IHME

Global burden of disease study : Past, present, and future

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Outline

1) **GBD overview and evolution**
2) Some key results from GBD 2015
3) New analytical directions

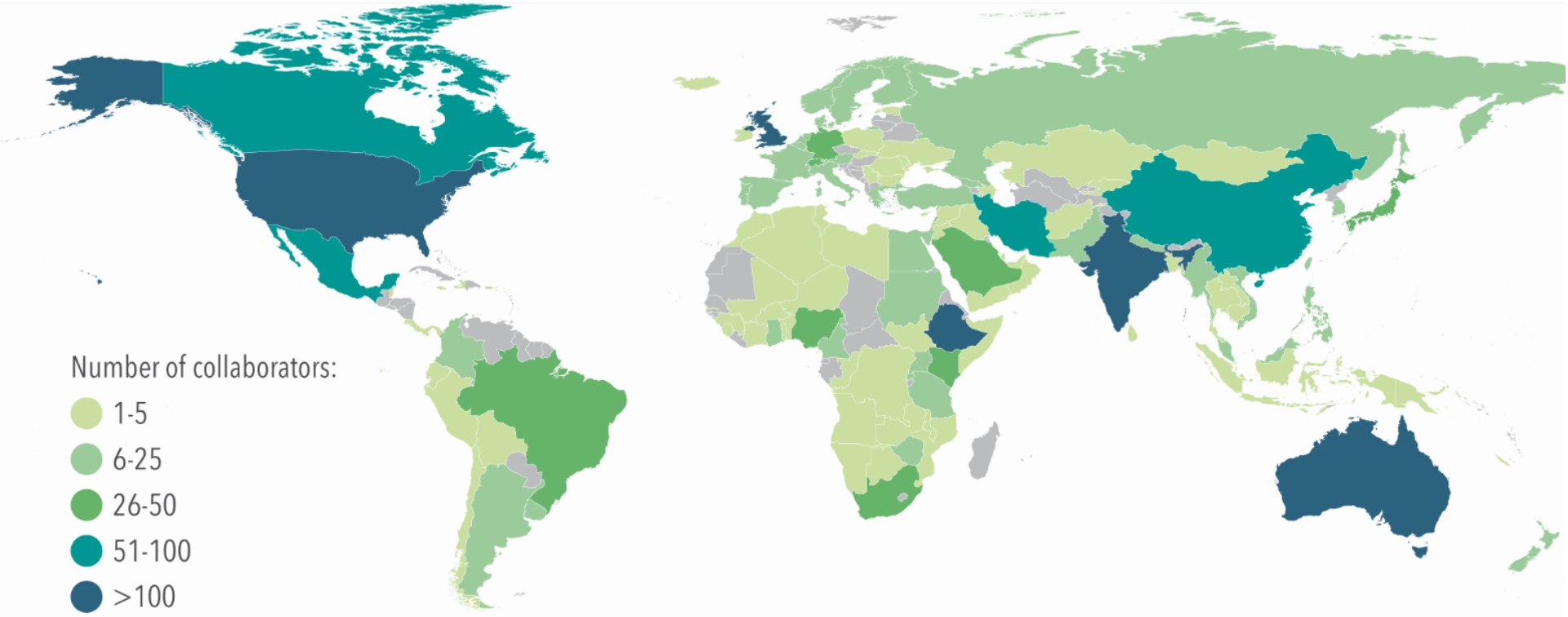
Global Burden of Disease today

- A ***systematic, scientific*** effort to quantify the ***comparative*** magnitude of ***health loss*** from all major diseases, injuries, and risk factors by age, sex, and population and over time.
- Goal is to inform decision-makers at every level (local, regional, national and global) with the best evidence on levels, trends and drivers of health so that decisions are ultimately more evidence-based.

Global Burden of Disease today (II)

- Covers 195 countries and territories from 1990 to present. Sub-national assessments for some countries including China, Mexico, UK, US, Brazil, Japan, India, Saudi Arabia, Kenya, South Africa
- 315 diseases and injuries, 2,619 sequelae, 79 risk factors or clusters of risk factors.
- Updated annually; release in September each year.
- Findings published in major medical journals, policy reports, and online data visualizations.

GBD: a global study with a global collaborative network of investigators



1,880 collaborators from 124 countries
and 3 non-sovereign territories

GBD: standardized solution to global health measurement challenges

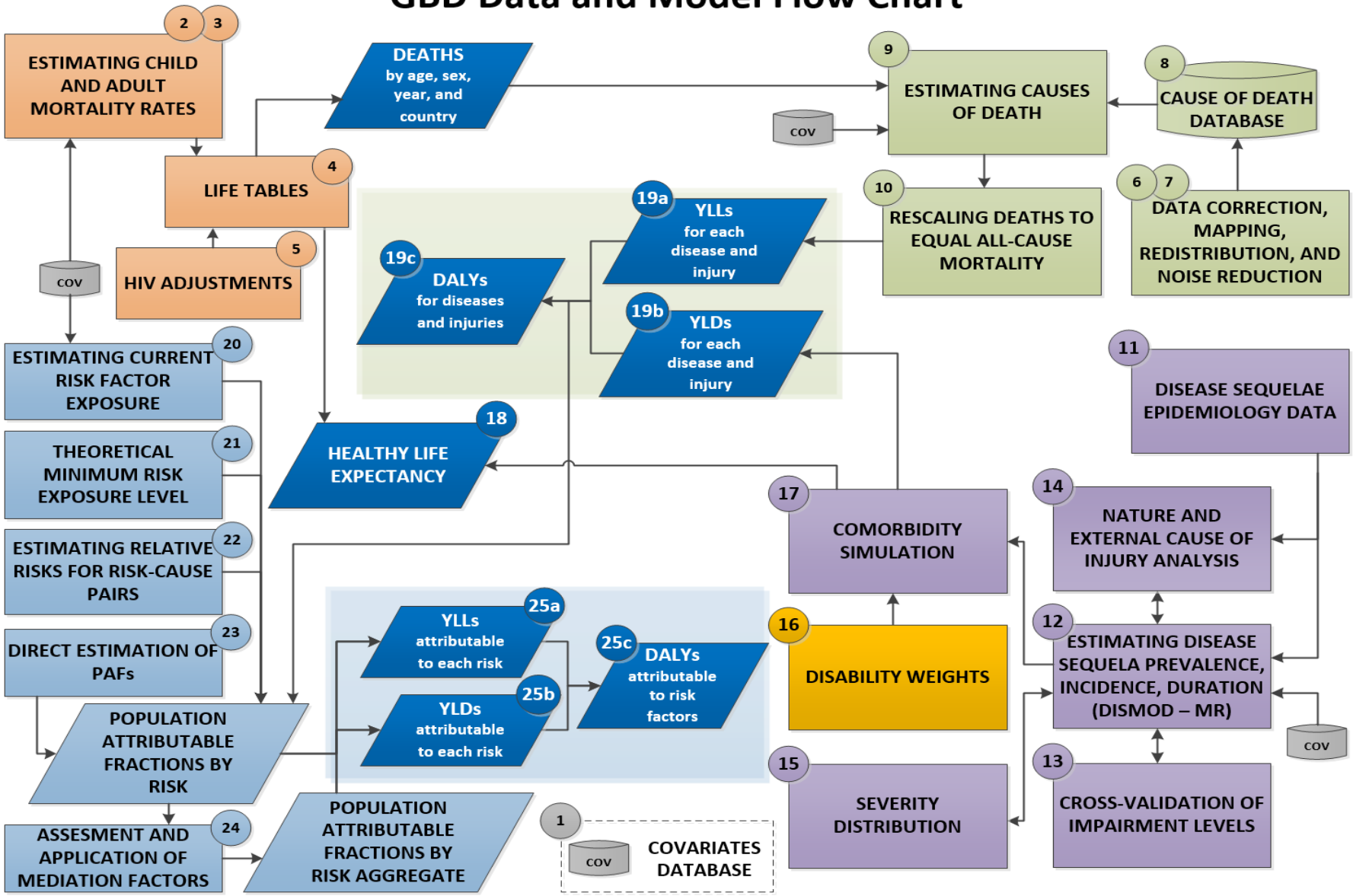
Challenges:

1. Inconsistent coding and case definitions
2. No data
3. Conflicting data
4. Sampling and non-sampling measurement error
5. Excluded groups

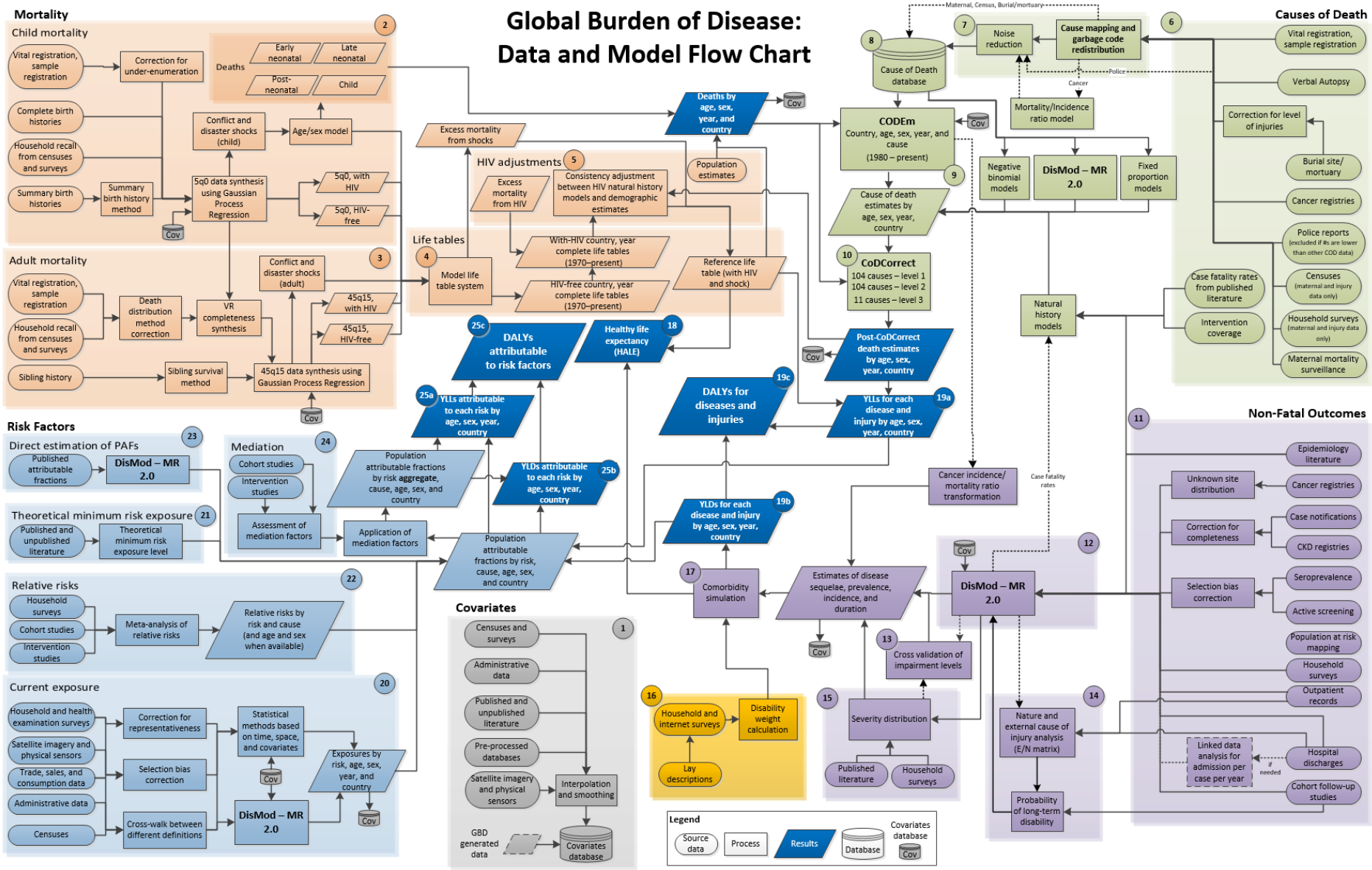
GBD solutions:

1. Quality review of all sources and corrections for garbage coding
2. Cross-walking different case definitions, diagnostic technologies, recall periods, etc., using statistical methods
3. Statistical methods to deal with missing data, inconsistent data, excluded groups and measurement error

