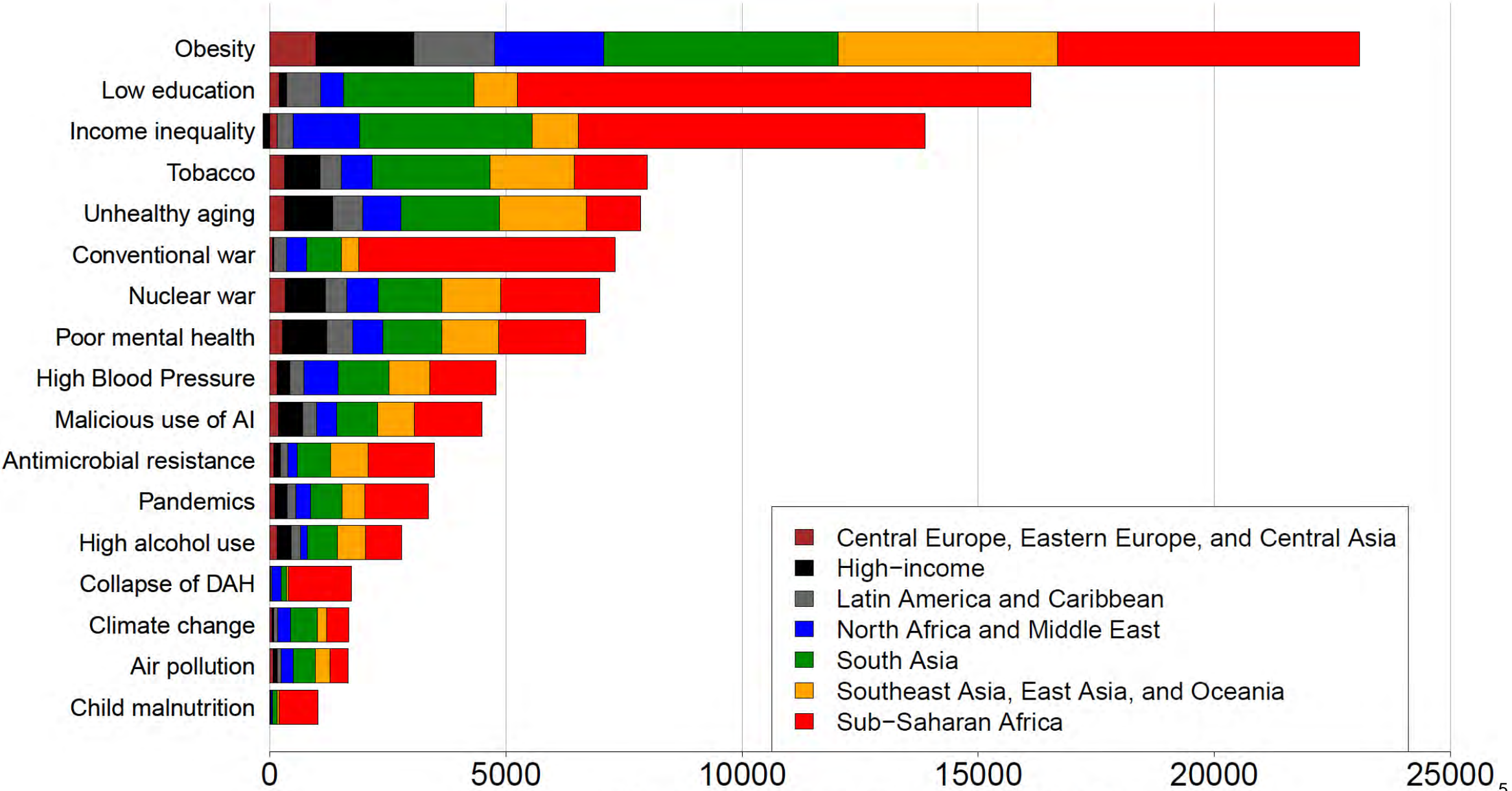
High blood pressure

Calculating the Price of Inaction: rank threats by what can be changed in the future

The difference between plausible best and plausible worst = Amenable range



Total Amenable DALYs by 17 major threats



Total DALYs (in millions) 2025-2100

Tier One: Highest Impact Threats or With Extinction Risk

Obesity - Metabolic Driver

Income Inequality - Social/Economic Driver

Low Education - Social Determinant

Malicious Use of AI - Existential Technological Threat

Nuclear War - Existential Geopolitical Threat

Tier Two: Significant & Foundational Threats

Environmental & Security

- Climate Change
- Air Pollution
- Pandemics
- Antimicrobial Resistance

Social & Behavioral

- High Alcohol Use
- Tobacco
- Poor Mental Health

Systemic Issues

- Collapse of Development Assistance for Health
- Unhealthy Ageing
- High Blood Pressure
- Childhood Malnutrition
- Conventional War

Recommendations

- Regularly monitor global threats and report to heads of government.
- Increase investment in innovation to create new strategies to reduce threats.
- Dedicate resources in each government to make health systems threat ready including a dedicated team to anticipate, prepare for and prevent threats.

Outline

- **What is the GBD?**
- **Building forecast models from the GBD**
- **Key drivers of future health and population**
- **Fertility, migration and population**
- **Future burden of disease and risks**
- **Opportunities for action**
- **The big picture**

Really big issues for global health

- Continued slow GDP growth in sub-Saharan Africa
- Migration and the politics of migration – push-pull phenomenon increasing migration from sub-Saharan Africa to the rest of the world where deaths exceed births.
- Obesity – the largest amenable threat to health.
- AI – increased productivity, decreased employment, risks of malicious use, loss of control.
- Understanding how to get more health for the money.

Opportunities

- Reducing income inequality, accelerating educational attainment and serious efforts to reduce obesity can be critical to future health.
- Ensuring access to effective population and individual health programs and interventions through UHC can advance health gains.
- Health systems need to be consciously built to be threat ready.

Questions

- Given the impact of demographic change and the wide range of threats ahead, how should health leaders prioritize action?
- How can we learn from each other on how to get more health for the available money?
- How can we build threat ready health systems?