



Drivers of Premature Mortality in the United States

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Outline

- 1) IHME
- 2) Premature mortality and its drivers
- 3) Health disparities
- 4) Summary and next steps

The Institute for Health Metrics and Evaluation

The Institute for Health Metrics and Evaluation: *Independent global health research organization at the University of Washington*

Focused on answering three critical questions:

- *What are the world's health problems?*
- *How well are we addressing these problems?*
- *How do we best allocate resources for maximum health impact?*

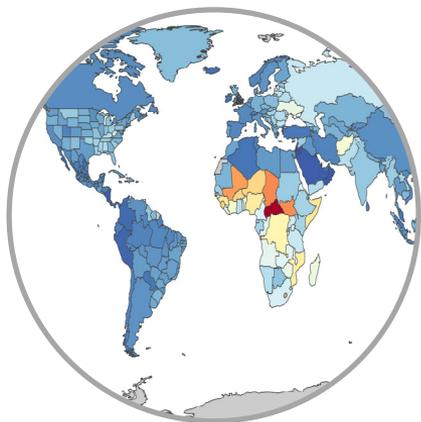
You can use our data to monitor and improve health in your community.

www.healthdata.org

IHME houses the world's most comprehensive collection of data on the incidence, prevalence, consequences and risks of disease

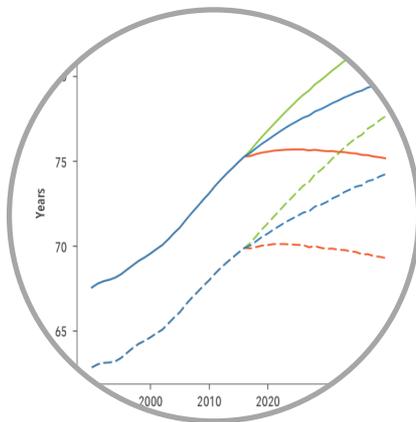
- Our resources:
 - 450 full-time professionals in Seattle, USA
 - 30+ full-time faculty
 - 30-member Scientific Council
 - Statisticians, data, and modeling professionals
 - Outreach and training personnel
 - 3,700 international collaborators

IHME data cover past and future trends in health, local burden of disease (1 of 3).



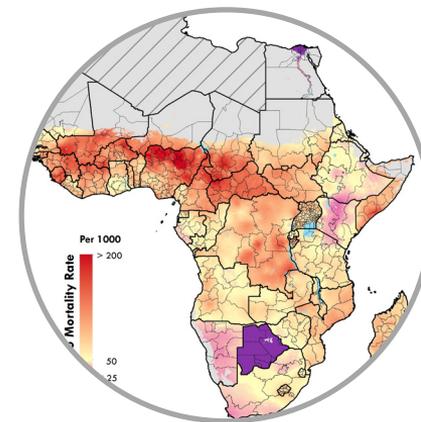
Measures of disease burden around the world from 1990

GBD distills large amounts of data that can be analyzed and visualized at the global, national and local levels to understand health trends over time. Produced with the input of 3,600+ collaborators from 146 countries and territories the GBD study is comprehensive, comparable, internally consistent, robust and transparent.



Forecast health trends to 2040

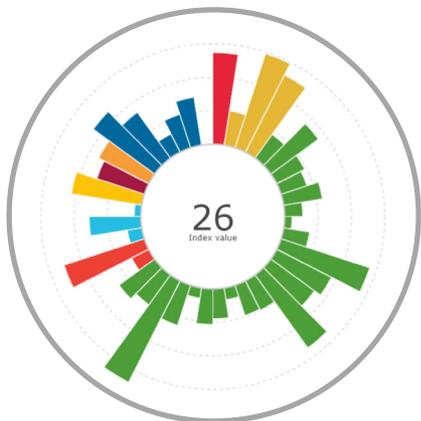
Based off GBD estimates, this unprecedented forecasting study tracks 250 causes of death and 79 risks in an integrated and comprehensive way out to the year 2040. The forecasting platform provides a robust, flexible forecasting platform from which reference forecasts and alternative health scenarios can be explored in relation to a wide range of independent drivers of health.



Health trends at a very detailed, local resolution

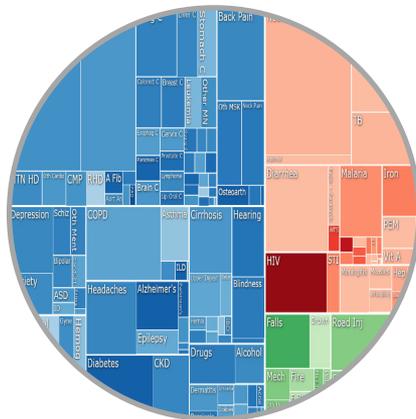
The LBD project produces estimates of selected health outcomes and related measures at a 5-by-5-kilometer resolution, measuring health outcomes and related measures that cover entire continents. Combining local detail with broad coverage – the LBD project produces 5-by-5 kilometer estimates for entire continents.

IHME data track progress towards SDGs, socio-demographic impact on burden, human capital index (2 of 3).



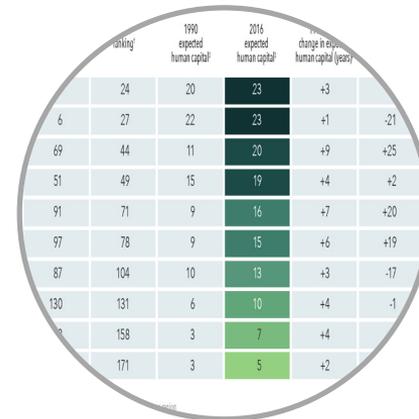
Progress toward achieving the Sustainable Development Goals

IHME measures progress toward achieving the United Nations Sustainable Development Goals (SDGs) for 195 countries and territories toward 41-health related SDG indicators. Measuring how countries have progressed over time, and where they might stand in 2030 on the basis of past trends. IHME's SDG estimates allow comparison of the relationship between SDG indicators and measures including the Socio-demographic Index (SDI).



Measure geographies on a spectrum of development

IHME's SDI summary measure identifies a geography's socio-demographic development. SDI contains an interpretable scale: zero represents the lowest income per capita, lowest educational attainment, and highest total fertility rate. SDI values are available for GBD geographies and groupings.



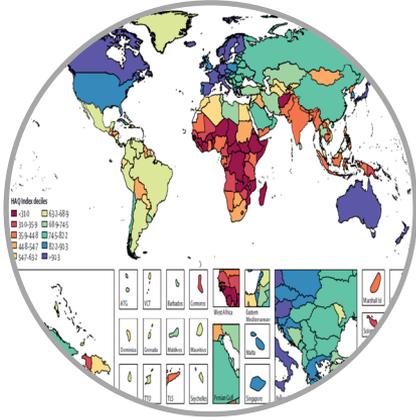
Internationally comparable index of human capital

IHME's Human capital index offers a measure of expected human capital that incorporates educational attainment, education quality or learning, functional health status, and survival for 195 countries from 1990 to 2016.

Expected human capital is computed similarly to life expectancy, by applying current age- and sex-specific rates of survival, functional health status, education, and learning to the population born each year.

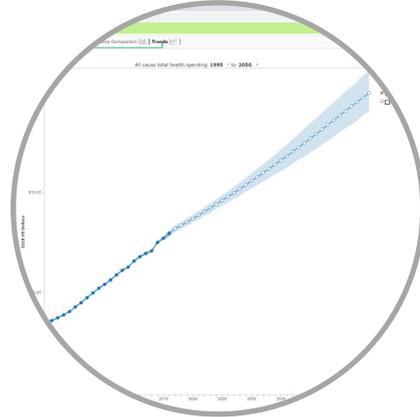
Institute for Health Metrics and Evaluation

IHME data track health access and quality of care, global health financing, US health expenditure and its trends (3 of 3).



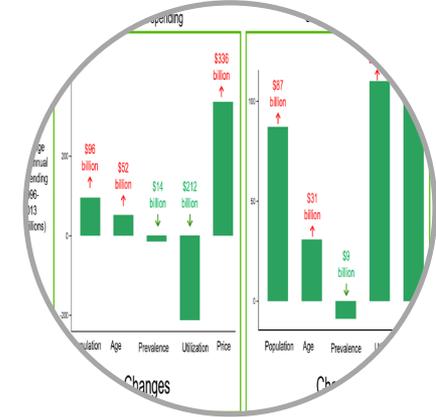
Health access and quality of care

The Healthcare Access and Quality (HAQ) Index is a summary measure based on 32 causes, that in the presence of high-quality health care, should not result in death. IHME reports HAQ for 195 countries and at the subnational level for some.



Global Health financing and its trends to 2050

IHME reports patterns of global health financing flows from 1990 to 2050 with the Development Assistance for Health (DAH) levels and changes over time by source, channel, recipient region, and health focus and program area. DAH disbursed or received by population, disability-adjusted life years, gross domestic product, and government health spending are available.



Factors associated with health spending in the US

IHME evaluates the association of change in population size, population aging, disease prevalence or incidence, service utilization, or service price and intensity with increases in health care spending for each health condition and type of care using the most detailed US health care spending database with similarly detailed disease prevalence and incidence data.

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.
- Covers 195 countries and territories from 1990 to present. Sub-national assessments for some countries including Indonesia, China, India, USA, Russia, UK
- 359 diseases and injuries, 3,228 sequelae, 84 risk factors or clusters of risk factors.
- Time series from 1990 to most recent year updated annually
- Findings published in major medical journals, policy reports, and online data visualizations.

The Global Burden of Disease Study 2015



THE LANCET

Volume 388 Number 10111 Pages 1442-1510 October 8-14, 2016 www.thelancet.com

The Global Burden of Disease Study 2016

THE LANCET

Volume 392 Number 10120 Pages 1403-1418 November 10-16, 2018 www.thelancet.com

The Global Burden of Disease Study 2017

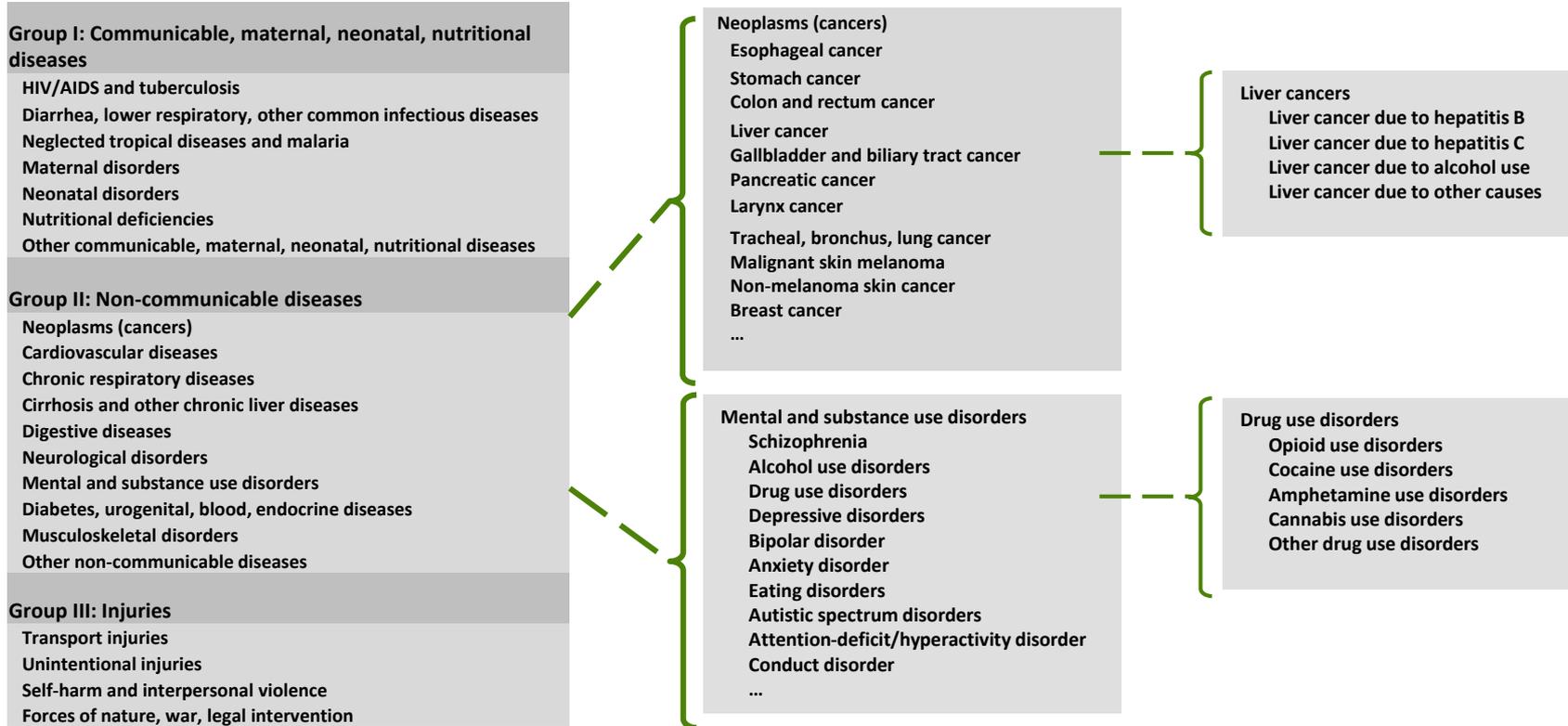


Multiple metrics for health to facilitate different types of uses

- 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.