GBD Data and Model Flow Chart



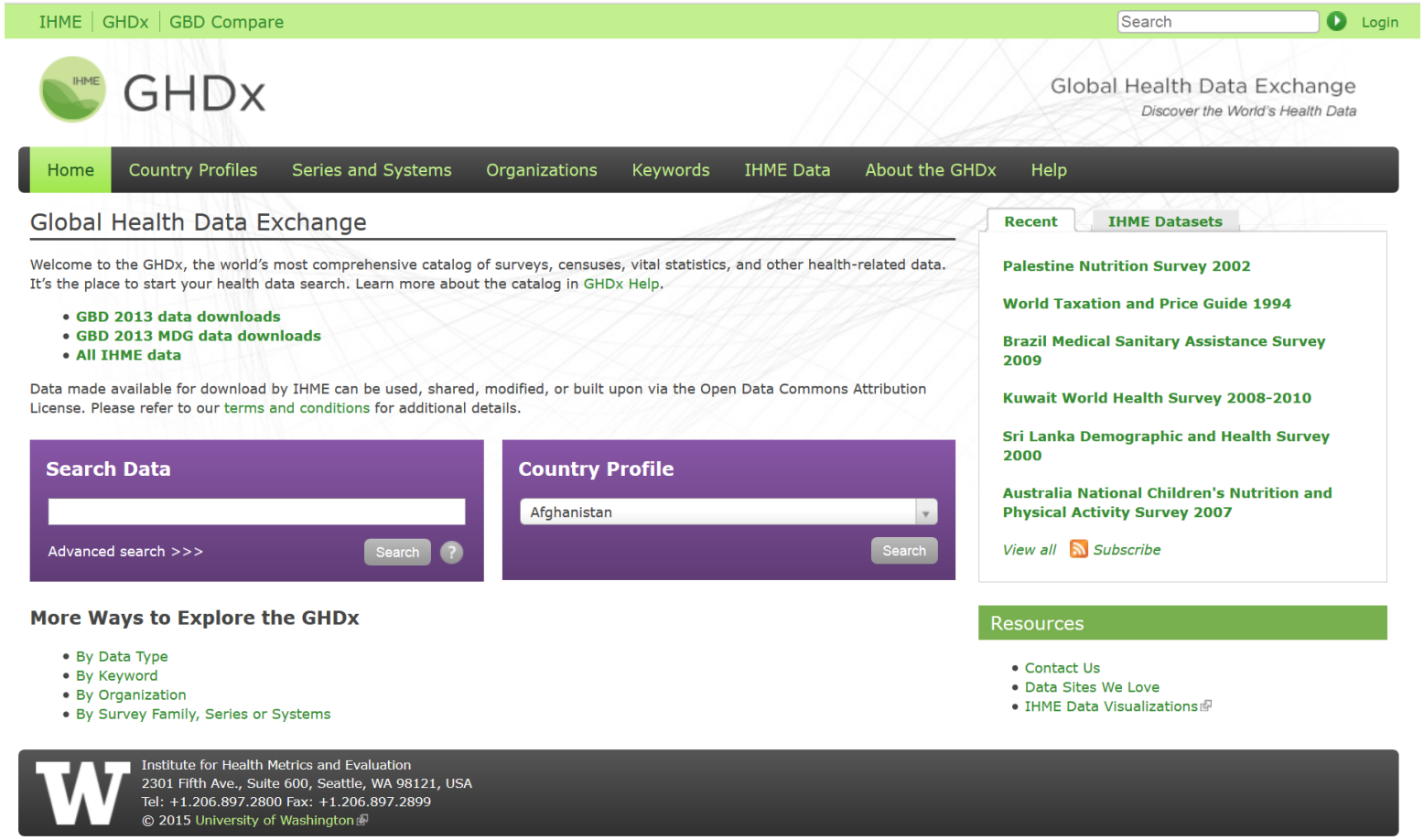
Global Burden of Disease: Data and Model Flow Chart



Multiple metrics for health

1. **Traditional metrics:** Disease and injury prevalence and incidence, death numbers and rates.
2. **Years of life lost** due to premature mortality (YLLs) – count the number of years lost at each age compared to a reference life expectancy of 86 at birth.
3. **Years lived with disability** (YLDs) for a cause in an age-sex group equals the prevalence of the condition times the disability weight for that condition.
4. **Disability-adjusted life years (DALYs)** are the sum of YLLs and YLDs and are an overall metric of the burden of disease.
5. **Healthy life expectancy (HALE)** is a positive summary measure counting the expected years of life in full health.

All data sources in the GBD indexes in on-line catalog with metadata on 60,000+ GBD sources



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The Global Burden of Disease Study 2015

£5.00 Registered as a newspaper · ISSN 0140-6736
Founded 1823 · Published weekly

GBD as a dynamic scientific enterprise

1. Five cycles of GBD estimation: GBD 1990, GBD 1999-2004, GBD 2010, GBD 2013 and GBD 2015.
2. Cause list: 109 causes GBD 1990 → 315 causes for GBD 2015.
3. Risks: 10 risks in GBD 1990 → 79 risks in GBD 2015
4. Locations: 8 regions in GBD 1990 →195 countries/territories more than 500 subnational locations in GBD 2015
5. Data processing: GBD 1990 redistribution for ill-defined causes of death to statistical cross-walking and detailed garbage code redistribution
6. Estimation methods: plausible internally consistent point estimates in GBD 1990 to posterior distributions for each quantity using Bayesian inference.
7. Disability weights: GBD 1990 expert panels → population-based surveys in multiple countries for GBD 2010 and beyond.

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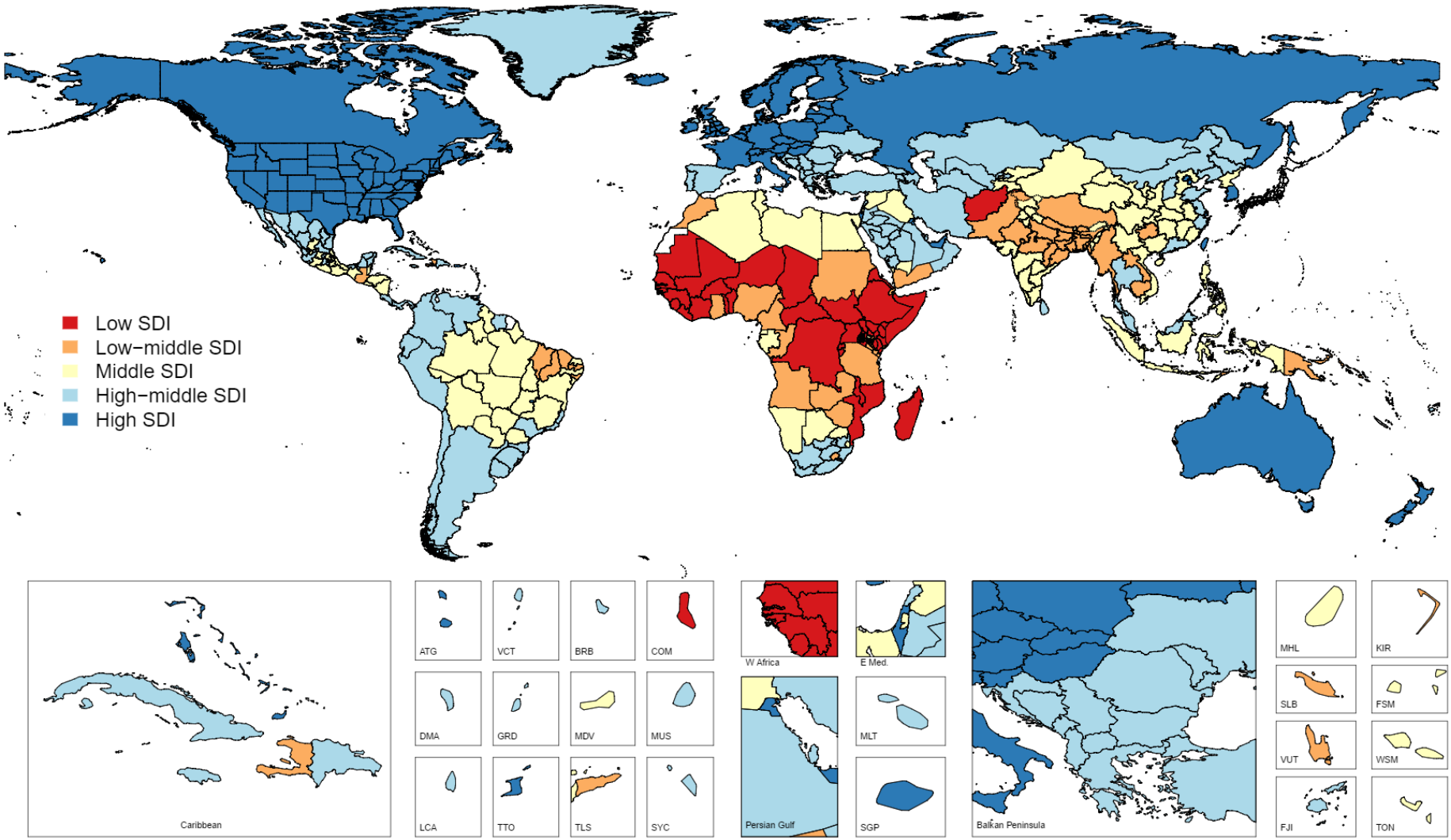
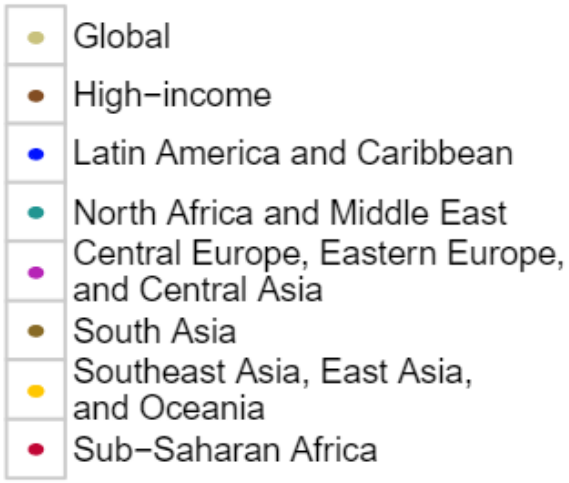
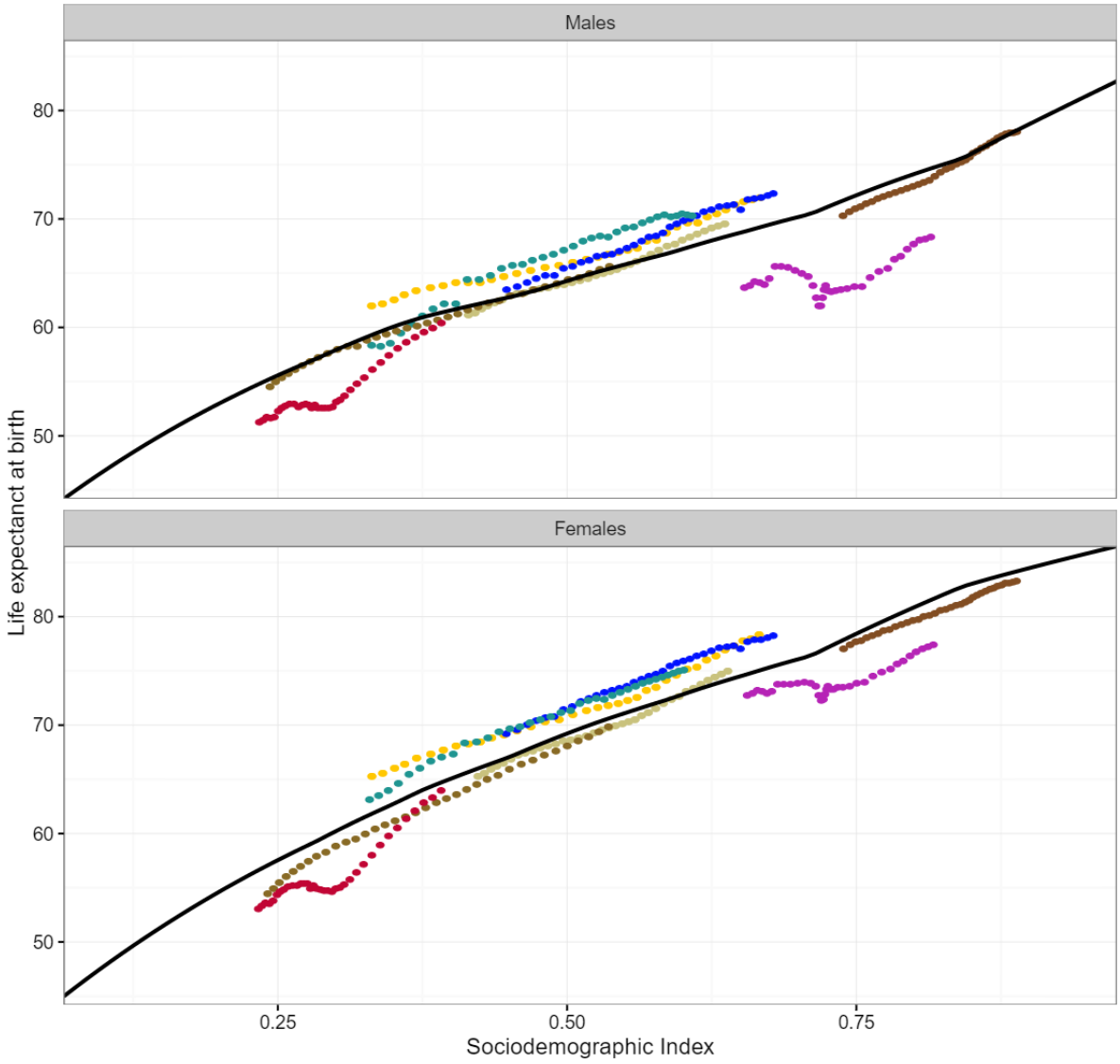
3) New analytical directions

Socio-Demographic Index (SDI) quintiles by GBD subnational level 1 geography, 2015. SDI is meant to place locations on the development continuum based on income per capita, average years of schooling and total fertility rate.