Diseases and injuries in the GBD datasets form a hierarchy of 333 causes, mutually exclusive and exhaustive of all-cause mortality

Higher-level group data can be interrogated in progressively greater detail:



Risk factors: 84

Metabolic risks

| Level | Risks |
|-------|------------------------------|
| 1 | Metabolic risks |
| 2 | High fasting plasma glucose |
| 2 | High total cholesterol |
| 2 | High systolic blood pressure |
| 2 | High body mass index |
| 2 | Low bone mineral density |
| 2 | Impaired kidney function |

Environmental/occupational risks

| Level | Risks |
|-------|---|
| 1 | Environmental/occupational risks |
| 2 | Unsafe water, sanitation, and handwashing |
| 3 | Unsafe water source |
| 3 | Unsafe sanitation |
| 3 | No access to handwashing facility |
| 2 | Air pollution |
| 3 | Ambient particulate matter pollution |
| 3 | Household air pollution from solid fuels |
| 3 | Ambient ozone pollution |
| 2 | Other environmental risks |
| 3 | Residential radon |
| 3 | Lead exposure |
| 2 | Occupational risks |
| 3 | Occupational carcinogens |
| 4 | Occupational exposure to arsenic |
| 4 | Occupational exposure to asbestos |
| 4 | Occupational exposure to benzene |
| 4 | Occupational exposure to beryllium |
| 4 | Occupational exposure to cadmium |
| 4 | Occupational exposure to chromium |
| 4 | Occupational exposure to diesel engine exhaust |
| 4 | Occupational exposure to formaldehyde |
| 4 | Occupational exposure to nickel |
| 4 | Occupational exposure to polycyclic aromatic hydrocarbons |
| 4 | Occupational exposure to secondhand smoke |
| 4 | Occupational exposure to silica |
| 4 | Occupational exposure to sulfuric acid |
| 4 | Occupational exposure to trichloroethylene |
| 3 | Occupational asthmagens |
| 3 | Occupational ergonomic factors |
| 3 | Occupational injuries |
| 3 | Occupational noise |
| 3 | Occupational particulate matter, gases, and fumes |

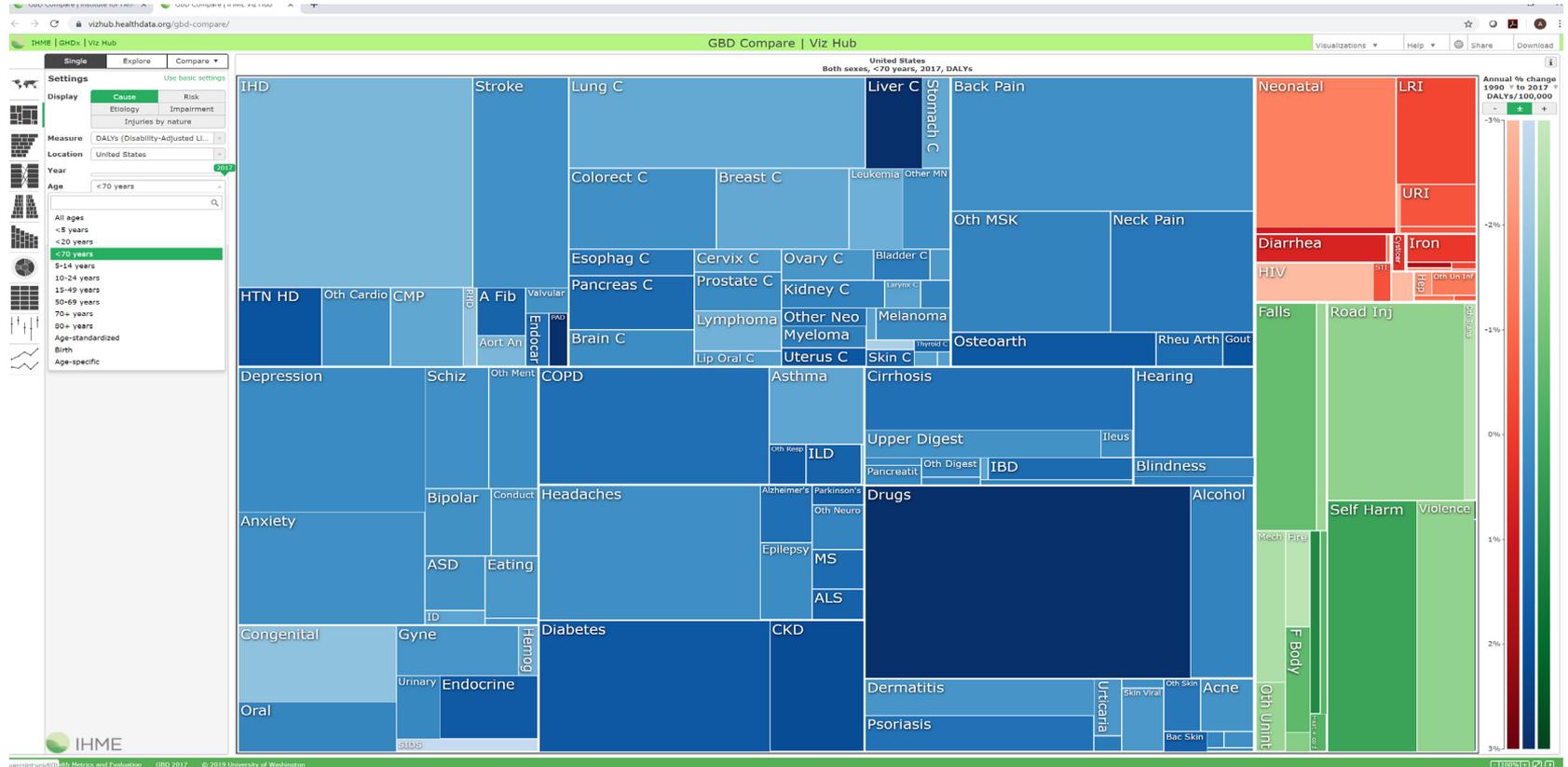
Behavioral risks

| Level | Risks |
|-------|---|
| 1 | Behavioral risks |
| 2 | Child and maternal malnutrition |
| 3 | Suboptimal breastfeeding |
| 4 | Non-exclusive breastfeeding |
| 4 | Discontinued breastfeeding |
| 3 | Child growth failure |
| 4 | Child underweight |
| 4 | Child wasting |
| 4 | Child stunting |
| 3 | Low birth weight and short gestation |
| 4 | Short gestation for birth weight |
| 4 | Low birth weight for gestation |
| 3 | Iron deficiency |
| 3 | Vitamin A deficiency |
| 3 | Zinc deficiency |
| 2 | Tobacco |
| 3 | Smoking |
| 3 | Smokeless tobacco |
| 3 | Secondhand smoke |
| 2 | Alcohol and drug use |
| 3 | Alcohol use |
| 3 | Drug use |
| 2 | Dietary risks |
| 3 | Diet high in processed meat |
| 3 | Diet high in red meat |
| 3 | Diet high in sodium |
| 3 | Diet high in sugar-sweetened beverages |
| 3 | Diet high in trans fatty acids |
| 3 | Diet low in calcium |
| 3 | Diet low in fiber |
| 3 | Diet low in fruits |
| 3 | Diet low in legumes |
| 3 | Diet low in milk |
| 3 | Diet low in nuts and seeds |
| 3 | Diet low in polyunsaturated fatty acids |
| 3 | Diet low in seafood omega-3 fatty acids |
| 3 | Diet low in vegetables |
| 3 | Diet low in whole grains |
| 2 | Sexual abuse and violence |
| 3 | Childhood sexual abuse |
| 3 | Intimate partner violence |
| 2 | Unsafe sex |
| 2 | Low physical activity |

Increased transparency

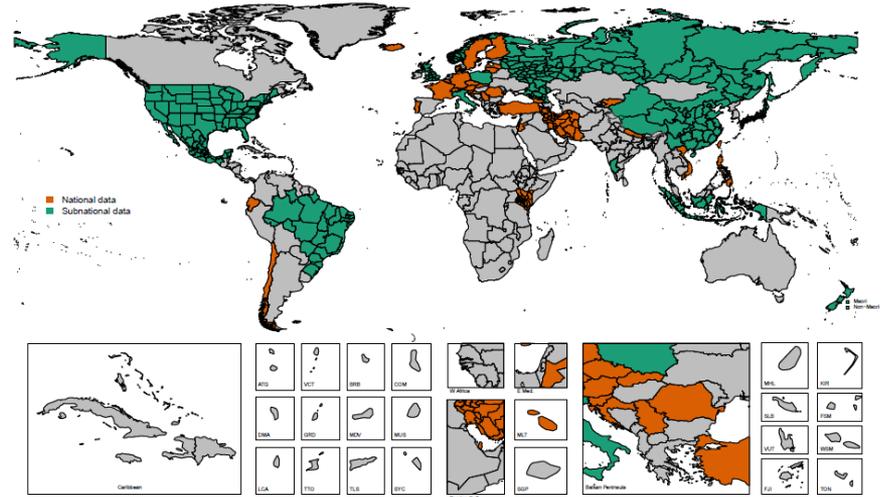
- GBD 1990 analysis published in two volumes (1000p +); neither the primary data nor the spreadsheets used were made available (for various reasons); limited methodological detail published
- Subsequently, public debate about strengthening global health metrics led to the creation of the *Guidelines for Accurate and Transparent Health Estimates Reporting* (GATHER)
- As of GBD 2015, all GBD studies are GATHER compliant: we release documentation for each source, provide an online searchable catalogue of the more than 100,000 sources used, and post the code for each step in the analysis

The screenshot shows the GHDx website interface. At the top, there is a navigation bar with links for 'Home', 'Country Profiles', 'Series and Systems', 'Organizations', 'Keywords', 'IHME Data', 'About the GHDx', and 'Help'. Below the navigation bar, the main content area features a search bar and a 'Country Profile' dropdown menu currently set to 'Afghanistan'. To the right, there is a 'Recent IHME Datasets' section listing various surveys such as 'Palestine Nutrition Survey 2002' and 'World Taxation and Price Guide 1994'. At the bottom, there is a footer with the IHME logo and contact information for the Institute for Health Metrics and Evaluation at the University of Washington.



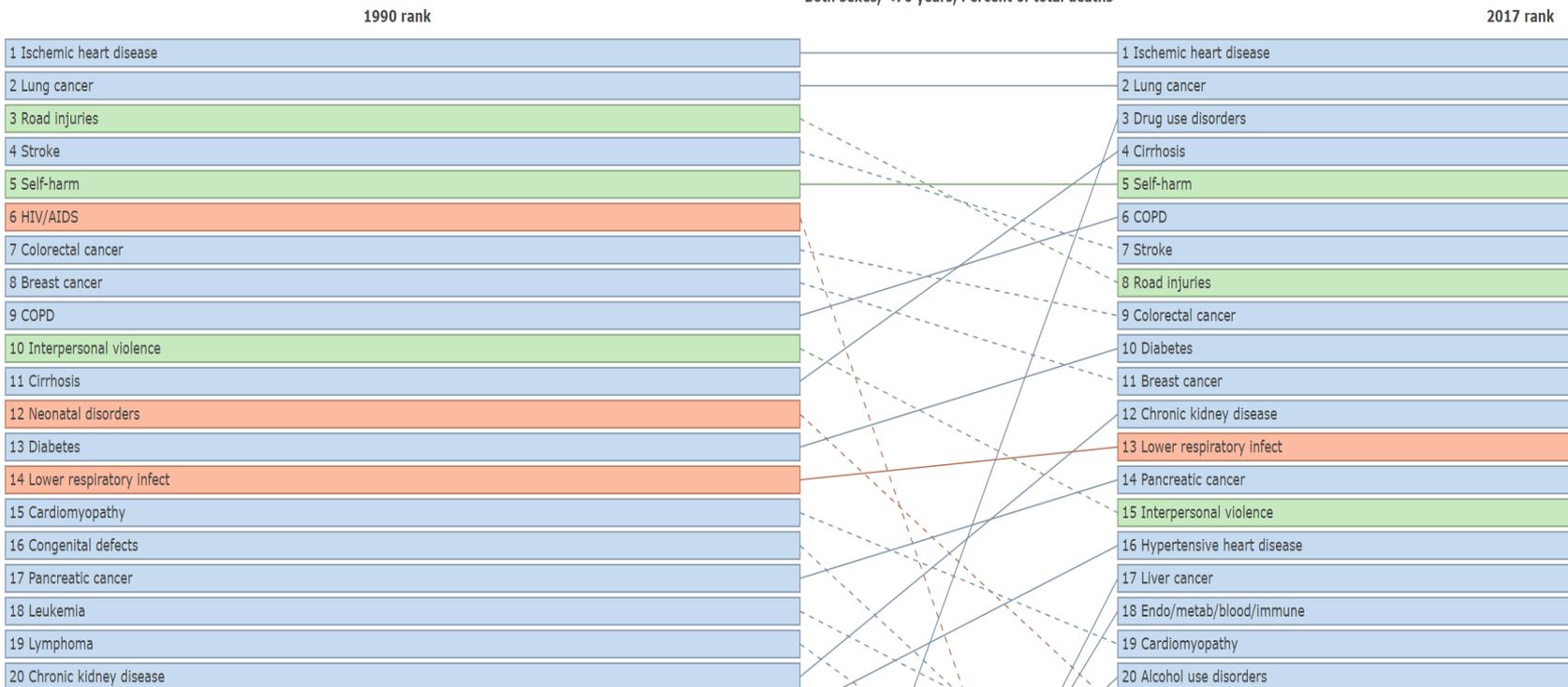
Clinical Informatics – background

- IHME Clinical Informatics database
 - One of seven core inputs to GBD estimation
 - Records include inpatient admissions, outpatient clinic visits, and health insurance claims records
 - Information includes diagnosis codes, procedure codes, demographic information, mortality outcomes
 - Steadily increasing volume of data from GBD 2010 through GBD 2019
 - Database represents 7 billion clinical encounters from 47 countries