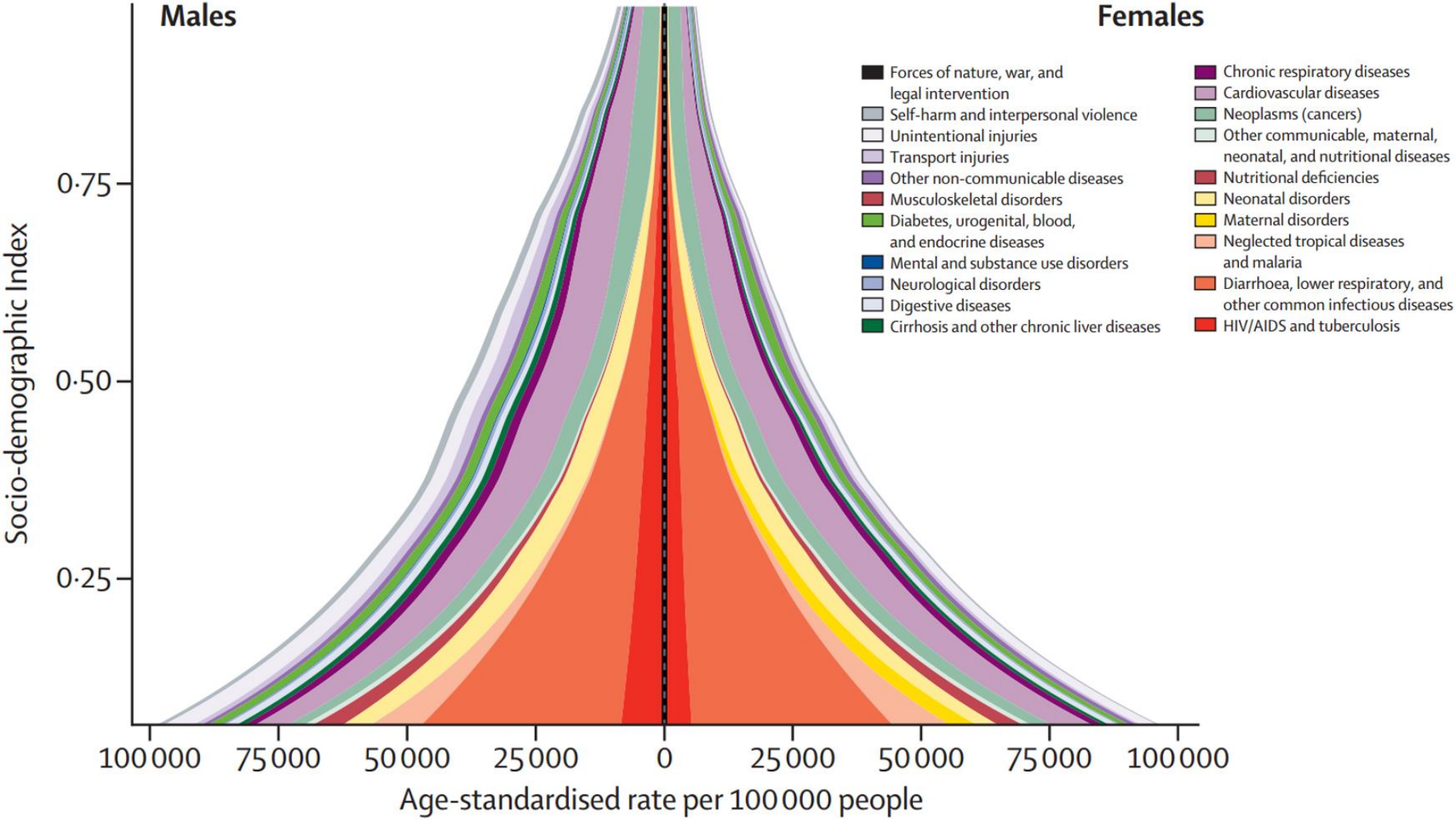


Life expectancy at birth and SDI. Black line shows average relationship 1980-2015 and points show the co-evolution of life expectancy and SDI for GBD super-regions

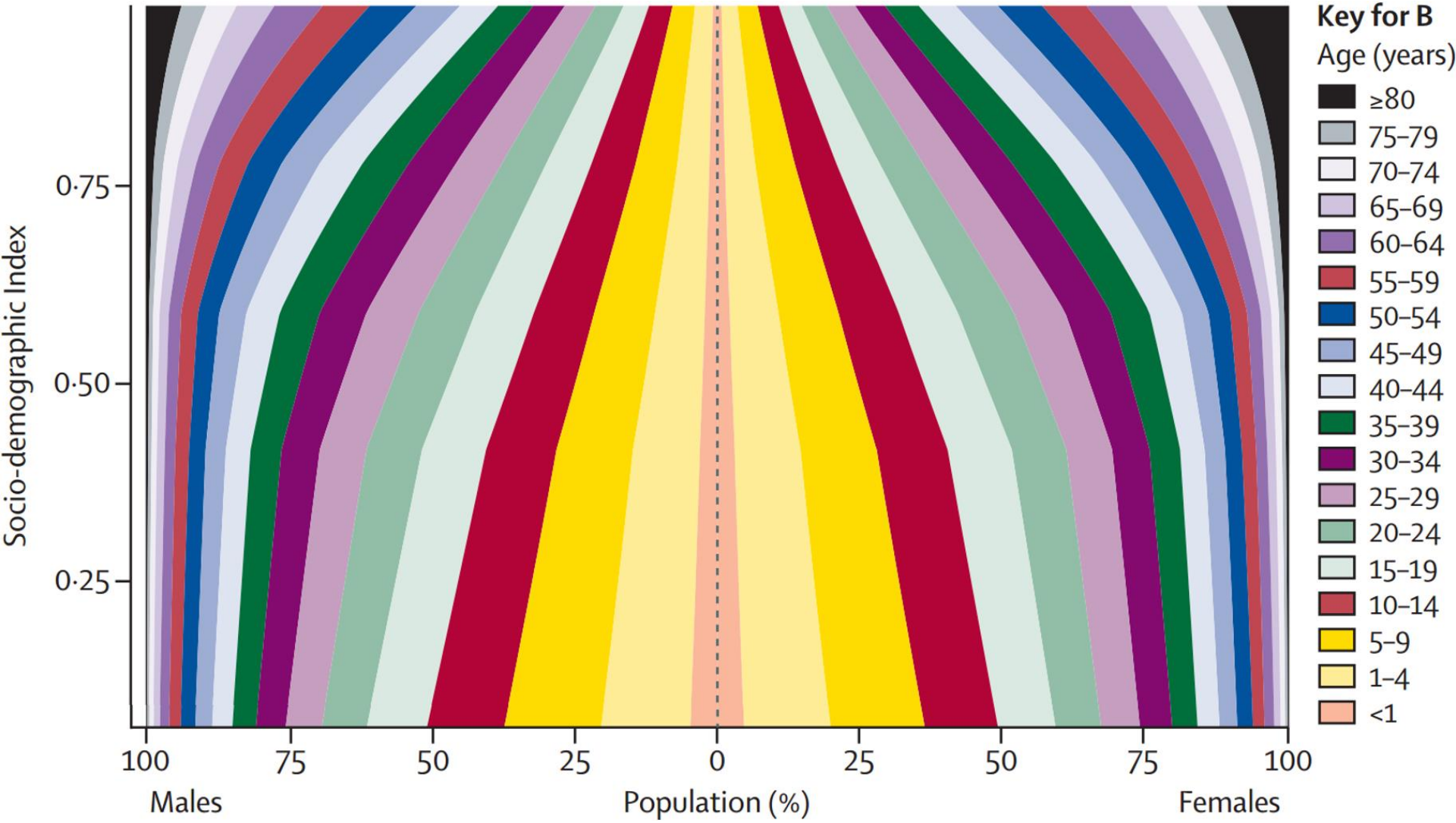




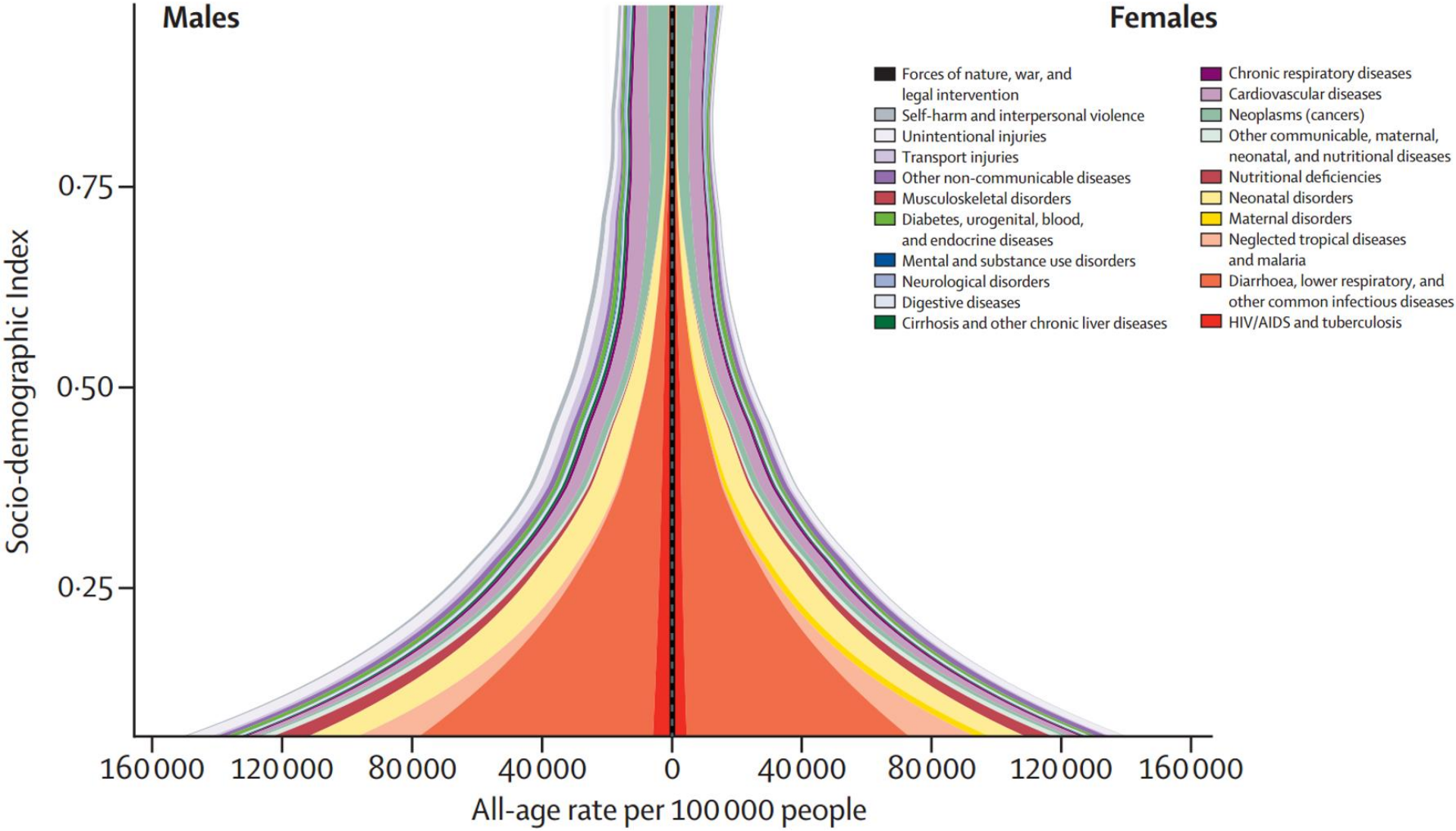
Expected relationship between age-standardized YLL rates by cause, SDI and sex



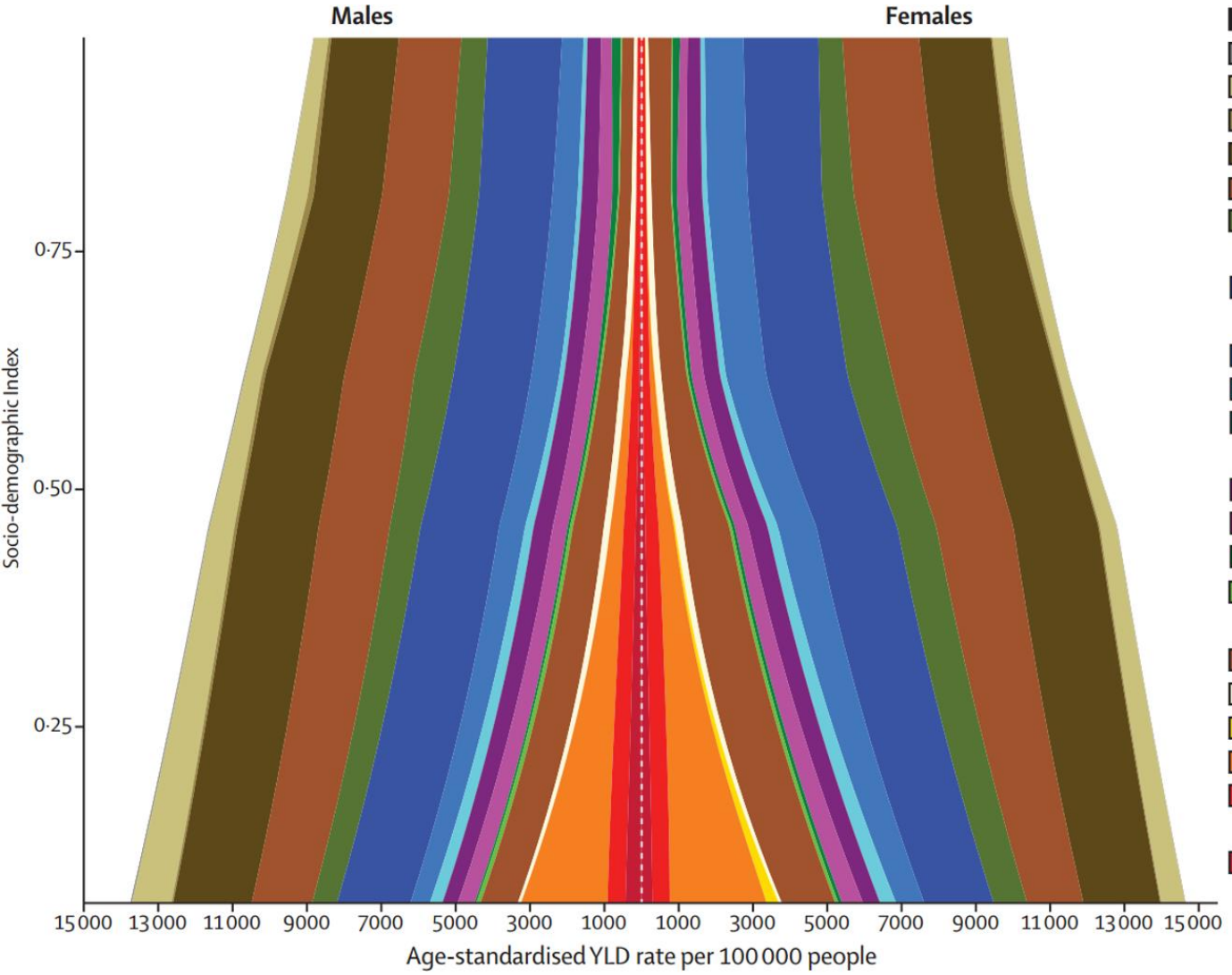
Expected relationship between population and SDI



Expected relationship between all-age YLL rates by cause, SDI and sex

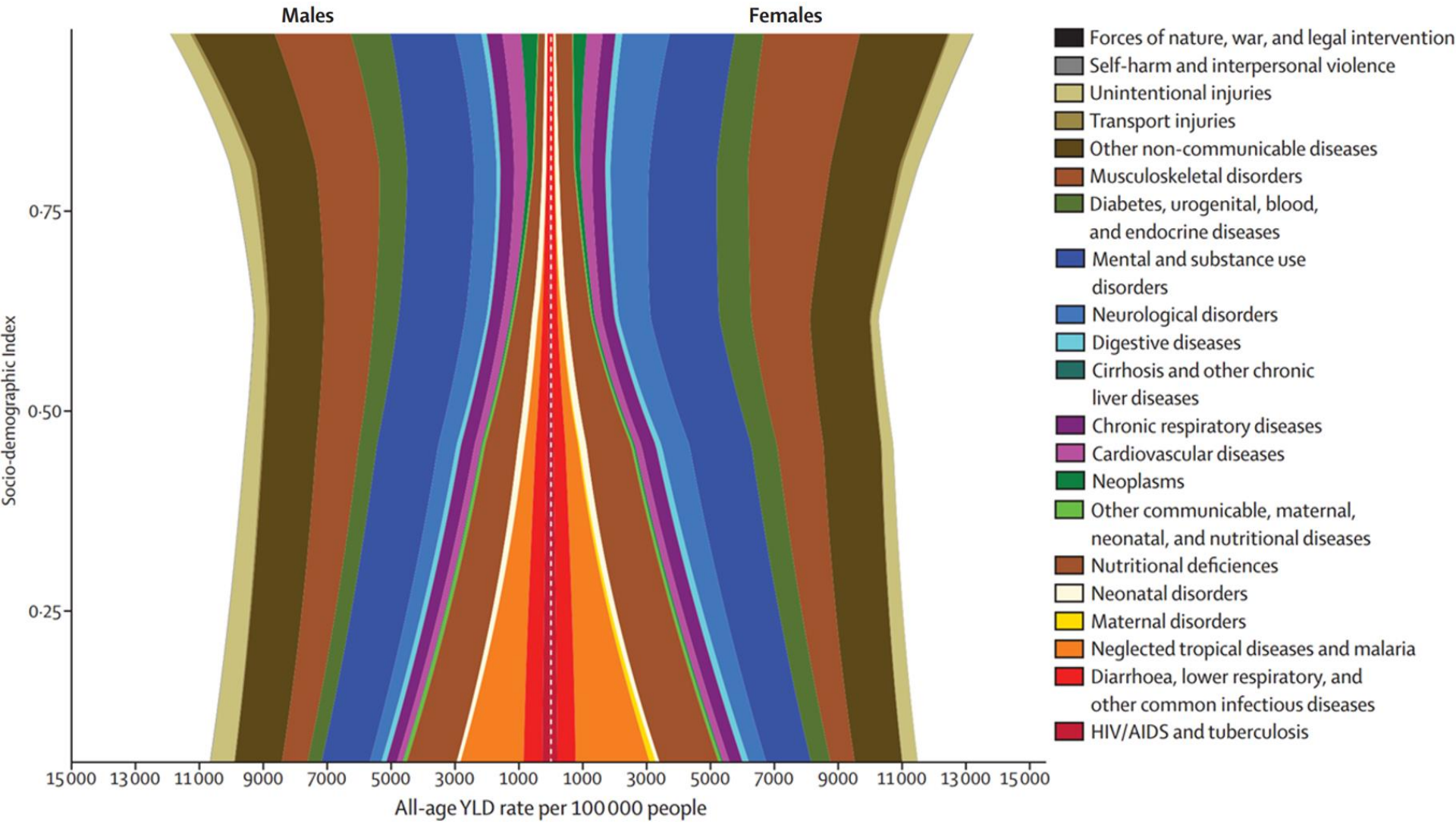


Expected relationship between age-standardized YLD rates by cause, SDI and sex

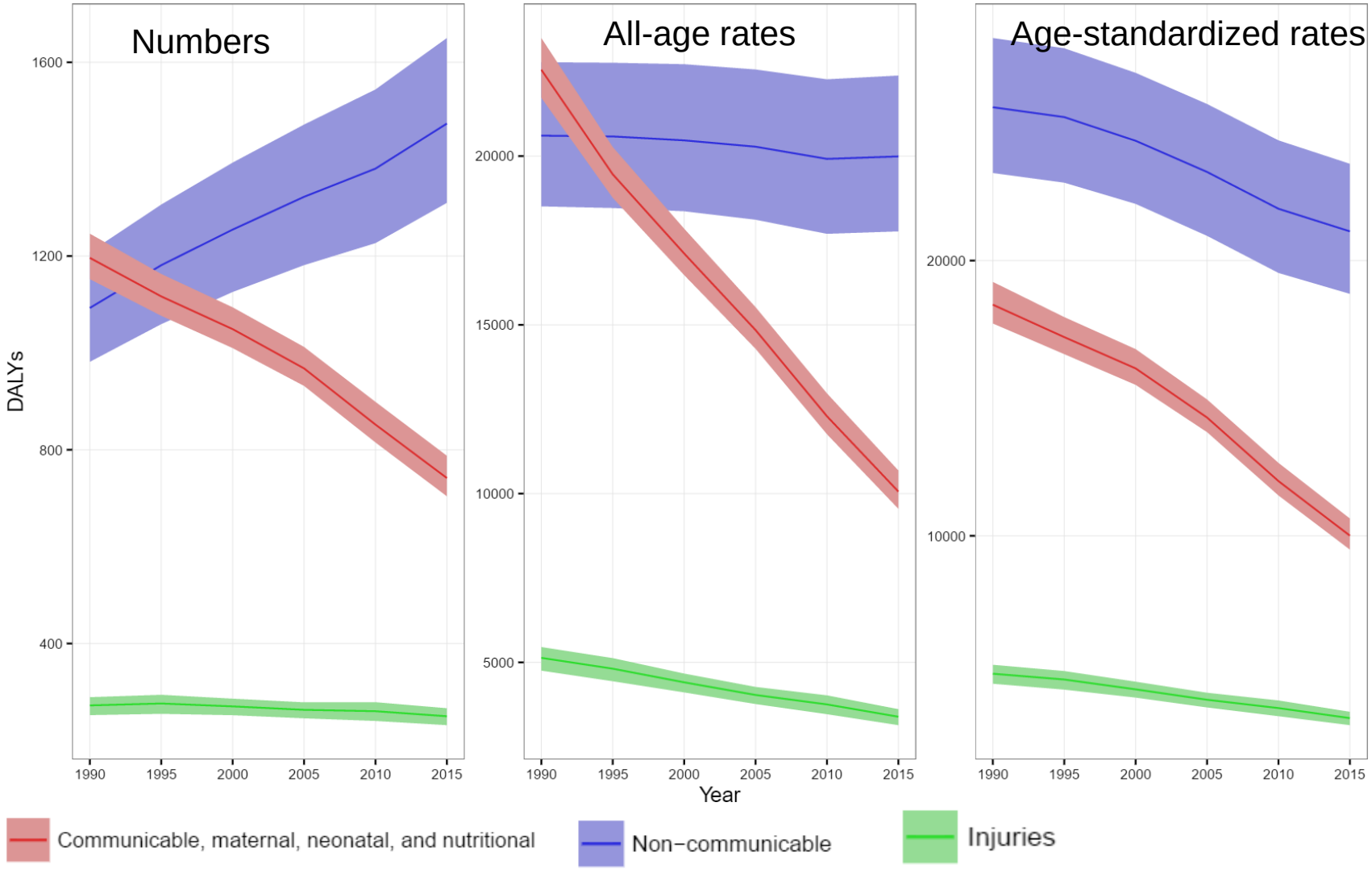


- Forces of nature, war, and legal intervention
- Self-harm and interpersonal violence
- Unintentional injuries
- Transport injuries
- Other non-communicable diseases
- Musculoskeletal disorders
- Diabetes, urogenital, blood, and endocrine diseases
- Mental and substance use disorders
- Neurological disorders
- Digestive diseases
- Cirrhosis and other chronic liver diseases
- Chronic respiratory diseases
- Cardiovascular diseases
- Neoplasms
- Other communicable, maternal, neonatal, and nutritional diseases
- Nutritional deficiences
- Neonatal disorders
- Maternal disorders
- Neglected tropical diseases and malaria
- Diarrhoea, lower respiratory, and other common infectious diseases
- HIV/AIDS and tuberculosis

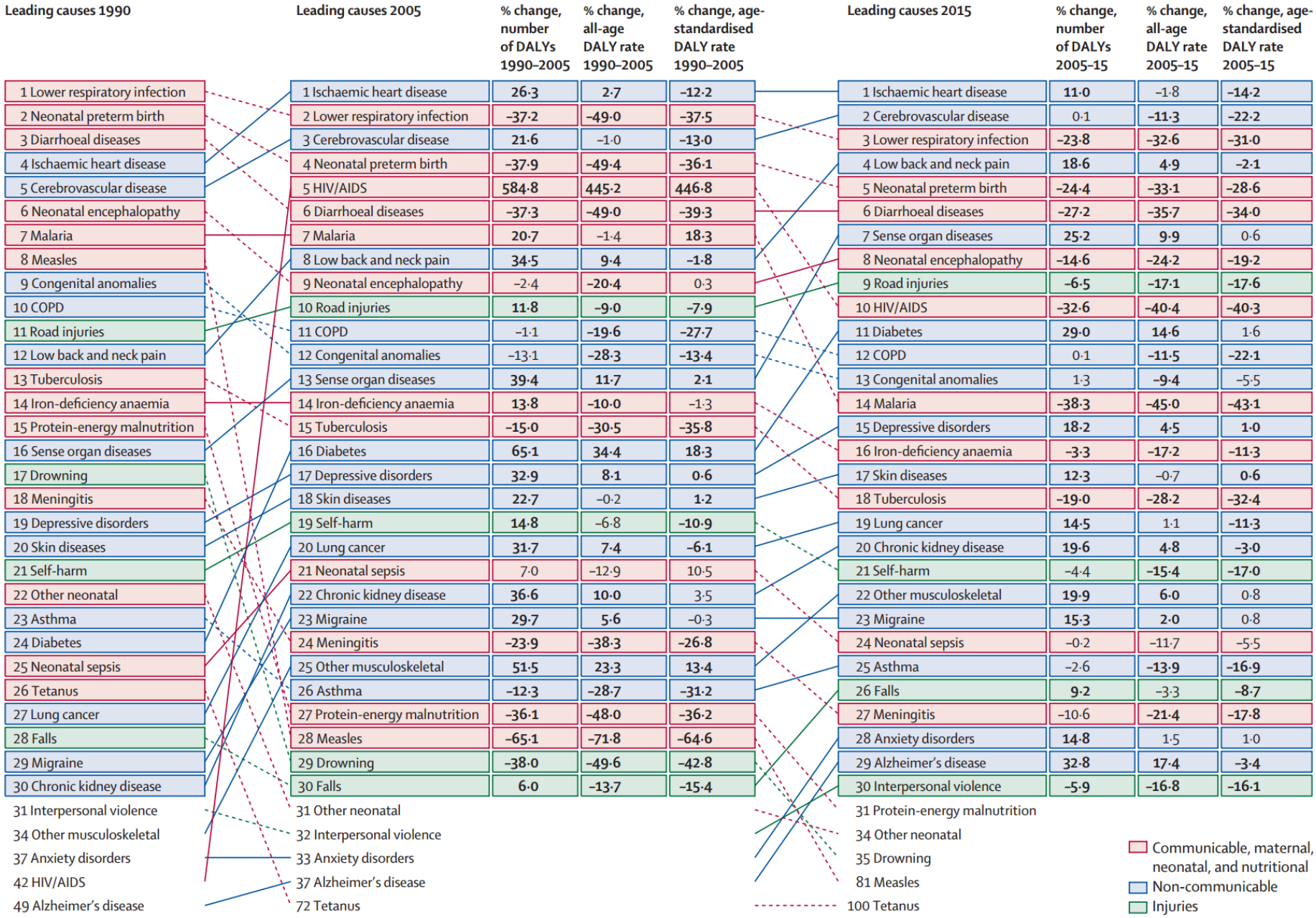
Expected relationship between all-age YLD rates by cause, SDI and sex