Locations with clinical data in clinical informatics database

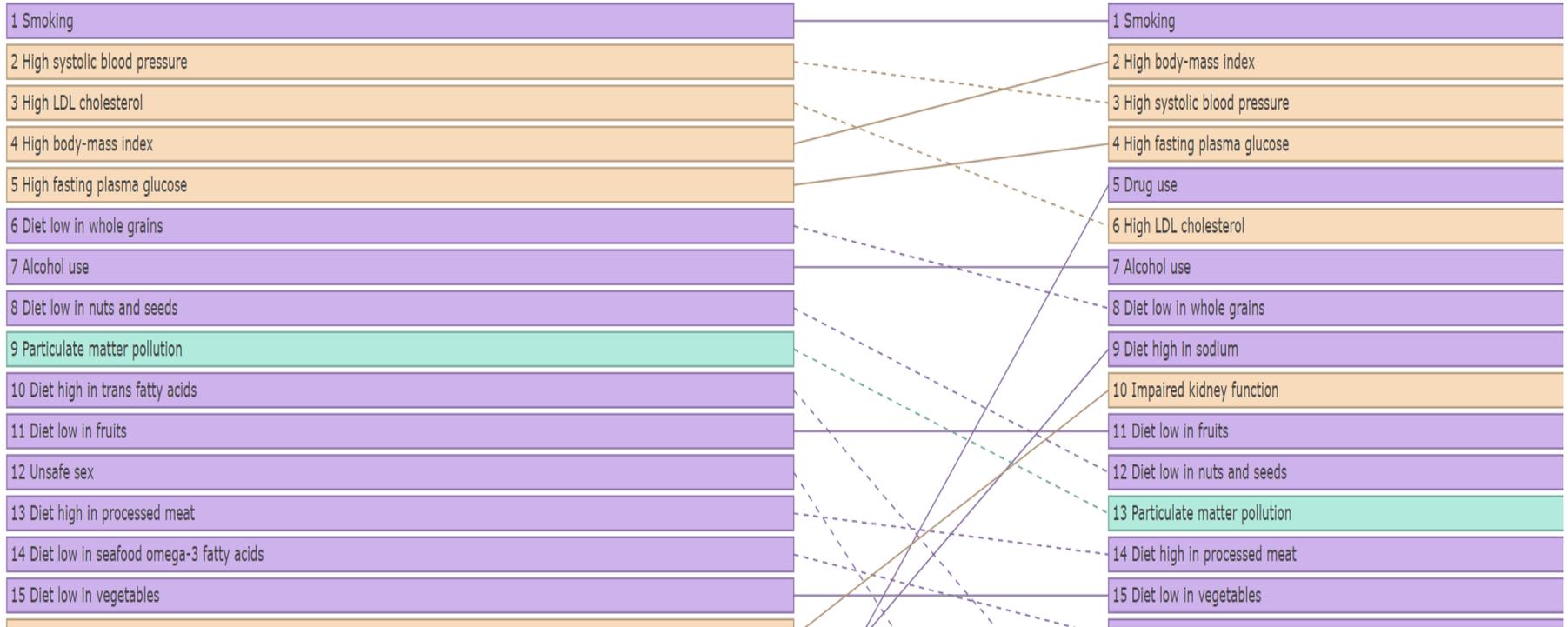
United States
Both sexes, <70 years, Percent of total deaths



United States
Both sexes, <70 years, Percent of total deaths

1990 rank

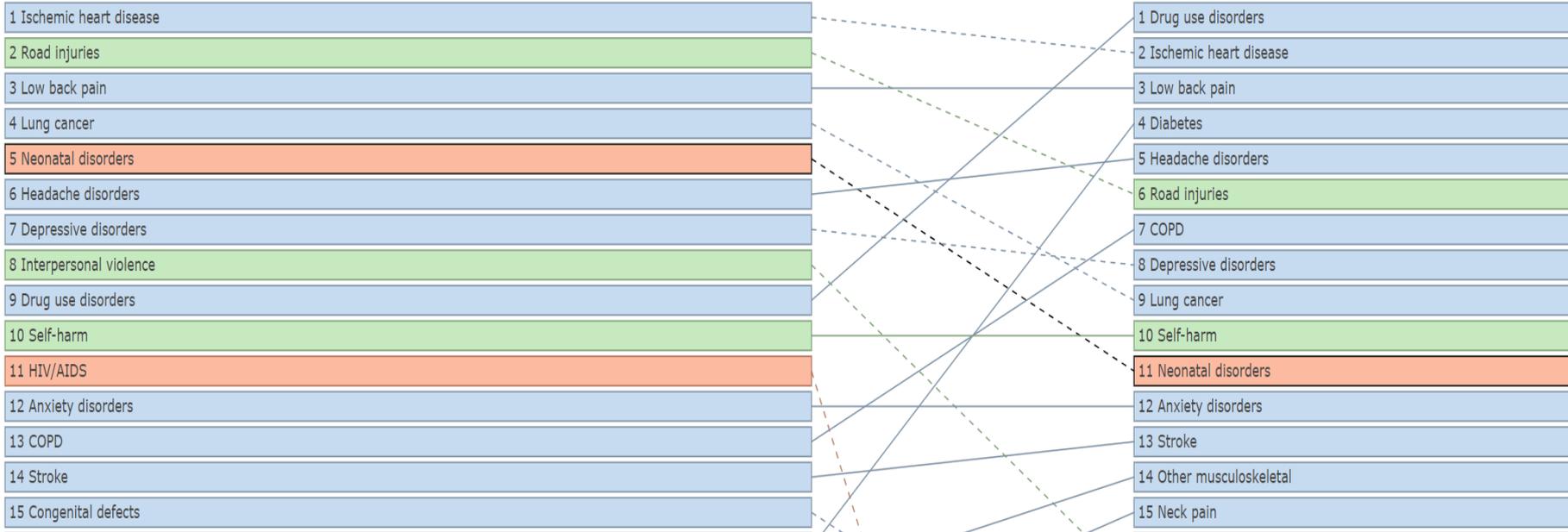
2017 rank



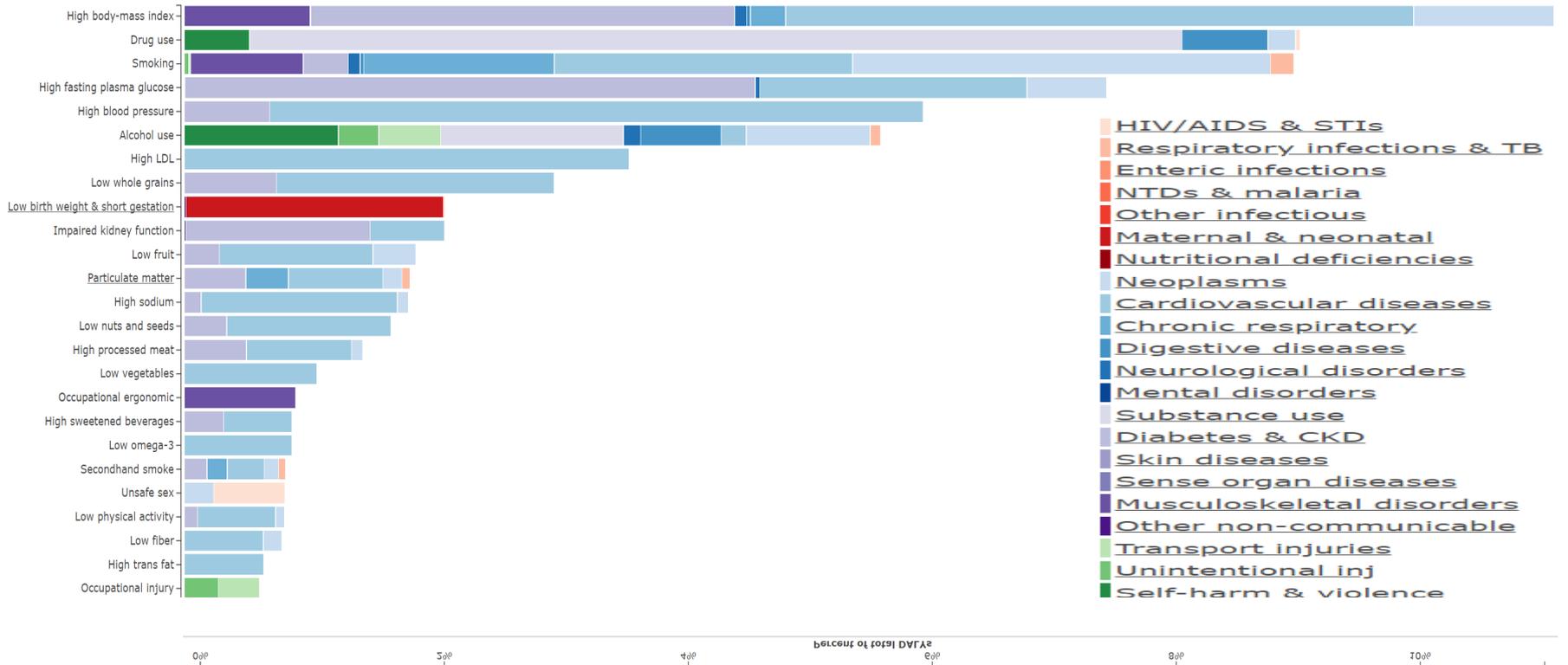
United States
Both sexes, <70 years, Percent of total DALYs