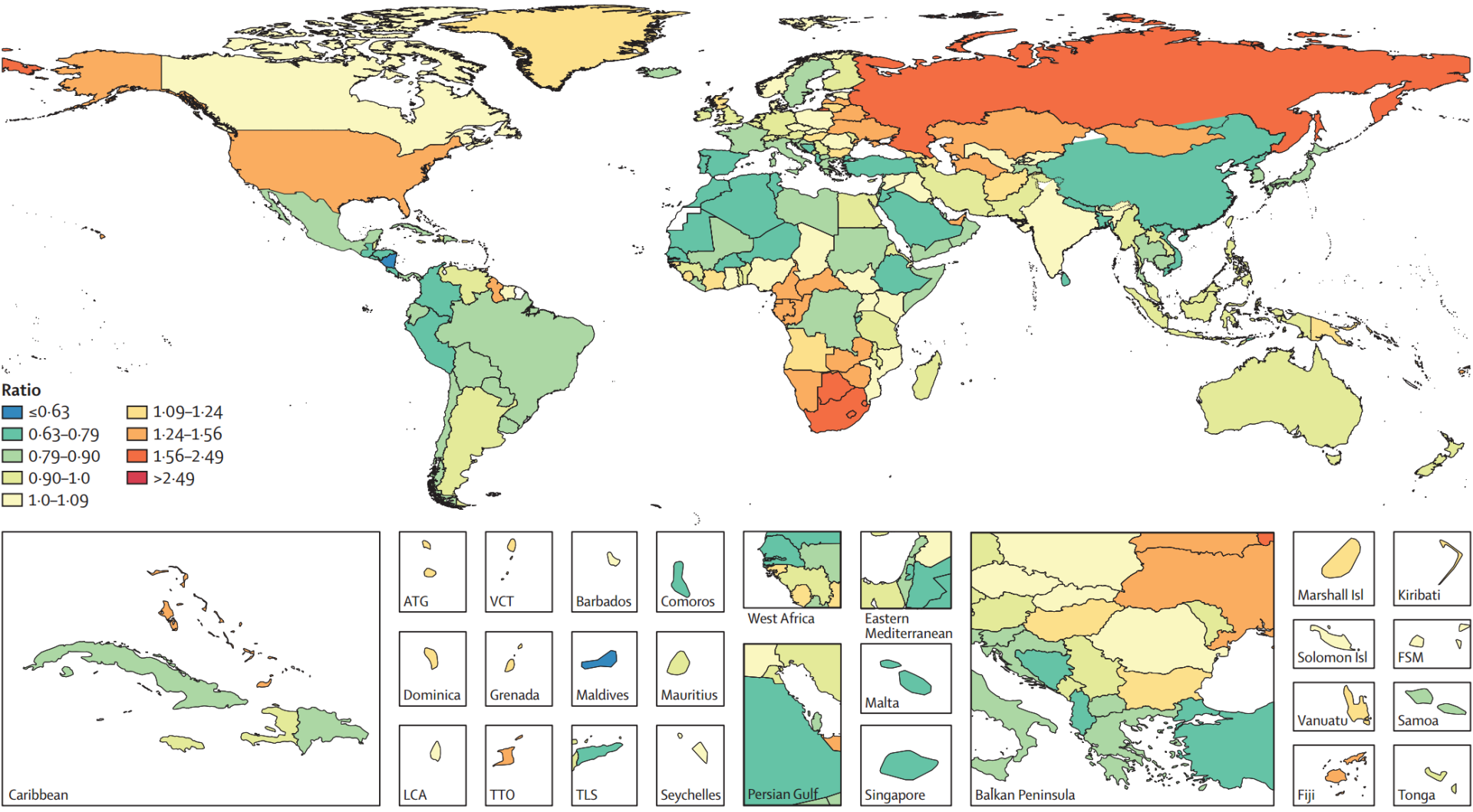
Global DALYs by Level 1 GBD causes 1990 to 2015. Panel A: numbers of DALYs; Panel B: all-age DALY rates and Panel C: age-standardized DALY rates



Leading 30 causes of global DALYs for both sexes combined, 1990, 2005, 2015



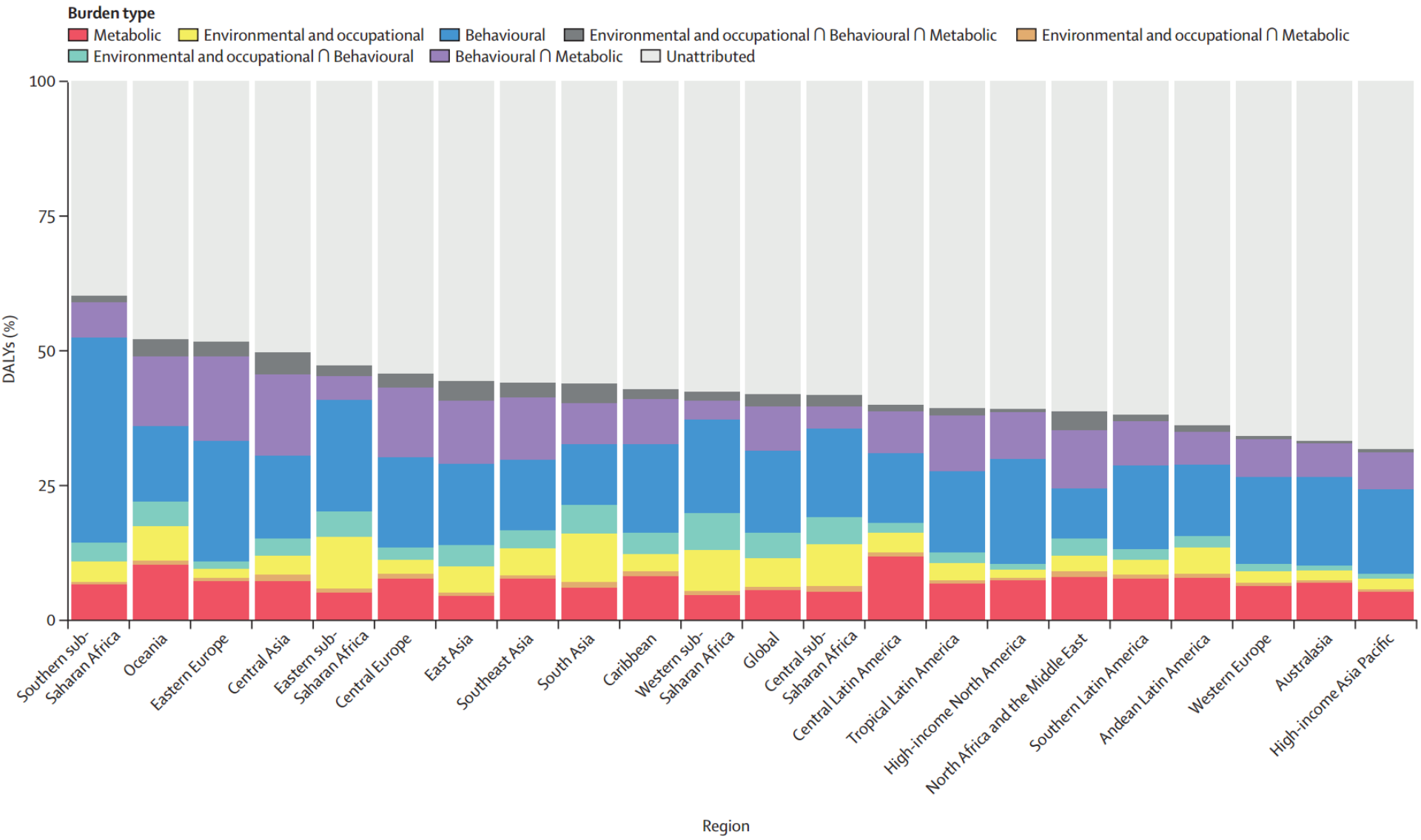
Observed vs expected age-standardized DALY rates per 100,000 based on SDI alone for both sexes combined, 2015



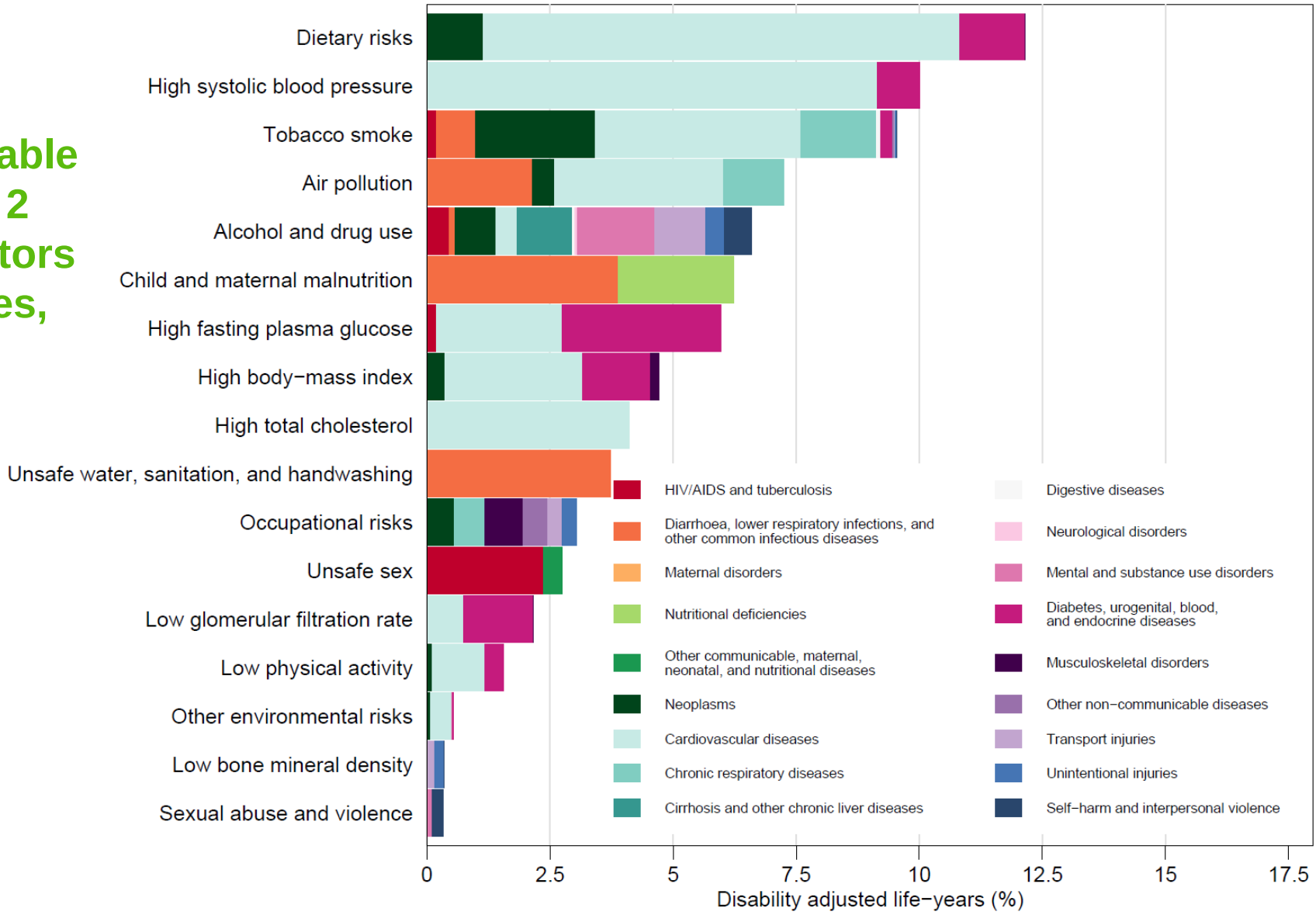
Leading ten causes of DALYs with the ratio of observed DALYs to DALYs expected on the basis of SDI in 2015, by location

	1	2	3	4	5	6	7	8	9	10
Global	IHD (0·92)	Stroke (0·93)	LRI (0·65)	Back & neck (0·96)	NN Preterm (0·72)	Diarrhoea (0·76)	Sense (1·00)	NN Enceph (1·17)	Road injuries (0·80)	HIV (0·66)
High income	IHD (0·91)	Back & neck (1·11)	Sense (0·94)	Lung C (0·98)	Stroke (0·59)	Diabetes (1·32)	Alzheimer's (0·77)	Depression (1·11)	COPD (1·24)	Skin (0·92)
High-income North America	IHD (1·79)	Back & neck (1·08)	Diabetes (2·48)	Lung C (1·30)	Depression (1·31)	COPD (2·35)	Alzheimer's (0·97)	Drugs (3·82)	Sense (0·89)	Other MSK (1·79)
Canada	Back & neck (1·31)	IHD (1·31)	Lung C (1·20)	Alzheimer's (0·92)	Sense (0·91)	Diabetes (1·75)	Depression (0·98)	Other MSK (1·56)	Skin (1·02)	Stroke (0·55)
Greenland	Self-harm (4·70)	Lung C (2·65)	IHD (0·74)	Back & neck (1·10)	NN Preterm (1·60)	Stroke (0·81)	Congenital (0·80)	COPD (1·81)	Other MSK (2·14)	Skin (1·04)
USA	IHD (1·84)	Back & neck (1·05)	Diabetes (2·57)	Lung C (1·31)	Depression (1·34)	COPD (2·49)	Drugs (4·01)	Alzheimer's (0·98)	Sense (0·89)	Other MSK (1·81)
Australasia	Back & neck (1·12)	IHD (1·01)	Depression (1·30)	Other MSK (1·87)	Sense (0·84)	Diabetes (1·36)	Lung C (0·78)	Stroke (0·56)	Skin (0·93)	Anxiety (1·72)
Australia	Back & neck (1·12)	IHD (1·02)	Depression (1·33)	Other MSK (1·93)	Sense (0·84)	Diabetes (1·36)	Lung C (0·78)	Stroke (0·57)	Skin (0·93)	Drugs (2·93)
New Zealand	Back & neck (1·15)	IHD (0·96)	Depression (1·14)	Diabetes (1·40)	Sense (0·85)	Lung C (0·79)	Stroke (0·53)	COPD (1·38)	Skin (0·93)	Other MSK (1·52)
High-income Asia Pacific	Back & neck (0·84)	Stroke (0·74)	IHD (0·52)	Sense (1·04)	Alzheimer's (0·68)	Self-harm (1·25)	LRI (0·83)	Lung C (0·70)	Diabetes (0·93)	Depression (0·86)
Brunei	Diabetes (4·62)	IHD (2·13)	Back & neck (0·82)	Stroke (1·59)	Road injuries (2·44)	Skin (0·94)	Depression (0·90)	Congenital (1·56)	Sense (1·05)	Iron (1·06)
Japan	IHD (0·52)	Back & neck (0·82)	Sense (1·05)	Stroke (0·69)	Alzheimer's (0·67)	LRI (0·89)	Lung C (0·66)	Self-harm (1·20)	Stomach C (1·15)	Colorect C (0·77)
Singapore	IHD (0·92)	LRI (1·88)	Back & neck (0·60)	Sense (1·01)	Stroke (0·61)	Depression (0·95)	Skin (0·94)	Lung C (0·75)	CKD (1·13)	Colorect C (0·82)
South Korea	Back & neck (0·90)	Stroke (0·97)	Self-harm (1·45)	Diabetes (1·76)	Sense (1·02)	IHD (0·46)	Lung C (0·85)	Liver C (2·42)	Depression (0·83)	Skin (0·91)

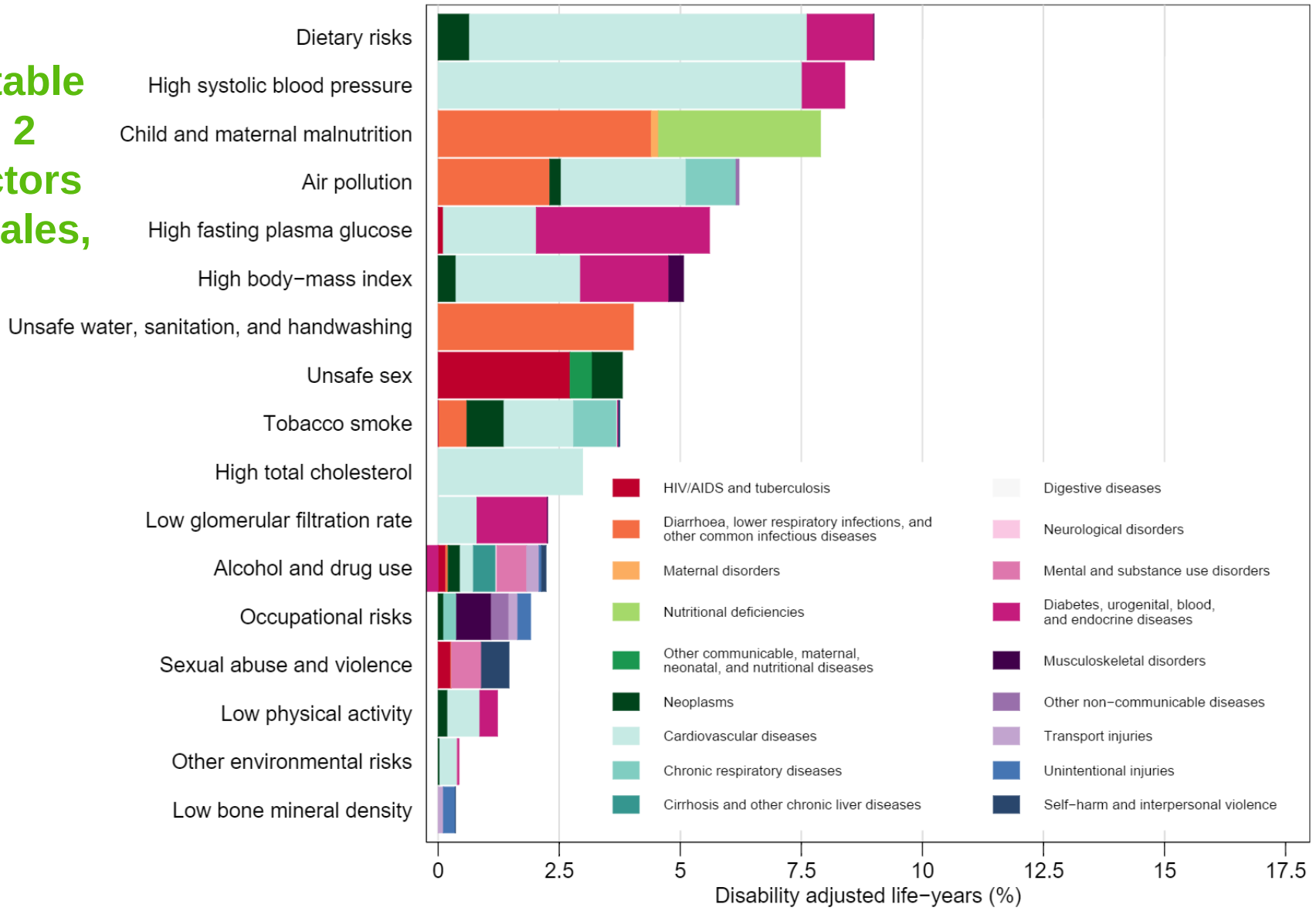
Global proportion of all-cause DALYs attributable to risk factors, and overlaps by region, both sexes, 2015



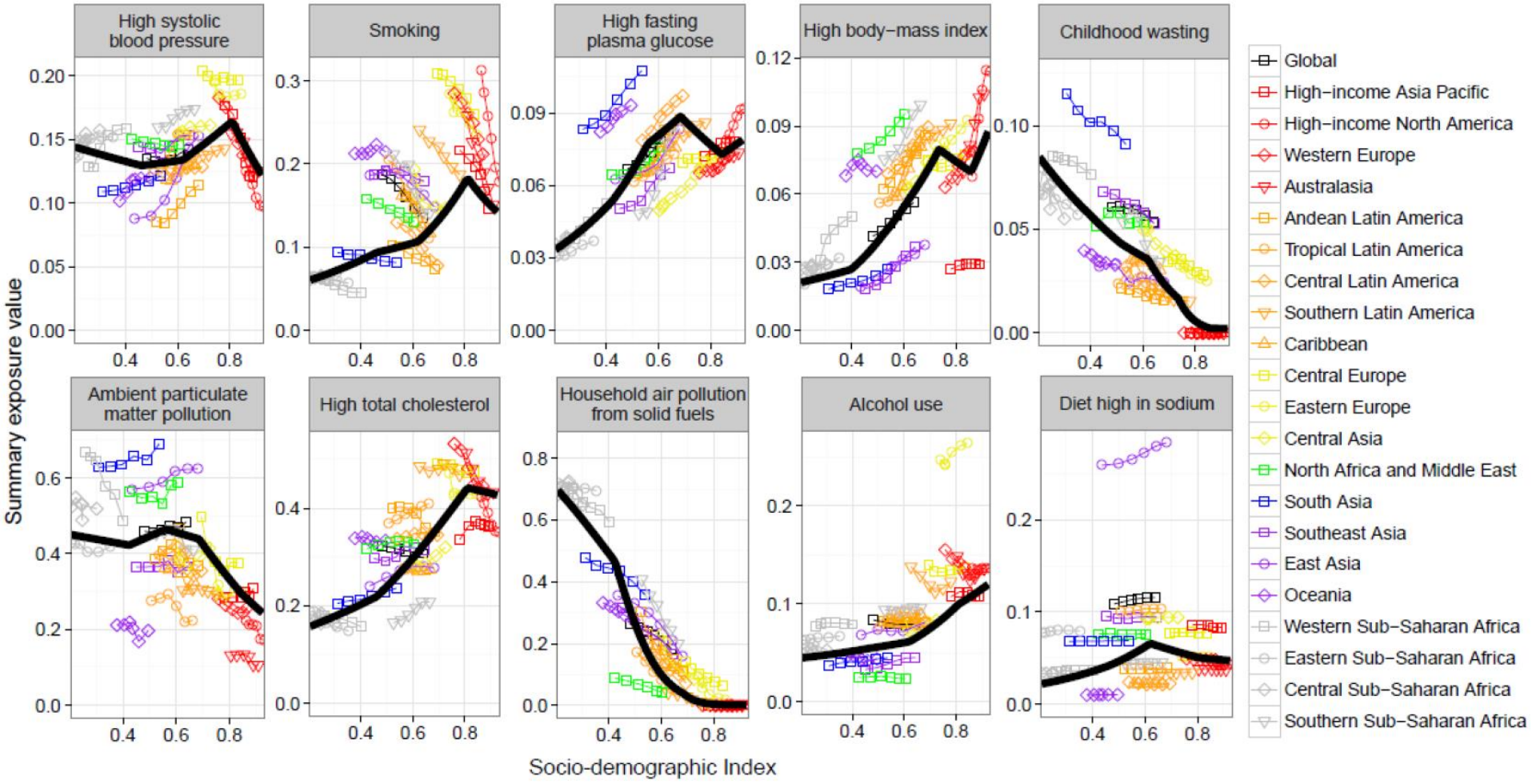
Global DALYs attributable to level 2 risk factors for males, 2015



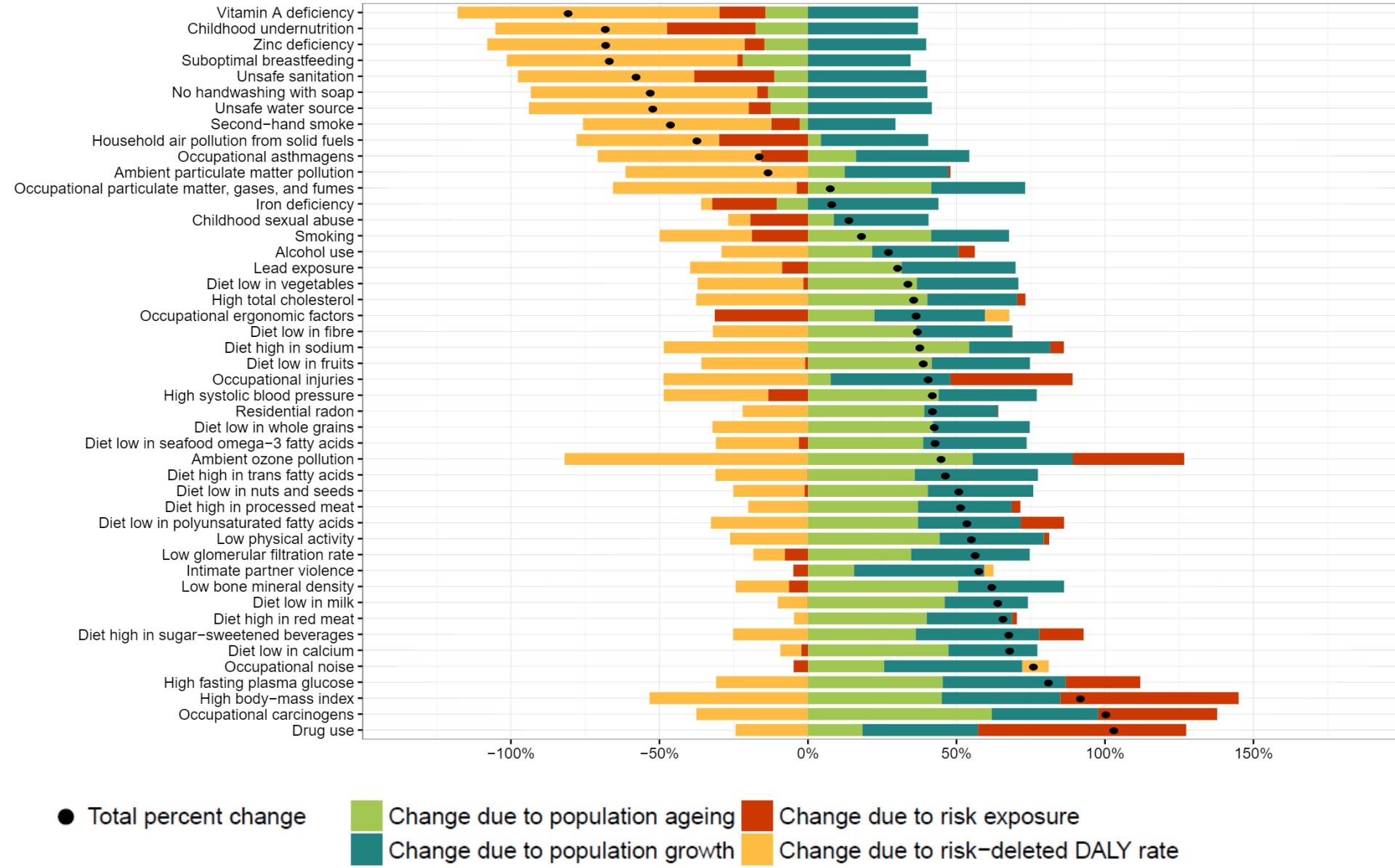
Global DALYs attributable to level 2 risk factors for females, 2015