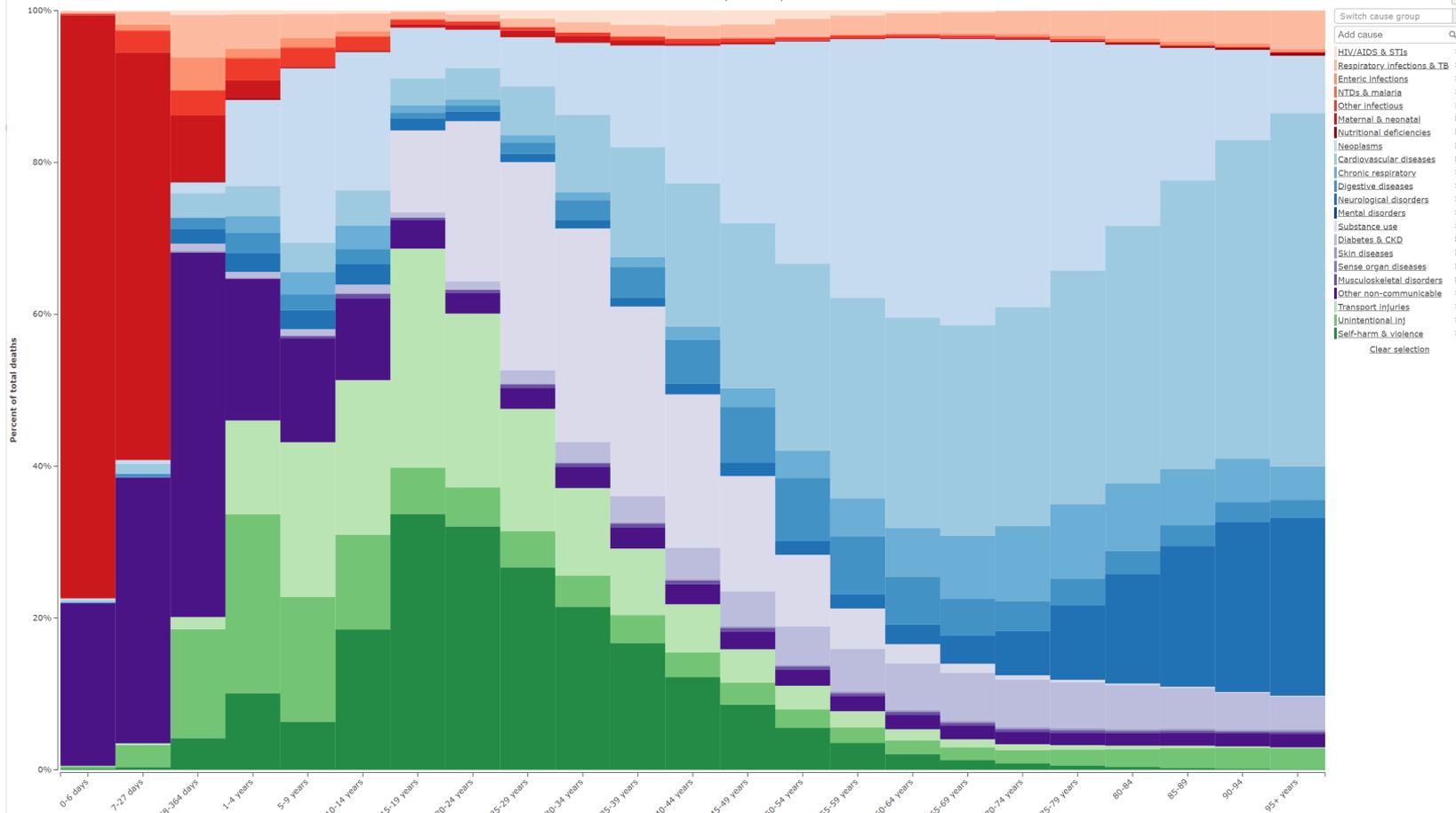
1990 rank

2017 rank

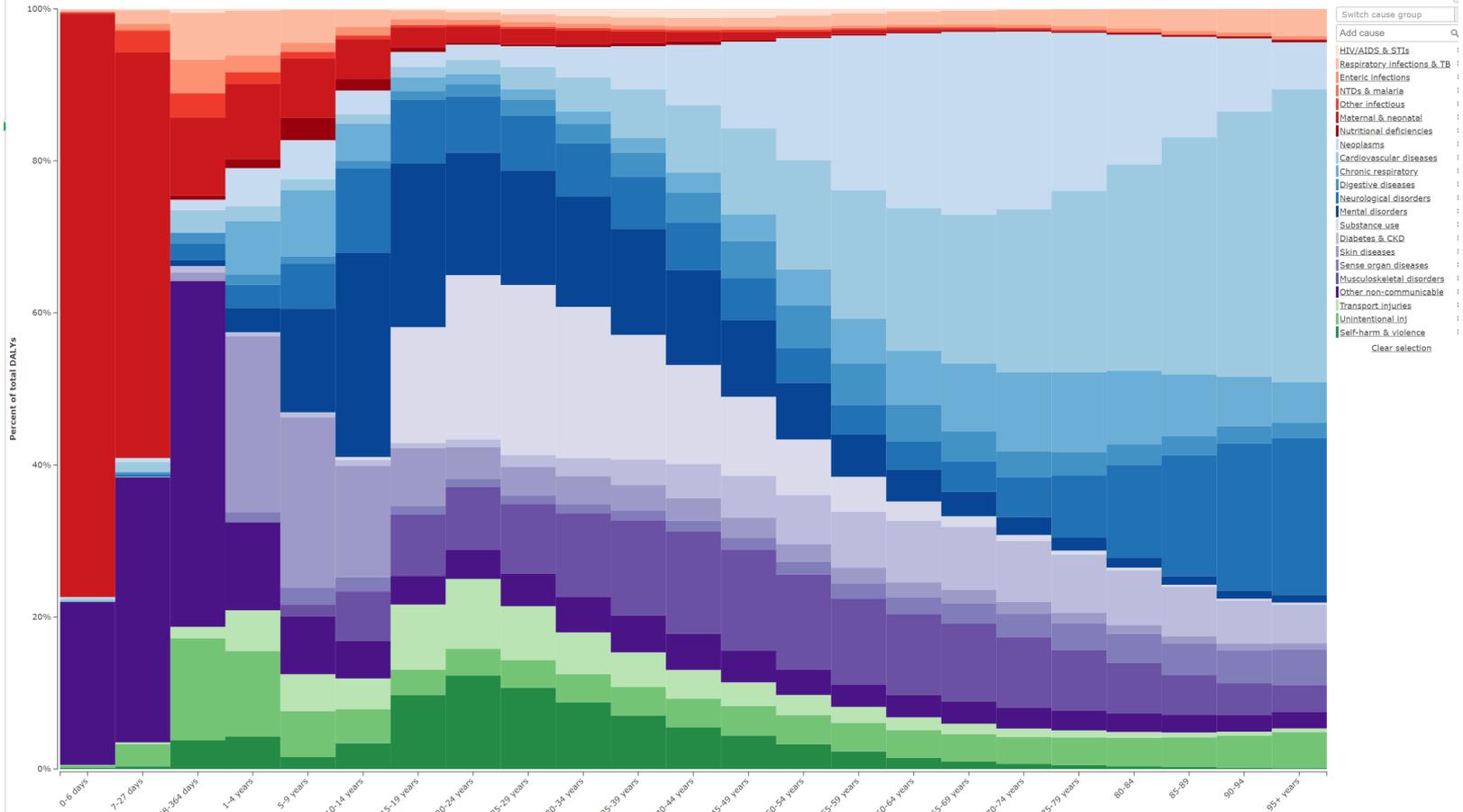


United States, Both sexes, <70 years, 2017

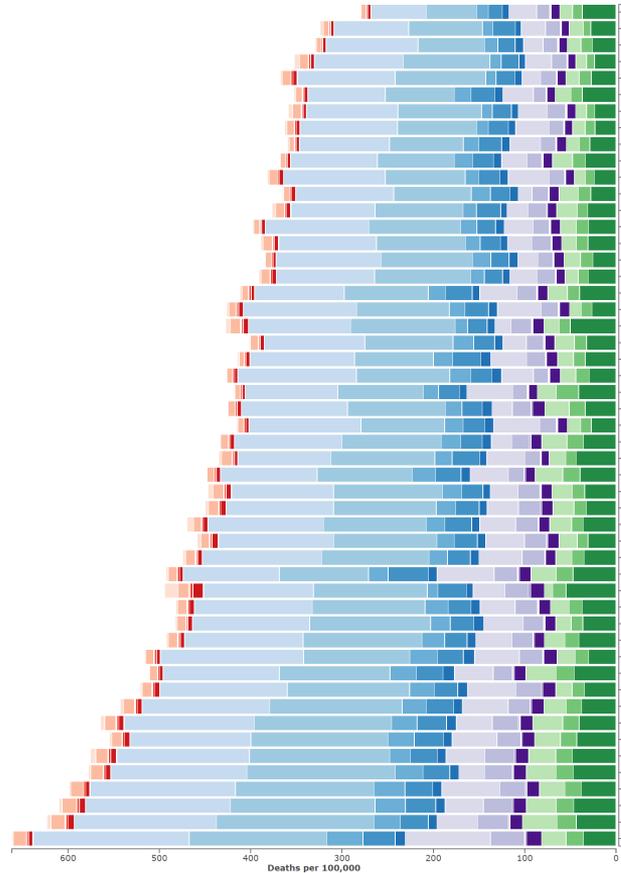




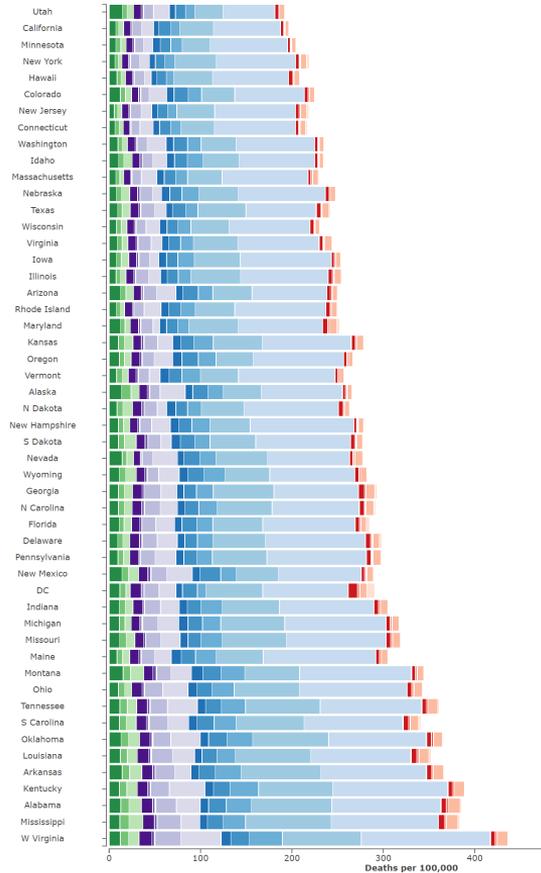
- Switch cause group
- Add cause
- HIV/AIDS & STIs
- Respiratory infections & TB
- Enteric infections
- IntDs & malaria
- Other infectious
- Maternal & neonatal
- Nutritional deficiencies
- Neoplasms
- Cardiovascular diseases
- Chronic respiratory
- Digestive diseases
- Neurological disorders
- Mental disorders
- Substance use
- Diabetes & CKD
- Skin diseases
- Sense organ diseases
- Musculoskeletal disorders
- Other non-communicable
- Transport injuries
- Unintentional Inj
- Self-harm & violence
- Clear selection



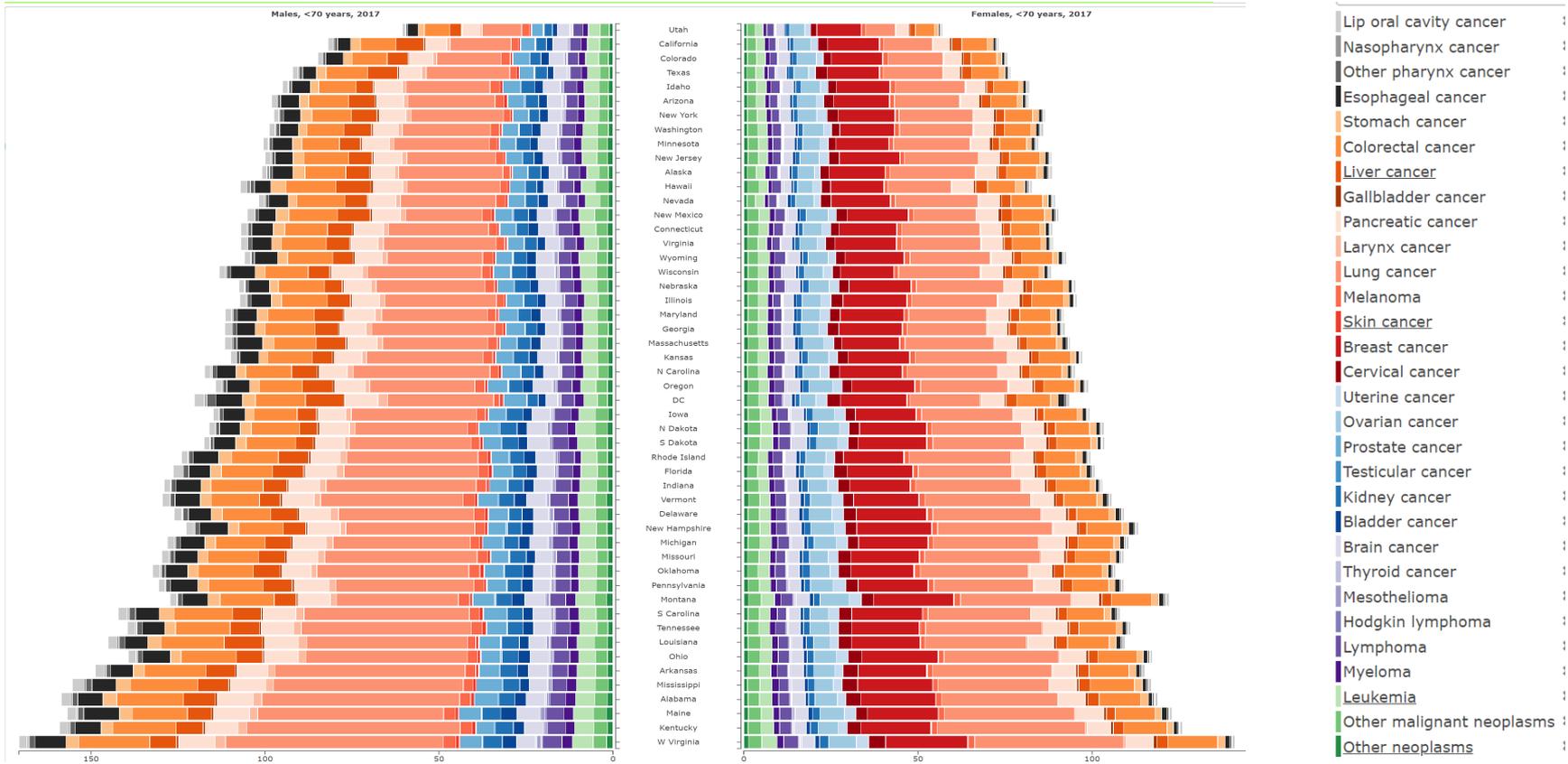
Males, <70 years, 2017



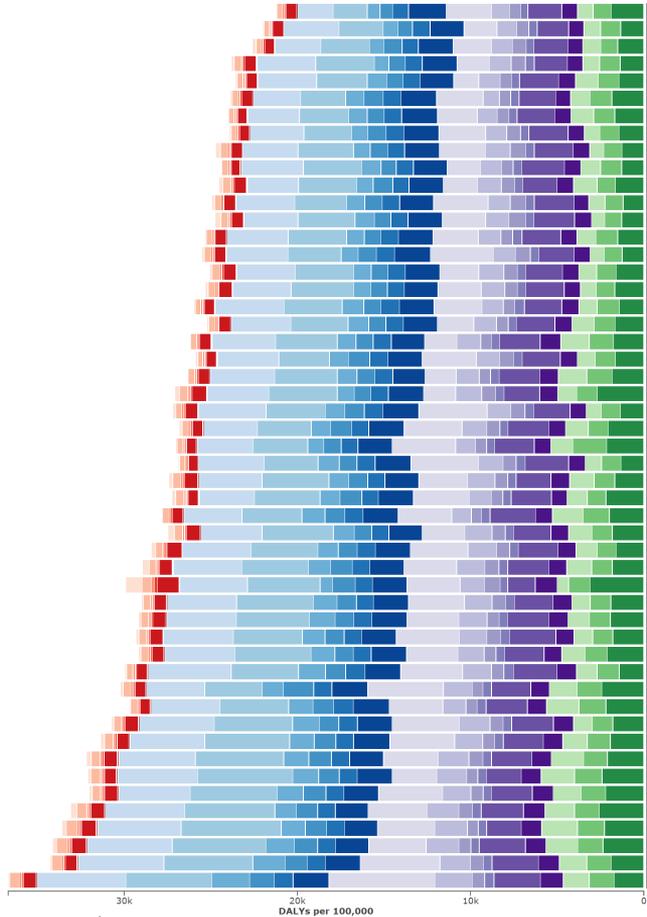
Females, <70 years, 2017



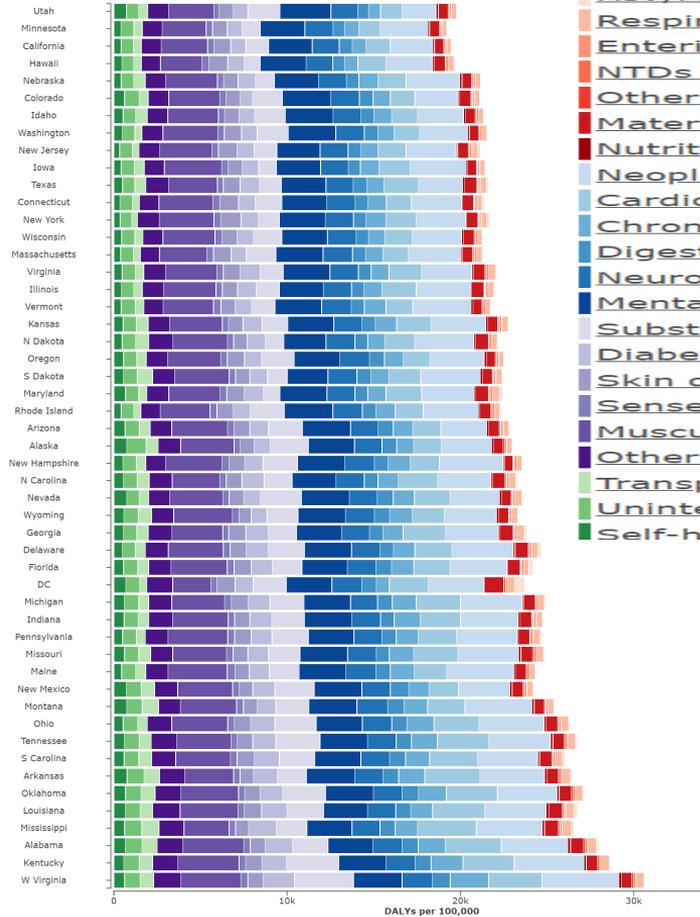
- HIV/AIDS & STIs
- Respiratory infections & TB
- Enteric infections
- NTDs & malaria
- Other infectious
- Maternal & neonatal
- Nutritional deficiencies
- Neoplasms
- Cardiovascular diseases
- Chronic respiratory
- Digestive diseases
- Neurological disorders
- Mental disorders
- Substance use
- Diabetes & CKD
- Skin diseases
- Sense organ diseases
- Musculoskeletal disorders
- Other non-communicable
- Transport injuries
- Unintentional inj
- Self-harm & violence