Summary exposure value and SDI for top global risks in terms of attributable DALYs in 2015, with comparisons to expected summary exposure value on basis of SDI



Global decomposition of changes in DALYs attributable to risk factors, 1990-2015 due to population growth and ageing, risk exposure and the risk-deleted DALY rate



Data viz

www.healthdata.org

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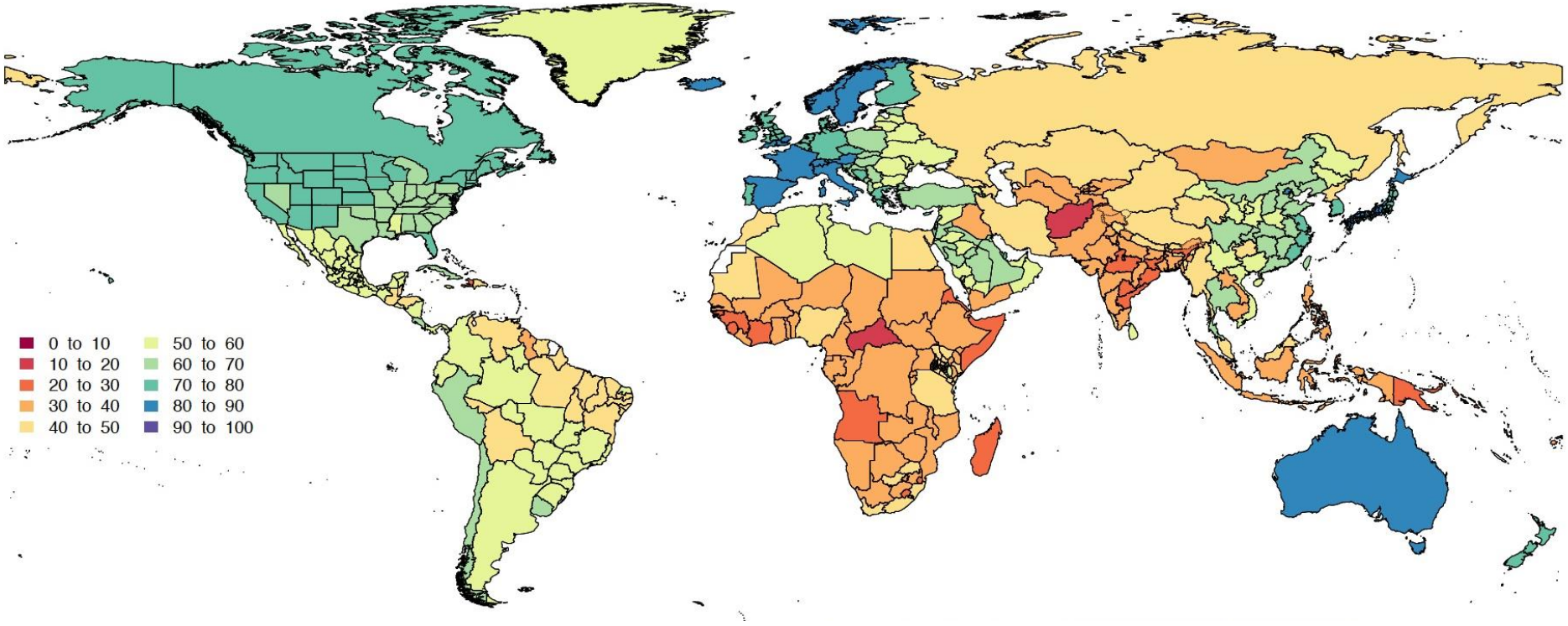
New directions for the GBD and related analytics

Broadly, the goal of the GBD is to help decision-makers make better decisions. We are continuing to expand a number of directions to enhance the interpretability and relevance of the GBD results for different users.

1) Healthcare quality and access measured using mortality highly amenable to health care
2) Absolute and relative avertable burden
3) Forecasts of the GBD 25 years into the future by location
4) Finer grained spatial estimation: 2nd administrative level or 5x5 km pixel level.
5) Health expenditure by GBD cause/risk

Health system access and quality, 2015

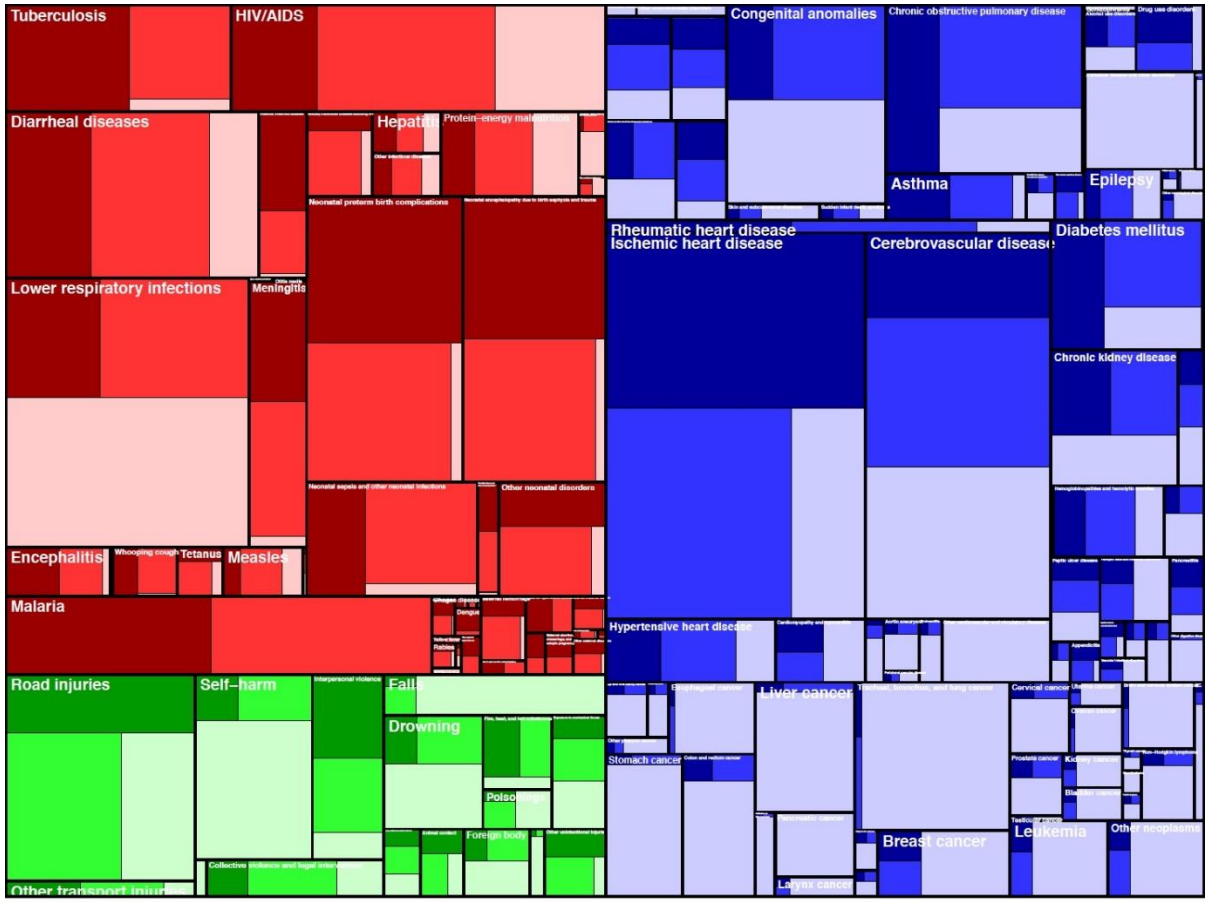
Using the set of causes highly amenable to healthcare e.g. testicular cancer, chronic kidney disease or tuberculosis, to proxy access to high quality healthcare. Rates are risk standardized.



Potential of healthcare to reduce premature mortality

Estimate the absolute fraction of each cause that could be averted through high quality healthcare and the fraction relative to level of development.

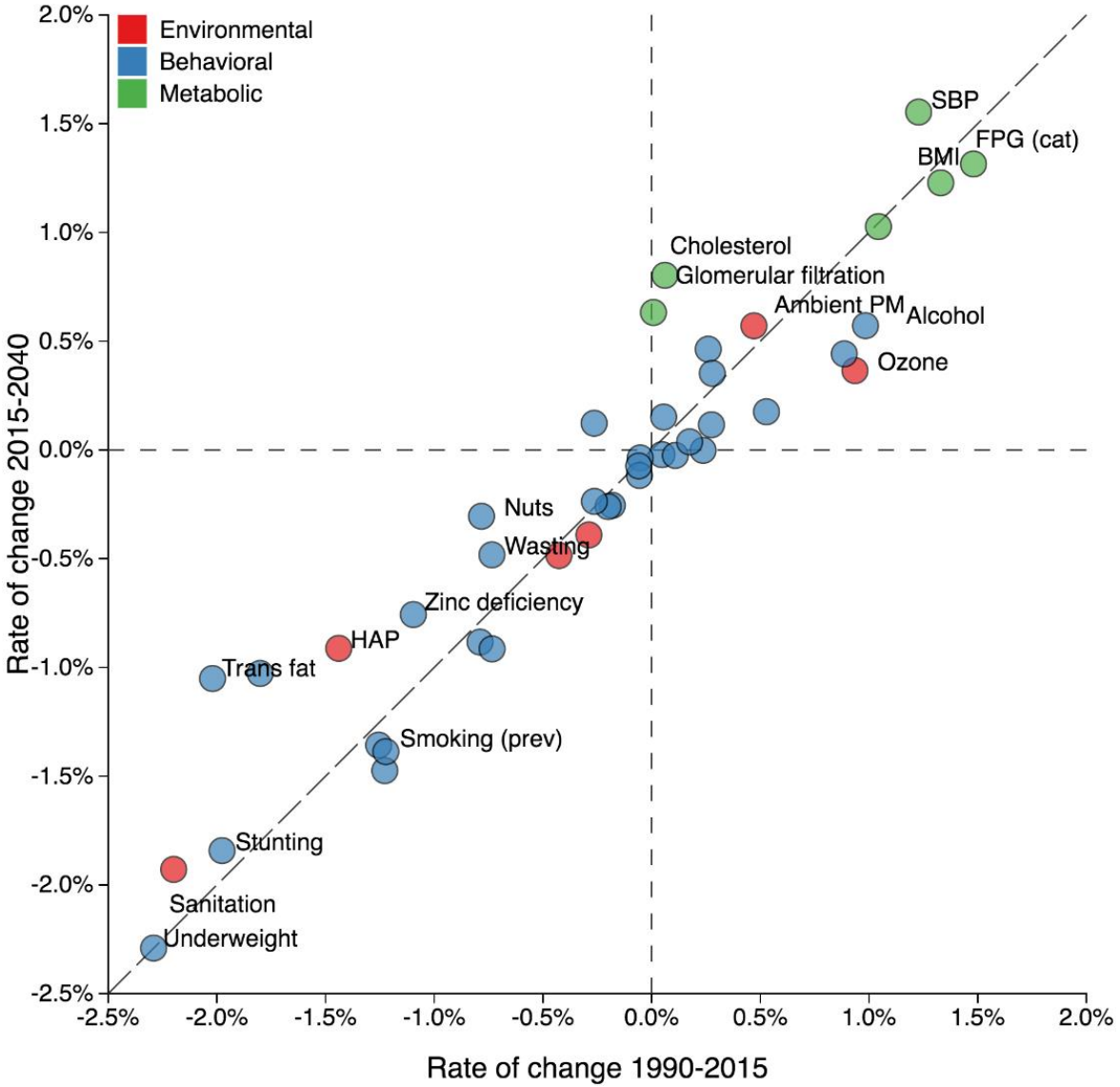
Treemap of global deaths in 2015. Dark color is avertable through healthcare relative to development level, intermediate color is avertable through highest quality healthcare, light shade not avertable through healthcare