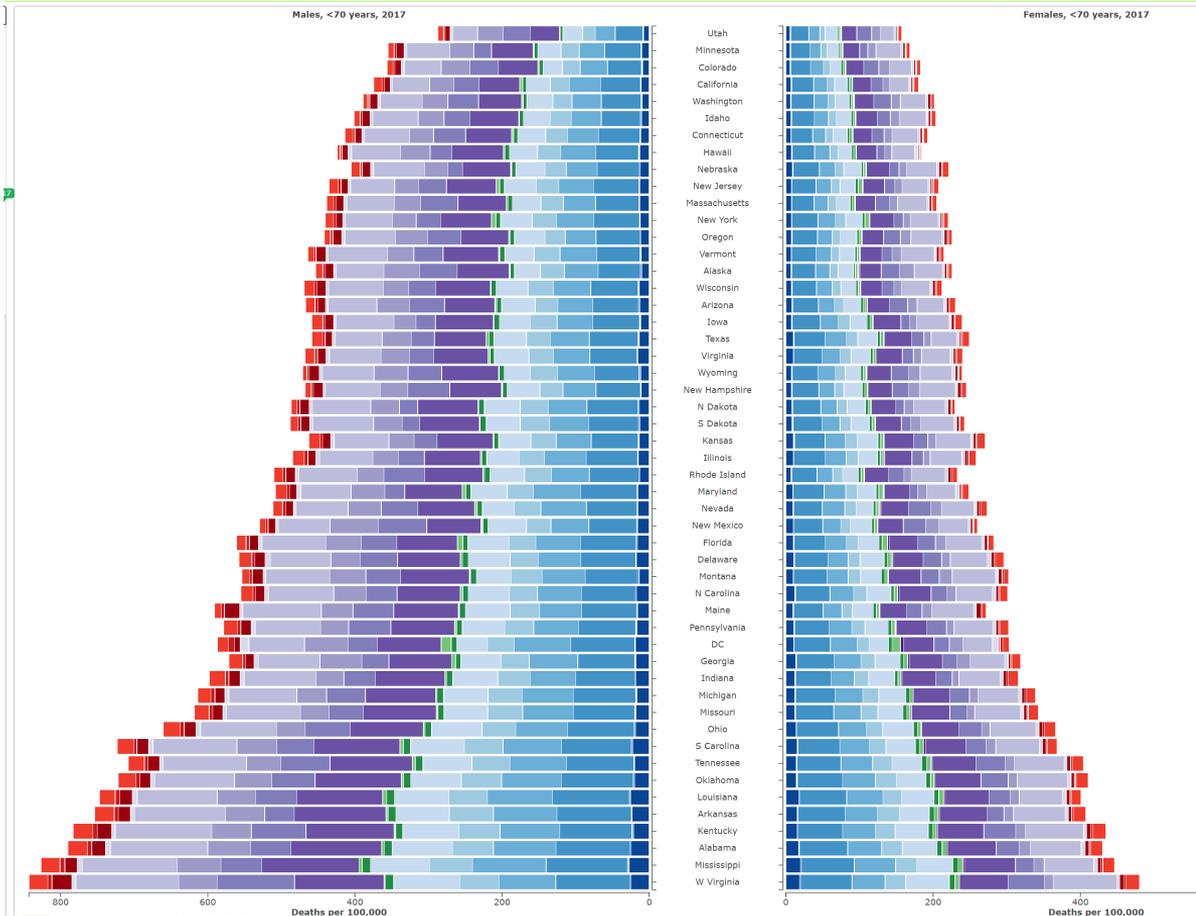
Males, <70 years, 2017



Females, <70 years, 2017

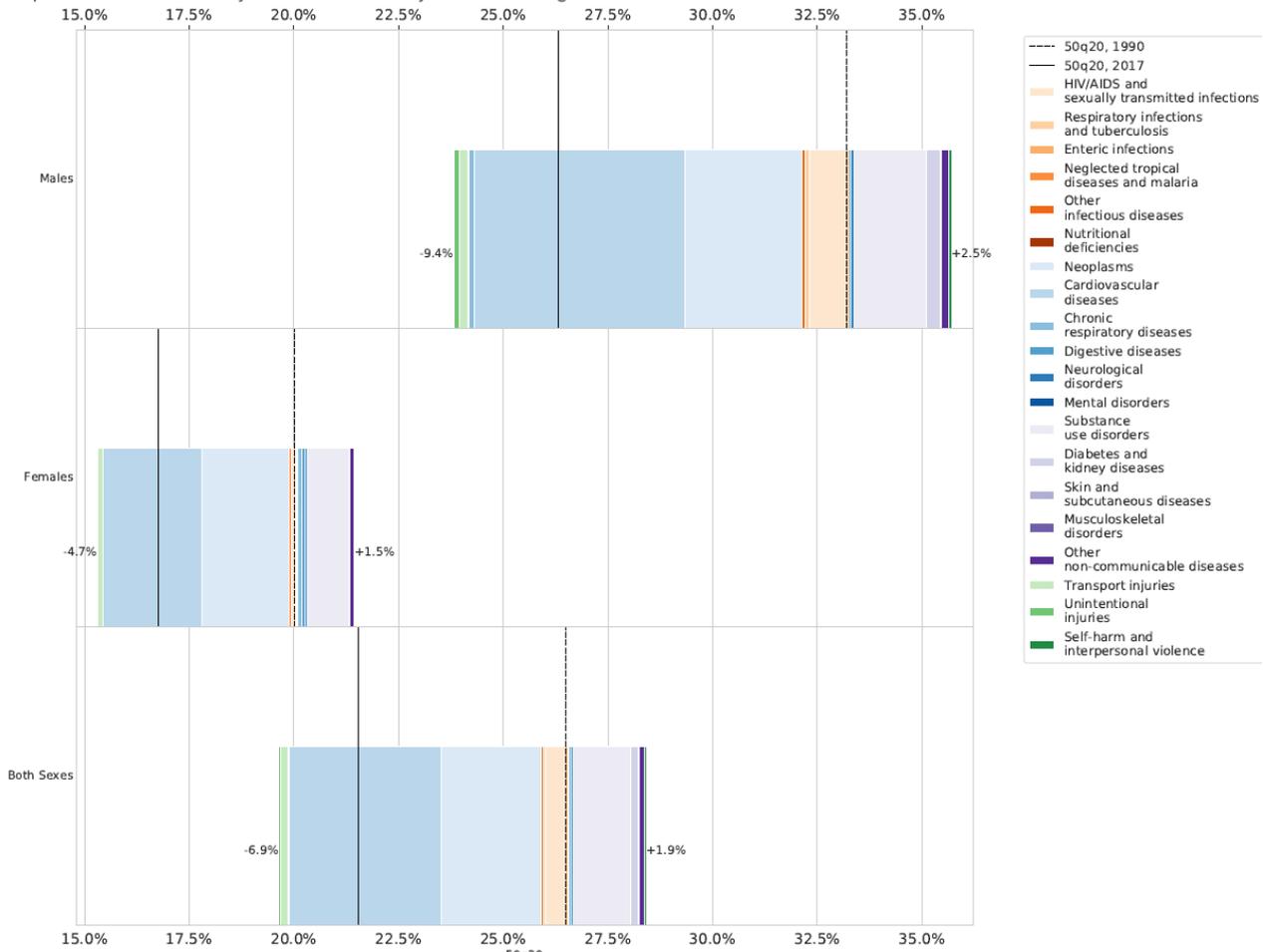


- HIV/AIDS & STIs
- Respiratory infections & TB
- Enteric infections
- NTDs & malaria
- Other infectious
- Maternal & neonatal
- Nutritional deficiencies
- Neoplasms
- Cardiovascular diseases
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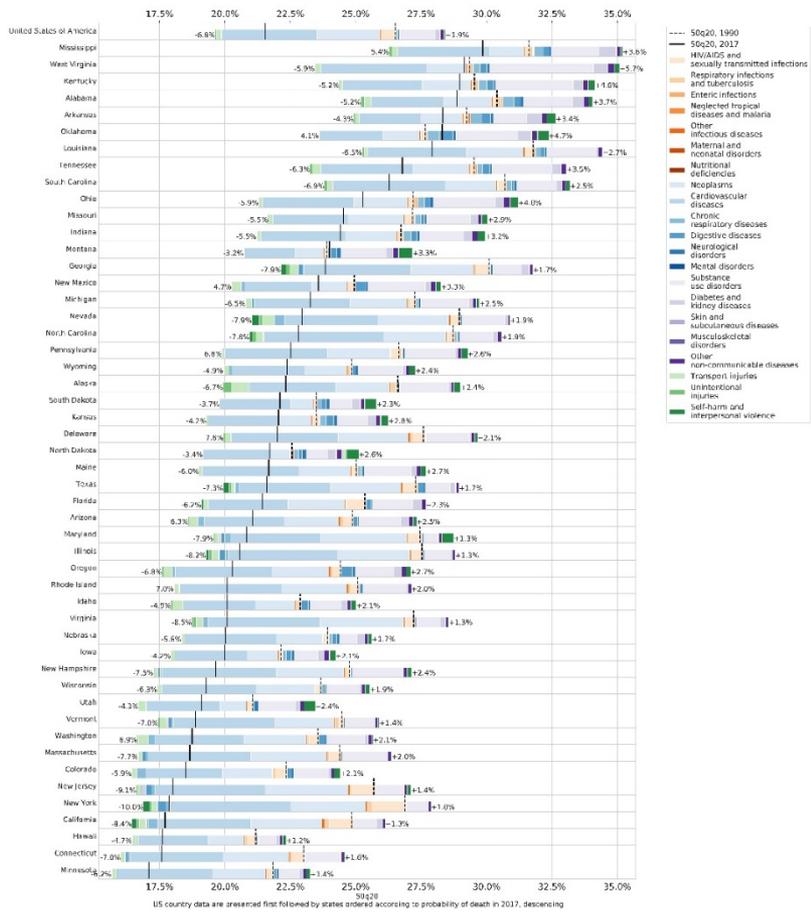
- WaSH)
- Air pollution)
- Other environmental)
- Occupational risks)
- Malnutrition)
- Tobacco)
- Alcohol use)
- Drug use)
- Dietary risks)
- Intimate partner violence)
- Childhood maltreatment)
- Unsafe sex)
- Low physical activity)
- High fasting plasma glucose)
- High LDL)
- High blood pressure)
- High body-mass index)
- Low bone mineral density)
- Impaired kidney function)

Decomposition of the Probability of Death in the US by sex for adults age 20 to 69

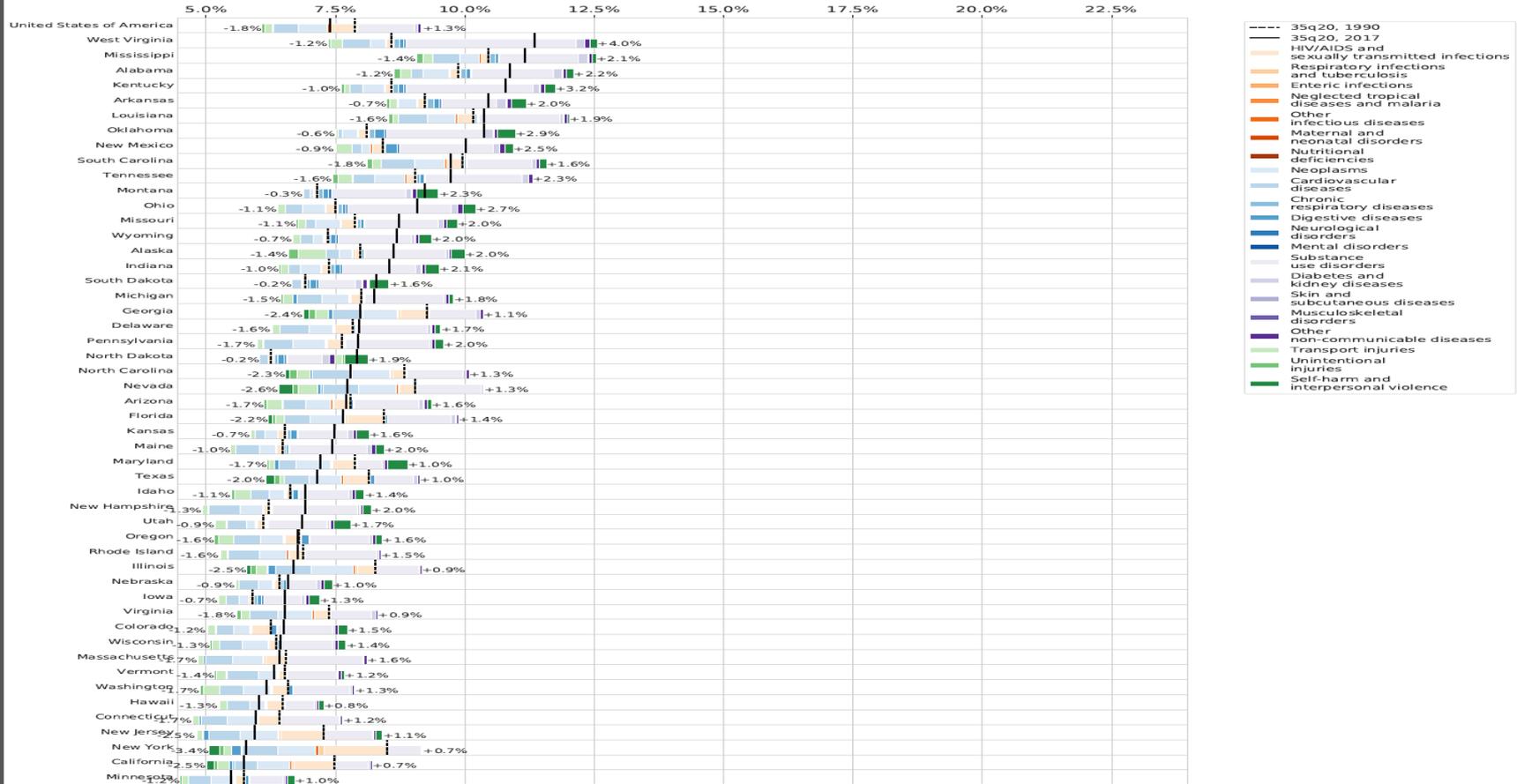


Decomposition of probability of death by state for adults ages 20-69, 2017 both sexes

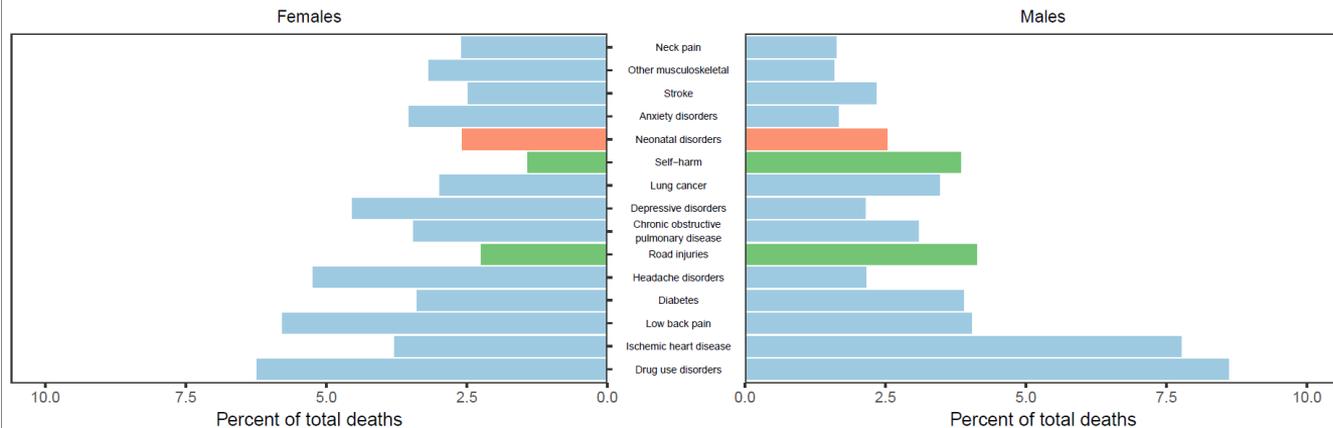
Decomposition of the Probability of Death in the US and 50 states for years 1990 to 2017, both sexes combined



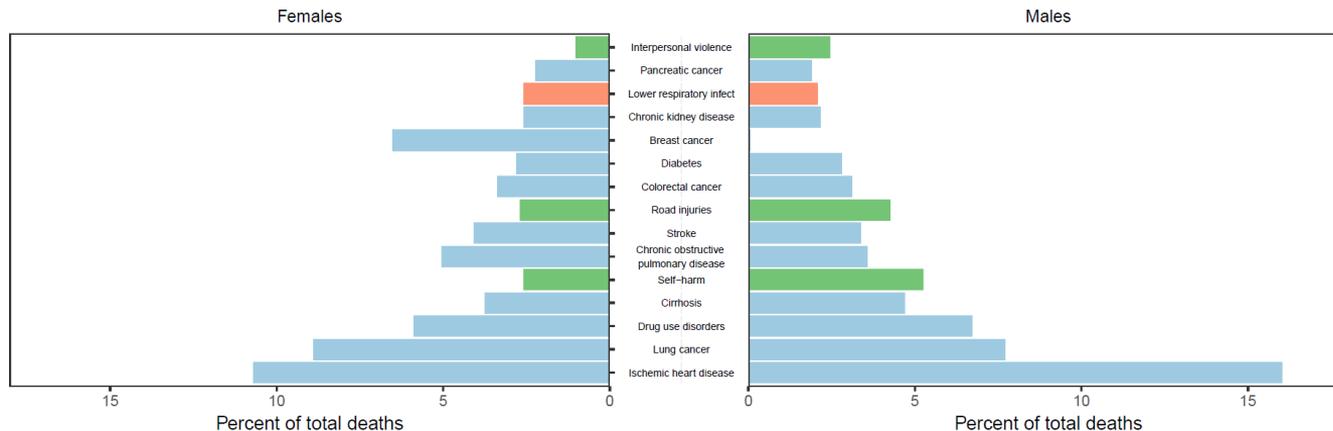
Decomposition of the Probability of Death in the US and 50 states for 20 to 55 years from 1990 to 2017, both sexes combined



What caused the most DALYs by sex for Americans under 70 in 2017



What caused the most deaths by sex for Americans under 70 in 2017



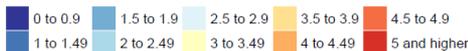
Group I NCD Injuries

Ratio of male to female mortality rates among leading 25 causes of death among Americans under 70, 2017