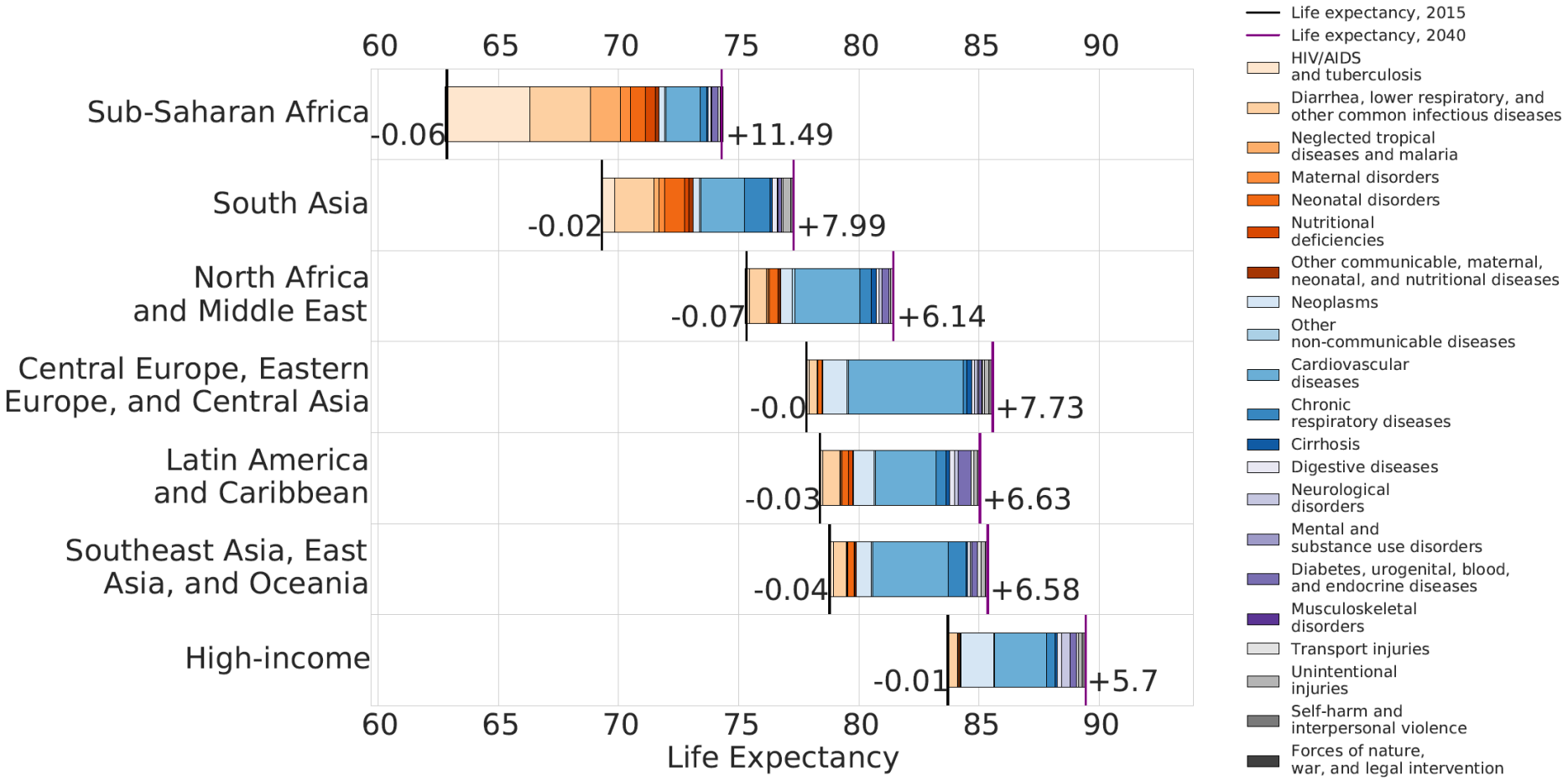
Two distinct goals for health futures platform

1) Generate and regularly update past trends and relationships scenario (PTRS) for mortality, morbidity and population from now to 25 years in the future by age, sex, cause and GBD geographies (over 500 now)
2) Create a comprehensive framework to assess alternative scenarios of interest to relevant stakeholders with different trajectories for independent drivers

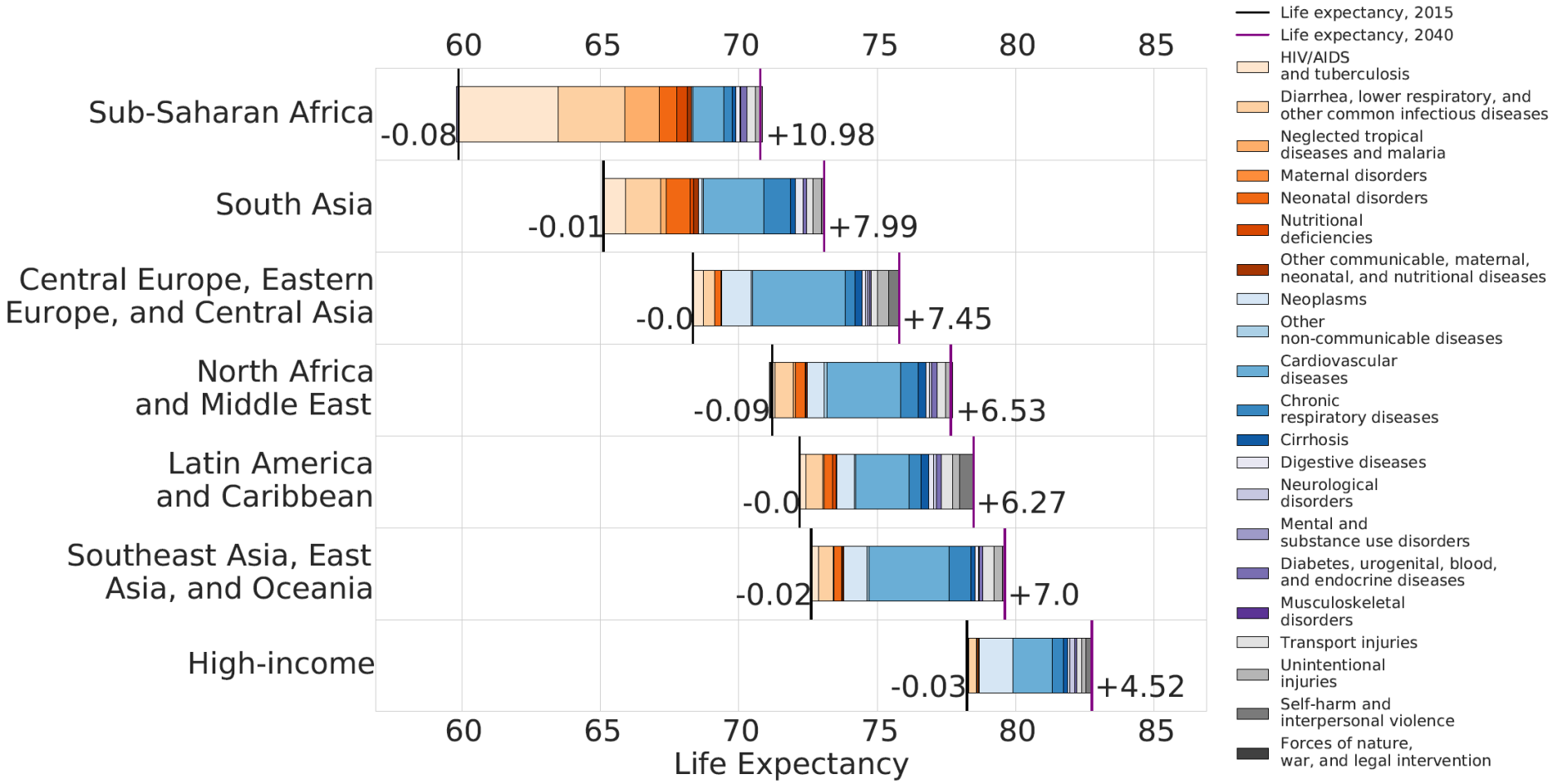
Historic vs projected annualized rate of change in global risk factors



Super-region life expectancy decomposition, females

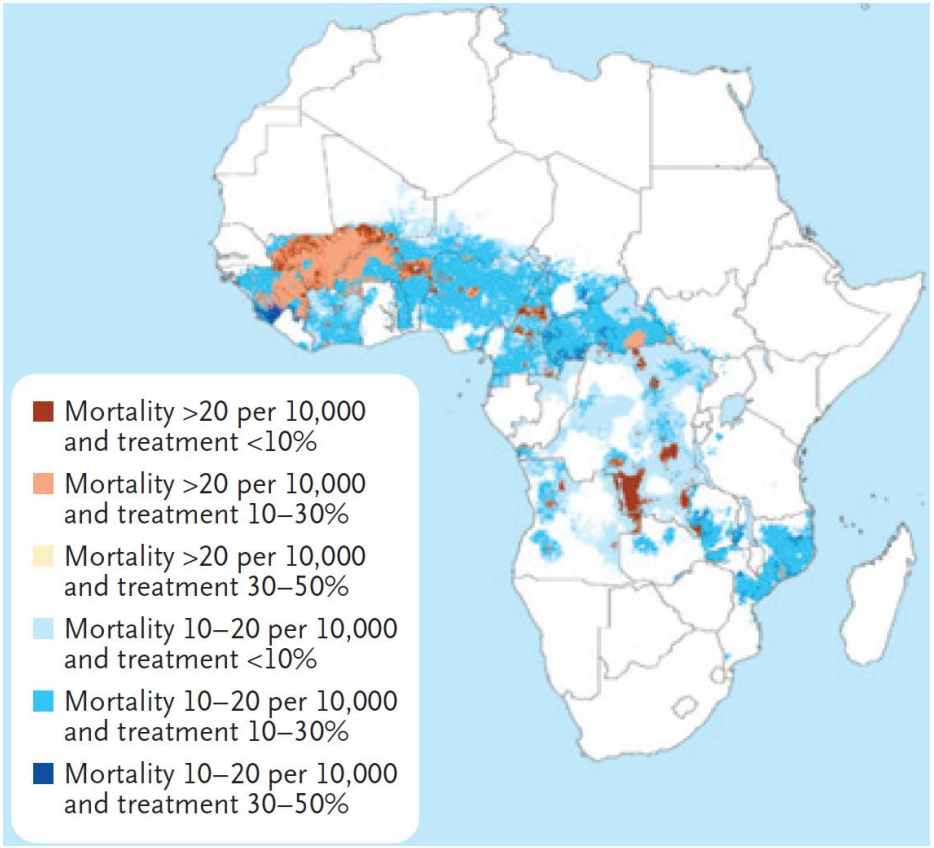


Super-region life expectancy decomposition, males

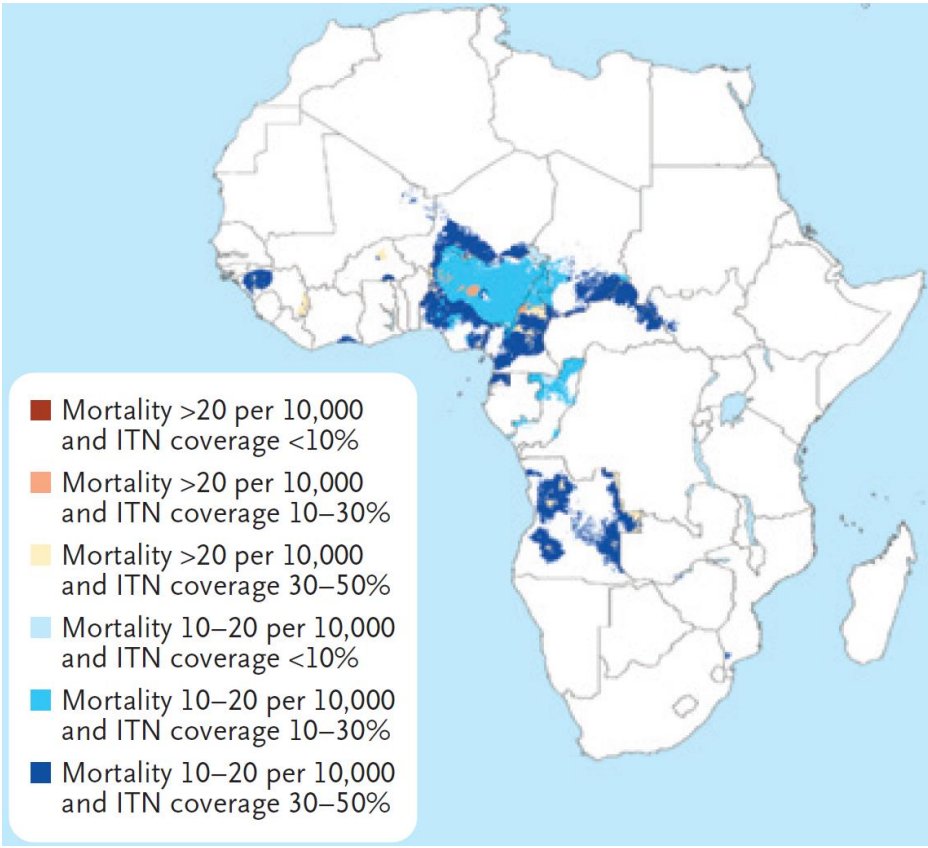


Using high resolution maps to target interventions: malaria in sub-Saharan Africa

High mortality and low treatment coverage, 2015



High mortality and low bed-net coverage, 2015



NEJM, 2016

Complete estimation of age, sex, cause, county mortality 1980-2014