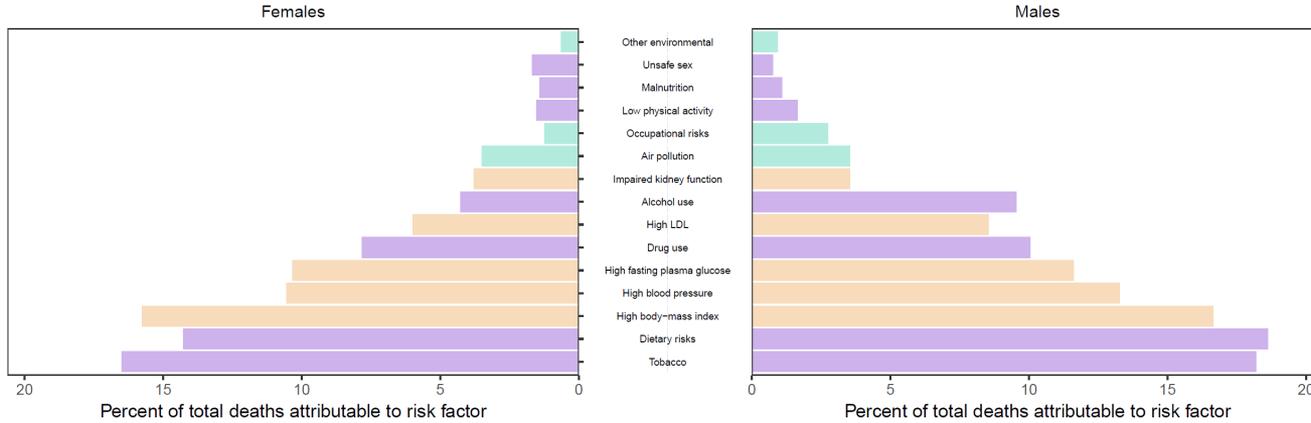
| | Ischemic heart disease | Lung cancer | Drug use disorders | Cirrhosis | Self-harm | COPD | Stroke | Road injuries | Colorectal cancer | Diabetes | Breast cancer | Chronic kidney disease | Lower respiratory infect | Pancreatic cancer | Interpersonal violence | Hypertensive heart disease | Liver cancer | Endometrial/blood/immune | Cardiomyopathy | Alcohol use disorders | Neonatal disorders | Brain cancer | Leukemia | Esophageal cancer | Congenital def |
|----------------------|------------------------|-------------|--------------------|-----------|-----------|------|--------|---------------|-------------------|----------|---------------|------------------------|--------------------------|-------------------|------------------------|----------------------------|--------------|--------------------------|----------------|-----------------------|--------------------|--------------|----------|-------------------|----------------|
| United States | 2.37 | 1.37 | 1.81 | 1.97 | 3.22 | 1.12 | 1.31 | 2.5 | 1.46 | 1.58 | 0.01 | 1.33 | 1.28 | 1.35 | 3.82 | 1.94 | 2.93 | 1.49 | 2.19 | 3.02 | 1.28 | 1.48 | 1.53 | 5.79 | 1.14 |
| Alabama | 2.09 | 1.71 | 1.51 | 1.98 | 3.46 | 1.23 | 1.29 | 2.35 | 1.61 | 1.42 | 0.01 | 1.31 | 1.25 | 1.37 | 3.84 | 1.62 | 2.83 | 1.35 | 1.85 | 2.84 | 1.35 | 1.45 | 1.53 | 6.36 | 1.16 |
| Alaska | 3.22 | 1.23 | 1.93 | 1.48 | 3.33 | 0.95 | 1.28 | 1.78 | 1.36 | 1.6 | 0.01 | 1.16 | 1.09 | 1.14 | 1.99 | 1.98 | 2.8 | 1.4 | 2.14 | 1.6 | 1.09 | 1.53 | 1.38 | 4.91 | 0.94 |
| Arizona | 2.66 | 1.34 | 1.72 | 1.85 | 2.96 | 1.17 | 1.32 | 2.51 | 1.52 | 1.68 | 0.01 | 1.34 | 1.31 | 1.44 | 3.66 | 1.98 | 2.85 | 1.67 | 2.27 | 3.12 | 1.18 | 1.48 | 1.56 | 6.04 | 1.09 |
| Arkansas | 2.18 | 1.6 | 1.4 | 1.88 | 3.23 | 1.07 | 1.2 | 2.37 | 1.54 | 1.45 | 0.01 | 1.38 | 1.21 | 1.36 | 3.25 | 1.92 | 2.64 | 1.39 | 1.83 | 3.99 | 1.46 | 1.45 | 1.57 | 6.15 | 1.15 |
| California | 2.84 | 1.28 | 1.84 | 2.03 | 3.12 | 1.2 | 1.4 | 2.81 | 1.39 | 1.75 | 0.01 | 1.42 | 1.35 | 1.28 | 5.38 | 2.2 | 2.79 | 1.46 | 2.53 | 3.02 | 1.21 | 1.45 | 1.45 | 5.76 | 1.14 |
| Colorado | 2.81 | 1.17 | 1.56 | 1.85 | 3.04 | 1.23 | 1.19 | 2.52 | 1.36 | 1.67 | 0.01 | 1.36 | 1.3 | 1.33 | 2.76 | 1.92 | 2.85 | 1.35 | 2.2 | 2.36 | 1.16 | 1.43 | 1.56 | 6.61 | 1.14 |
| Connecticut | 2.95 | 1.29 | 2.46 | 2.14 | 3.4 | 1.1 | 1.5 | 3.01 | 1.45 | 1.71 | 0.01 | 1.5 | 1.34 | 1.42 | 3.97 | 2.25 | 3.52 | 1.69 | 2.78 | 3.12 | 1.28 | 1.55 | 1.61 | 6.41 | 1.15 |
| Delaware | 2.43 | 1.26 | 1.82 | 2.15 | 3.12 | 1.08 | 1.22 | 2.52 | 1.49 | 1.51 | 0.01 | 1.44 | 1.28 | 1.33 | 3.47 | 1.94 | 3.22 | 1.36 | 2.13 | 2.85 | 1.39 | 1.43 | 1.53 | 5.28 | 1.06 |
| District of Columbia | 2.3 | 1.52 | 1.62 | 2.05 | 2.95 | 1.3 | 1.43 | 1.97 | 1.48 | 1.49 | 0.02 | 1.66 | 1.59 | 1.47 | 5.38 | 2.2 | 3.57 | 1.53 | 2.24 | 3.06 | 1.4 | 1.58 | 1.42 | 4.12 | 1.07 |
| Florida | 2.43 | 1.44 | 1.79 | 2 | 3.03 | 1.18 | 1.36 | 2.87 | 1.52 | 1.75 | 0.01 | 1.45 | 1.39 | 1.44 | 3.79 | 2.11 | 3.19 | 1.65 | 2.29 | 2.73 | 1.31 | 1.52 | 1.58 | 5.34 | 1.15 |
| Georgia | 2.07 | 1.55 | 1.67 | 1.92 | 3.21 | 1.14 | 1.3 | 2.38 | 1.47 | 1.44 | 0.01 | 1.23 | 1.2 | 1.38 | 3.54 | 1.93 | 2.88 | 1.32 | 1.98 | 2.91 | 1.33 | 1.49 | 1.48 | 5.18 | 1.12 |
| Hawaii | 3.06 | 1.47 | 2.66 | 2.26 | 3.32 | 1.42 | 1.48 | 2.81 | 1.8 | 1.61 | 0.01 | 1.47 | 1.56 | 1.39 | 2.05 | 1.84 | 2.89 | 1.55 | 2.66 | 3.2 | 1.25 | 1.57 | 1.57 | 6.04 | 1.19 |
| Idaho | 2.91 | 1.21 | 1.68 | 1.86 | 3.39 | 1.14 | 1.27 | 2.17 | 1.48 | 1.56 | 0.01 | 1.23 | 1.19 | 1.47 | 2.04 | 1.53 | 2.59 | 1.45 | 2.09 | 2.83 | 1.32 | 1.58 | 1.53 | 6.33 | 1.18 |
| Illinois | 2.25 | 1.3 | 2.17 | 1.9 | 3.36 | 1.09 | 1.28 | 2.33 | 1.42 | 1.53 | 0.01 | 1.32 | 1.29 | 1.29 | 5 | 2.07 | 2.53 | 1.47 | 2.16 | 3.19 | 1.25 | 1.45 | 1.46 | 5.4 | 1.13 |
| Indiana | 2.33 | 1.43 | 1.7 | 1.94 | 3.31 | 1.09 | 1.32 | 2.41 | 1.53 | 1.56 | 0.01 | 1.3 | 1.27 | 1.38 | 3.36 | 1.67 | 2.73 | 1.5 | 2.29 | 3.43 | 1.34 | 1.52 | 1.62 | 6.77 | 1.13 |
| Iowa | 2.44 | 1.37 | 1.98 | 1.89 | 3.54 | 1.13 | 1.19 | 2.14 | 1.31 | 1.52 | 0.01 | 1.28 | 1.2 | 1.35 | 1.9 | 1.7 | 2.75 | 1.47 | 2 | 3.33 | 1.11 | 1.47 | 1.5 | 5.89 | 1.13 |
| Kansas | 2.27 | 1.27 | 1.85 | 1.82 | 3.32 | 1.05 | 1.09 | 2.18 | 1.43 | 1.38 | 0.01 | 1.22 | 1.15 | 1.34 | 1.53 | 1.77 | 2.45 | 2 | 3.08 | 3.36 | 1.53 | 1.43 | 1.43 | 6.17 | 1.11 |
| Kentucky | 2.15 | 1.44 | 1.52 | 2 | 3.48 | 1.06 | 1.21 | 2.29 | 1.47 | 1.43 | 0.01 | 1.26 | 1.19 | 1.41 | 2.96 | 1.99 | 2.62 | 1.47 | 2.03 | 3.66 | 1.32 | 1.51 | 1.5 | 6.61 | 1.19 |
| Louisiana | 2.16 | 1.59 | 1.68 | 2.1 | 3.41 | 1.11 | 1.36 | 2.57 | 1.51 | 1.53 | 0.01 | 1.29 | 1.24 | 1.33 | 4.62 | 1.77 | 3.36 | 1.37 | 1.88 | 2.96 | 1.27 | 1.47 | 1.5 | 5.64 | 1.14 |
| Maine | 2.95 | 1.42 | 2.55 | 2.13 | 3.76 | 1.31 | 1.4 | 2.27 | 1.4 | 2.08 | 0.01 | 1.37 | 1.32 | 1.31 | 1.62 | 1.78 | 2.78 | 1.89 | 2.48 | 3.56 | 1.15 | 1.71 | 1.71 | 6.72 | 1.15 |
| Maryland | 2.42 | 1.36 | 2.35 | 2.06 | 3.33 | 1.1 | 1.43 | 2.84 | 1.5 | 1.81 | 0.02 | 1.53 | 1.43 | 1.47 | 5.75 | 2.79 | 3.14 | 1.7 | 2.2 | 3.08 | 1.19 | 1.59 | 1.59 | 5.51 | 1.16 |
| Massachusetts | 2.85 | 1.18 | 2.52 | 2.2 | 3.08 | 1.07 | 1.41 | 2.64 | 1.46 | 1.94 | 0.01 | 1.47 | 1.41 | 1.36 | 3.85 | 2.22 | 3.61 | 1.72 | 2.6 | 3.31 | 1.37 | 1.52 | 1.55 | 6.28 | 1.23 |
| Michigan | 2.22 | 1.3 | 1.78 | 1.88 | 2.98 | 1.06 | 1.18 | 2.31 | 1.39 | 1.46 | 0.01 | 1.22 | 1.25 | 1.31 | 3.86 | 1.94 | 2.63 | 1.48 | 2.05 | 2.93 | 1.28 | 1.48 | 1.54 | 5.51 | 1.14 |
| Minnesota | 3.26 | 1.25 | 1.91 | 1.79 | 3.6 | 1.13 | 1.49 | 2.36 | 1.39 | 1.88 | 0.01 | 1.42 | 1.25 | 1.46 | 2.87 | 1.63 | 2.97 | 1.51 | 2.54 | 2.88 | 1.42 | 1.6 | 1.71 | 5.93 | 2.1 |
| Mississippi | 2.12 | 1.71 | 2.04 | 2.02 | 3.51 | 1.22 | 1.41 | 2.33 | 1.53 | 1.35 | 0.01 | 1.23 | 1.23 | 1.33 | 3.96 | 1.68 | 2.73 | 1.26 | 1.79 | 3.68 | 1.33 | 1.37 | 1.54 | 6.25 | 1.14 |
| Missouri | 2.19 | 1.32 | 1.71 | 2.08 | 3.3 | 1.05 | 1.23 | 2.3 | 1.45 | 1.5 | 0.01 | 1.32 | 1.22 | 1.39 | 3.97 | 1.8 | 3 | 1.37 | 1.78 | 3.4 | 1.24 | 1.47 | 1.53 | 5.94 | 1.16 |
| Montana | 2.64 | 1.1 | 1.71 | 1.66 | 3.09 | 1.1 | 1.15 | 2.12 | 1.35 | 1.43 | 0.01 | 1.22 | 1.15 | 1.25 | 2.07 | 1.48 | 2.33 | 1.62 | 1.94 | 2.64 | 1.22 | 1.48 | 1.46 | 5.06 | 1.24 |
| Nebraska | 2.58 | 1.26 | 1.19 | 1.9 | 3.69 | 1.13 | 1.27 | 2.26 | 1.5 | 1.49 | 0.01 | 1.16 | 1.16 | 1.45 | 2.97 | 1.42 | 2.65 | 1.48 | 1.93 | 2.89 | 1.48 | 1.42 | 1.45 | 6.42 | 1.15 |
| Nevada | 2.51 | 1.16 | 1.85 | 2.89 | 1.07 | 1.16 | 2.44 | 1.6 | 1.54 | 1.54 | 0.01 | 1.45 | 1.35 | 1.31 | 3.36 | 1.99 | 2.44 | 1.36 | 2.23 | 2.47 | 1.18 | 1.61 | 1.62 | 5.82 | 1.13 |
| New Hampshire | 2.63 | 1.13 | 2.44 | 1.94 | 2.84 | 0.99 | 1.19 | 2.03 | 1.25 | 1.57 | 0.01 | 1.18 | 1.14 | 1.41 | 1.47 | 2.16 | 3 | 1.61 | 2.37 | 2.63 | 1.39 | 1.6 | 1.54 | 6.43 | 1.13 |
| New Jersey | 2.65 | 1.2 | 2.7 | 2.16 | 3.66 | 1.13 | 1.52 | 2.7 | 1.5 | 1.85 | 0.01 | 1.61 | 1.45 | 1.36 | 5.1 | 2.19 | 3.08 | 1.62 | 2.69 | 3.08 | 1.3 | 1.54 | 1.61 | 5.46 | 1.12 |
| New Mexico | 2.65 | 1.22 | 1.87 | 2.12 | 3.12 | 1.24 | 1.29 | 2.41 | 1.5 | 1.61 | 0.01 | 1.32 | 1.37 | 1.36 | 3.77 | 2.02 | 3.1 | 1.59 | 2.3 | 3.5 | 1.31 | 1.62 | 1.47 | 6.15 | 1.2 |
| New York | 2.42 | 1.25 | 2.53 | 2.16 | 3.42 | 1.12 | 1.37 | 2.66 | 1.41 | 1.74 | 0.01 | 1.51 | 1.47 | 1.36 | 4.17 | 1.88 | 3.06 | 1.46 | 2.72 | 3.46 | 1.31 | 1.44 | 1.5 | 5.33 | 1.14 |
| North Carolina | 2.26 | 1.52 | 1.67 | 1.96 | 2.91 | 1.04 | 1.29 | 2.25 | 1.43 | 1.51 | 0.01 | 1.25 | 1.22 | 1.37 | 3.59 | 1.92 | 3.04 | 1.39 | 2.1 | 2.93 | 1.3 | 1.44 | 1.57 | 5.83 | 1.2 |
| North Dakota | 3.05 | 1.26 | 1.88 | 1.95 | 4.44 | 1.2 | 1.43 | 2.35 | 1.43 | 1.63 | 0.01 | 1.26 | 1.37 | 1.42 | 4.81 | 1.54 | 2.17 | 1.68 | 2.08 | 2.73 | 1.19 | 1.37 | 1.64 | 5.67 | 1.17 |
| Ohio | 2.22 | 1.41 | 1.56 | 1.87 | 3.26 | 1.1 | 1.21 | 2.25 | 1.41 | 1.52 | 0.01 | 1.23 | 1.15 | 1.31 | 3.63 | 1.99 | 2.96 | 1.72 | 2.02 | 3.01 | 1.41 | 1.58 | 1.45 | 6.06 | 1.11 |
| Oklahoma | 2.05 | 1.41 | 1.35 | 1.8 | 3.26 | 1.03 | 1.15 | 2.26 | 1.45 | 1.42 | 0.01 | 1.25 | 1.11 | 1.32 | 3.12 | 2 | 2.71 | 1.47 | 1.89 | 3.23 | 1.3 | 1.56 | 1.55 | 6.61 | 1.23 |
| Oregon | 2.8 | 1.21 | 1.66 | 1.93 | 3.05 | 1.07 | 1.4 | 2.3 | 1.4 | 1.73 | 0.01 | 1.31 | 1.17 | 1.32 | 2.29 | 1.53 | 3.24 | 1.6 | 2.58 | 3.14 | 1.41 | 1.55 | 1.59 | 5.87 | 1.08 |
| Pennsylvania | 2.33 | 1.39 | 2.01 | 1.98 | 3.39 | 1.19 | 1.3 | 2.52 | 1.47 | 1.58 | 0.01 | 1.39 | 1.27 | 1.39 | 4.29 | 2.01 | 3.08 | 1.64 | 2.22 | 3.11 | 1.23 | 1.47 | 1.53 | 5.94 | 1.13 |
| Rhode Island | 2.8 | 1.29 | 2.5 | 2.27 | 3.42 | 1.03 | 1.46 | 2.89 | 1.47 | 1.8 | 0.01 | 1.56 | 1.44 | 1.43 | 3.11 | 2.46 | 3.55 | 1.69 | 3.09 | 3.54 | 1.27 | 1.6 | 1.69 | 5.92 | 1.19 |
| South Carolina | 2.45 | 1.61 | 1.56 | 1.97 | 3.38 | 1.2 | 1.42 | 2.96 | 1.58 | 1.53 | 0.01 | 1.33 | 1.32 | 1.37 | 3.81 | 1.61 | 3.23 | 1.47 | 1.96 | 3.22 | 1.33 | 1.53 | 1.62 | 5.36 | 1.22 |
| South Dakota | 2.82 | 1.33 | 1.65 | 1.6 | 3.78 | 1.3 | 1.24 | 2.07 | 1.44 | 1.5 | 0.01 | 1.22 | 1.23 | 1.3 | 2.13 | 1.33 | 2.34 | 1.49 | 2.12 | 2.61 | 1.44 | 1.49 | 1.46 | 6.02 | 1.11 |
| Tennessee | 2.07 | 1.46 | 1.42 | 2 | 3.04 | 0.99 | 1.2 | 2.33 | 1.46 | 1.34 | 0.01 | 1.23 | 1.17 | 1.37 | 3.41 | 1.75 | 3.13 | 1.38 | 1.74 | 3.26 | 1.34 | 1.46 | 1.57 | 6.49 | 1.16 |
| Texas | 2.18 | 1.41 | 1.64 | 2.02 | 3.19 | 1.08 | 1.26 | 2.54 | 1.51 | 1.43 | 0.01 | 1.22 | 1.27 | 1.34 | 3.38 | 1.8 | 3.04 | 1.34 | 1.97 | 2.94 | 1.27 | 1.4 | 1.48 | 5.53 | 1.07 |
| Utah | 2.47 | 1.34 | 1.62 | 1.56 | 2.6 | 1.29 | 1.11 | 1.84 | 1.35 | 1.4 | 0.01 | 1.23 | 1.07 | 1.35 | 1.88 | 1.54 | 2.19 | 1.38 | 2.14 | 2.68 | 1.34 | 1.49 | 1.48 | 6.89 | 1.21 |
| Vermont | 3.4 | 1.35 | 2.89 | 1.92 | 3.86 | 1.11 | 1.28 | 2.54 | 1.46 | 1.5 | 0.01 | 1.21 | 1.25 | 1.46 | 1.88 | 1.83 | 2.77 | 1.63 | 2.57 | 3.27 | 1.39 | 1.65 | 1.68 | 5.36 | 1.27 |
| Virginia | 2.4 | 1.43 | 1.99 | 1.99 | 3.38 | 1.12 | 1.4 | 2.63 | 1.55 | 1.63 | 0.01 | 1.38 | 1.3 | 1.29 | 3.32 | 1.96 | 3 | 1.38 | 2.07 | 3.62 | 1.3 | 1.52 | 1.6 | 5.88 | 1.1 |
| Washington | 2.77 | 1.2 | 1.52 | 1.8 | 2.97 | 1.2 | 1.28 | 2.43 | 1.39 | 1.71 | 0.01 | 1.29 | 1.15 | 1.31 | 2.7 | 1.91 | 3 | 1.48 | 2.48 | 2.33 | 1.15 | 1.52 | 1.53 | 3.38 | 1.13 |
| West Virginia | 2.03 | 1.46 | 2.03 | 2.01 | 3.13 | 1.06 | 1.18 | 2.15 | 1.43 | 1.41 | 0.01 | 1.19 | 1.18 | 1.34 | 2.12 | 1.52 | 2.38 | 1.51 | 2.02 | 4.09 | 1.34 | 1.43 | 1.36 | 6.63 | 1.07 |
| Wisconsin | 3.13 | 1.4 | 2.01 | 2.01 | 3.64 | 1.22 | 1.47 | 2.7 | 1.62 | 1.86 | 0.01 | 1.38 | 1.32 | 1.44 | 3.58 | 1.92 | 2.91 | 1.64 | 2.27 | 2.85 | 1.17 | 1.56 | 1.67 | 6.86 | 1.24 |
| Wyoming | 2.91 | 1.19 | 1.69 | 1.74 | 3.87 | 1.06 | 1.1 | 2.43 | 1.47 | 1.5 | 0.01 | 1.33 | | | | | | | | | | | | | |

Observed:Expected ratio of DALYs for level 2 risk factors among Americans under 70, 2017

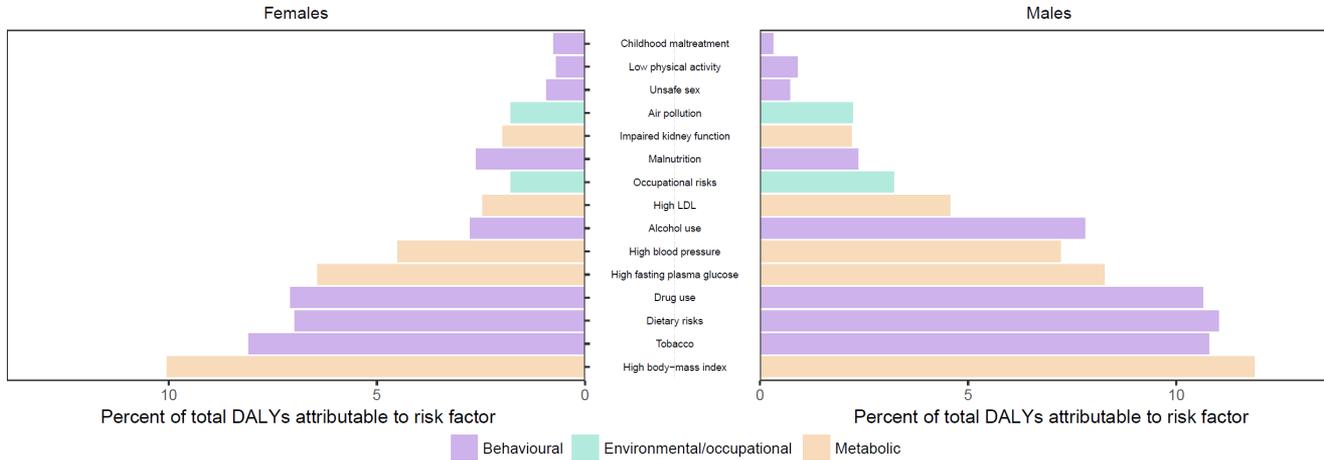
| | High body-mass index | Tobacco | Drug use | Dietary risks | High fasting plasma glucose | High systolic blood pressure | Alcohol use | High LDL cholesterol | Occupational risks | Child and maternal malnutrition | Impaired kidney function | Air pollution | Low physical activity | Unsafe sex | Childhood maltreatment | Low bone mineral density | Intimate partner violence | Other environmental risk | Unsafe wr: |
|--------------------------|----------------------|---------|----------|---------------|-----------------------------|------------------------------|-------------|----------------------|--------------------|---------------------------------|--------------------------|---------------|-----------------------|------------|------------------------|--------------------------|---------------------------|--------------------------|------------|
| United States of America | 1.48 | 0.76 | 4.57 | 0.98 | 1.45 | 0.78 | 0.74 | 0.77 | 0.91 | 1.29 | 1.58 | 0.77 | 0.84 | 1.74 | 1.82 | 0.99 | 2.06 | 0.85 | 2.05 |
| Alabama | 1.86 | 1.16 | 5.72 | 1.35 | 1.92 | 1.04 | 0.96 | 1.11 | 1.15 | 1.49 | 2.02 | 1.16 | 1.16 | 1.85 | 2.73 | 1.15 | 2.18 | 0.98 | 1.79 |
| Alaska | 1.27 | 0.69 | 5.5 | 0.89 | 1.17 | 0.64 | 1.05 | 0.68 | 0.93 | 1 | 1.19 | 0.88 | 0.67 | 0.94 | 2.32 | 1.25 | 2.55 | 0.86 | 1.82 |
| Arizona | 1.28 | 0.68 | 5.36 | 0.8 | 1.25 | 0.61 | 0.85 | 0.61 | 0.92 | 1.04 | 1.29 | 0.61 | 0.7 | 1.25 | 2.19 | 1.14 | 2.44 | 0.71 | 1.62 |
| Arkansas | 1.75 | 1.12 | 4.71 | 1.32 | 1.53 | 1.02 | 0.94 | 1.15 | 1.07 | 1.12 | 1.84 | 1.11 | 1.14 | 1.41 | 1.95 | 1.25 | 2.68 | 0.99 | 1.14 |
| California | 1.26 | 0.54 | 3.56 | 0.75 | 1.13 | 0.63 | 0.66 | 0.58 | 0.81 | 1.1 | 1.34 | 0.66 | 0.68 | 1.59 | 1.72 | 0.98 | 1.45 | 0.76 | 1.82 |
| Colorado | 1.04 | 0.53 | 4.29 | 0.69 | 0.89 | 0.56 | 0.81 | 0.53 | 0.79 | 1.32 | 1.13 | 0.4 | 0.57 | 1.14 | 2.15 | 1.13 | 1.91 | 0.67 | 2.08 |
| Connecticut | 1.3 | 0.61 | 4.75 | 0.84 | 1.32 | 0.63 | 0.59 | 0.64 | 0.8 | 1.47 | 1.43 | 0.6 | 0.7 | 1.73 | 1.63 | 0.84 | 1.68 | 0.66 | 3.19 |
| Delaware | 1.55 | 0.79 | 5.66 | 1.04 | 1.65 | 0.77 | 0.69 | 0.79 | 0.92 | 1.8 | 1.76 | 0.88 | 0.89 | 1.89 | 1.88 | 0.9 | 2.79 | 0.85 | 2.62 |
| District of Columbia | 1.9 | 0.79 | 4.01 | 1.28 | 1.53 | 1.33 | 1 | 0.97 | 0.67 | 2.5 | 2.5 | 0.9 | 1.11 | 1.96 | 1.62 | 0.91 | 3.3 | 2.09 | 3.75 |
| Florida | 1.47 | 0.79 | 4.82 | 0.95 | 1.46 | 0.78 | 0.79 | 0.72 | 0.93 | 1.37 | 1.37 | 0.61 | 0.79 | 3.07 | 1.84 | 1.06 | 2.32 | 0.83 | 1.97 |
| Georgia | 1.66 | 0.84 | 4.2 | 1.09 | 1.65 | 0.94 | 1 | 0.85 | 0.9 | 1.38 | 1.89 | 0.97 | 0.88 | 2.36 | 1.84 | 1.02 | 2.69 | 0.89 | 1.83 |
| Hawaii | 1.19 | 0.6 | 2.89 | 0.81 | 1.13 | 0.63 | 0.7 | 0.62 | 0.71 | 1.34 | 1.41 | 0.15 | 0.64 | 1.23 | 2.56 | 0.86 | 1.51 | 0.57 | 1.85 |
| Idaho | 1.13 | 0.65 | 4.39 | 0.78 | 1.05 | 0.54 | 0.73 | 0.57 | 0.9 | 0.92 | 1.05 | 0.39 | 0.62 | 0.72 | 2.1 | 1.1 | 1.67 | 0.64 | 1.41 |
| Illinois | 1.53 | 0.73 | 3.85 | 1.01 | 1.43 | 0.84 | 0.65 | 0.8 | 0.89 | 1.46 | 1.71 | 0.87 | 0.82 | 1.39 | 1.65 | 0.87 | 2.3 | 1.06 | 2.44 |
| Indiana | 1.62 | 0.96 | 4.99 | 1.11 | 1.65 | 0.81 | 0.69 | 0.9 | 1.09 | 1.34 | 1.69 | 1.08 | 0.91 | 1.24 | 1.54 | 0.97 | 2.35 | 0.92 | 1.94 |
| Iowa | 1.34 | 0.77 | 2.94 | 0.96 | 1.25 | 0.66 | 0.6 | 0.77 | 1 | 1.02 | 1.45 | 0.75 | 0.83 | 0.52 | 1.65 | 1.06 | 1.34 | 0.69 | 1.9 |
| Kansas | 1.44 | 0.79 | 3.71 | 1 | 1.4 | 0.72 | 0.7 | 0.78 | 0.96 | 1.17 | 1.54 | 0.79 | 0.81 | 1.15 | 1.9 | 1.02 | 1.83 | 0.74 | 1.98 |
| Kentucky | 1.76 | 1.22 | 8.09 | 1.28 | 1.75 | 0.96 | 0.88 | 1.06 | 1.23 | 1.15 | 1.74 | 1.18 | 1.05 | 1.12 | 2 | 1.1 | 2.37 | 1.04 | 1.38 |
| Louisiana | 1.9 | 1.01 | 5.97 | 1.31 | 1.82 | 1.13 | 0.89 | 1.06 | 1.05 | 1.38 | 2.17 | 0.97 | 1.14 | 2.46 | 1.64 | 0.99 | 2.62 | 1.13 | 1.35 |
| Maine | 1.29 | 0.82 | 5.31 | 0.86 | 1.39 | 0.62 | 0.67 | 0.67 | 1.04 | 1.4 | 1.29 | 0.36 | 0.74 | 1.05 | 1.92 | 0.96 | 1.81 | 0.74 | 2.42 |
| Maryland | 1.67 | 0.69 | 2.99 | 1.06 | 1.62 | 0.97 | 0.8 | 0.83 | 0.79 | 1.71 | 1.86 | 0.86 | 0.9 | 2.67 | 2.49 | 0.94 | 2.5 | 0.9 | 3.27 |
| Massachusetts | 1.34 | 0.64 | 5.21 | 0.91 | 1.34 | 0.68 | 0.64 | 0.72 | 0.79 | 1.51 | 1.62 | 0.52 | 0.75 | 1.49 | 1.78 | 0.8 | 1.71 | 0.75 | 3.78 |
| Michigan | 1.67 | 0.85 | 5.43 | 1.11 | 1.66 | 0.92 | 0.71 | 0.94 | 0.97 | 1.48 | 1.71 | 0.88 | 0.97 | 1.23 | 1.89 | 0.97 | 2.35 | 1.14 | 2.24 |
| Minnesota | 1.14 | 0.58 | 2.8 | 0.77 | 1.13 | 0.53 | 0.64 | 0.55 | 0.79 | 1.25 | 1.2 | 0.48 | 0.61 | 0.99 | 1.26 | 1 | 1.64 | 0.65 | 2.4 |
| Mississippi | 1.9 | 1.12 | 5.47 | 1.39 | 1.8 | 1.19 | 0.98 | 1.13 | 0.99 | 1.39 | 2.18 | 1.07 | 1.22 | 1.96 | 1.97 | 1.2 | 2.75 | 1.09 | 1.42 |
| Missouri | 1.62 | 0.97 | 4.91 | 1.16 | 1.56 | 0.91 | 0.71 | 0.88 | 0.99 | 1.28 | 1.7 | 0.96 | 0.96 | 1.35 | 1.97 | 1.04 | 2.43 | 0.95 | 2.07 |
| Montana | 1.29 | 0.78 | 6 | 0.97 | 1.2 | 0.69 | 0.91 | 0.77 | 0.93 | 1.14 | 1.28 | 0.43 | 0.8 | 0.93 | 2.31 | 1.21 | 2.18 | 0.73 | 1.7 |
| Nebraska | 1.35 | 0.73 | 2.58 | 0.89 | 1.31 | 0.64 | 0.64 | 0.65 | 0.96 | 1.18 | 1.43 | 0.67 | 0.74 | 1.05 | 1.73 | 1.01 | 1.77 | 0.7 | 2.02 |
| Nevada | 1.37 | 0.75 | 5.85 | 0.91 | 1.22 | 0.81 | 0.85 | 0.72 | 0.95 | 1.03 | 1.45 | 0.64 | 0.82 | 1.46 | 2.24 | 1.02 | 2.95 | 0.86 | 1.65 |
| New Hampshire | 1.31 | 0.69 | 5.96 | 0.89 | 1.41 | 0.62 | 0.65 | 0.64 | 0.89 | 1.34 | 1.32 | 0.43 | 0.72 | 1.19 | 1.91 | 0.92 | 1.97 | 0.68 | 3.54 |
| New Jersey | 1.42 | 0.62 | 4.06 | 0.93 | 1.45 | 0.72 | 0.6 | 0.7 | 0.84 | 1.36 | 1.6 | 0.73 | 0.81 | 2.55 | 1.54 | 0.84 | 1.52 | 0.85 | 3.18 |
| New Mexico | 1.29 | 0.69 | 6.52 | 0.8 | 1.35 | 0.61 | 1.14 | 0.6 | 0.88 | 1.01 | 1.33 | 0.35 | 0.7 | 1.13 | 2.46 | 1.19 | 2.27 | 0.65 | 1.43 |
| New York | 1.5 | 0.69 | 3.53 | 0.98 | 1.49 | 0.79 | 0.61 | 0.77 | 0.83 | 1.34 | 1.54 | 0.68 | 0.88 | 2.87 | 1.22 | 0.81 | 2.11 | 0.9 | 2.85 |
| North Carolina | 1.5 | 0.83 | 4.84 | 1.02 | 1.54 | 0.8 | 0.77 | 0.79 | 0.9 | 1.39 | 1.68 | 0.81 | 0.89 | 1.65 | 1.69 | 1.09 | 2.65 | 0.69 | 1.89 |
| North Dakota | 1.47 | 0.77 | 2.81 | 1.02 | 1.45 | 0.73 | 0.8 | 0.82 | 0.91 | 1.27 | 1.52 | 0.4 | 0.67 | 0.94 | 1.76 | 1.06 | 1.33 | 0.79 | 2.05 |
| Ohio | 1.75 | 0.96 | 5.24 | 1.15 | 1.79 | 0.91 | 0.88 | 0.93 | 1.05 | 1.43 | 1.71 | 1.1 | 0.99 | 1.85 | 2.32 | 0.98 | 1.97 | 1.12 | 2.26 |
| Oklahoma | 1.85 | 1.09 | 6.67 | 1.36 | 1.74 | 1.05 | 0.9 | 1.15 | 1.04 | 1.29 | 1.18 | 1.12 | 1.15 | 1.34 | 2.09 | 1.16 | 2.58 | 0.99 | 1.76 |
| Oregon | 1.21 | 0.64 | 4.98 | 0.75 | 1.17 | 0.55 | 0.76 | 0.54 | 0.88 | 1.21 | 1.17 | 0.38 | 0.62 | 1.1 | 2.06 | 1 | 1.99 | 0.67 | 1.91 |
| Pennsylvania | 1.59 | 0.84 | 6.05 | 1.05 | 1.6 | 0.82 | 0.65 | 0.83 | 1 | 1.52 | 1.71 | 0.95 | 0.89 | 1.66 | 1.75 | 0.94 | 2.12 | 0.88 | 2.69 |
| Rhode Island | 1.37 | 0.74 | 5.78 | 0.95 | 1.37 | 0.68 | 0.64 | 0.74 | 0.9 | 1.64 | 1.4 | 0.59 | 0.8 | 1.44 | 1.96 | 0.9 | 1.74 | 0.91 | 3.08 |
| South Carolina | 1.73 | 0.69 | 5.39 | 1.27 | 1.75 | 0.97 | 0.92 | 1.07 | 1.07 | 1.41 | 1.93 | 0.89 | 0.89 | 2.07 | 1.94 | 1.07 | 2.95 | 0.91 | 1.71 |
| South Dakota | 1.37 | 0.79 | 2.81 | 0.94 | 1.29 | 0.69 | 0.82 | 0.8 | 0.94 | 1.48 | 1.34 | 0.5 | 0.87 | 0.89 | 1.79 | 1.13 | 1.6 | 0.72 | 1.74 |
| Tennessee | 1.69 | 1.05 | 6.91 | 1.23 | 1.62 | 0.94 | 0.8 | 1.02 | 1.05 | 1.19 | 1.66 | 0.99 | 1.13 | 1.73 | 1.86 | 1 | 2.85 | 0.89 | 1.57 |
| Texas | 1.5 | 0.7 | 3.54 | 0.96 | 1.4 | 0.8 | 0.74 | 0.74 | 0.86 | 1.06 | 1.5 | 0.8 | 0.83 | 1.85 | 1.75 | 1 | 1.62 | 0.82 | 1.45 |
| Utah | 1.17 | 0.48 | 4.97 | 0.71 | 1.18 | 0.53 | 0.84 | 0.49 | 0.85 | 0.98 | 1.18 | 0.51 | 0.61 | 0.79 | 2.32 | 1 | 2.45 | 0.7 | 1.63 |
| Vermont | 1.15 | 0.67 | 4.05 | 0.82 | 1.15 | 0.61 | 0.62 | 0.63 | 0.84 | 1.31 | 1.17 | 0.34 | 0.71 | 1.04 | 1.78 | 0.98 | 1.58 | 0.62 | 2.93 |
| Virginia | 1.49 | 0.7 | 3.66 | 1.02 | 1.55 | 0.76 | 0.7 | 0.78 | 0.85 | 1.47 | 1.79 | 0.74 | 0.81 | 1.5 | 1.58 | 0.89 | 1.77 | 0.85 | 2.85 |
| Washington | 1.25 | 0.69 | 4.82 | 0.78 | 1.2 | 0.59 | 0.65 | 0.67 | 0.87 | 1.16 | 1.34 | 0.32 | 0.65 | 1.19 | 2.2 | 0.95 | 2.1 | 0.69 | 2.29 |
| West Virginia | 1.67 | 1.19 | 9.92 | 1.14 | 1.84 | 0.8 | 0.8 | 0.91 | 1.32 | 1.2 | 1.72 | 1.1 | 1.07 | 1.1 | 2.04 | 1.1 | 2.17 | 0.86 | 1.67 |
| Wisconsin | 1.31 | 0.69 | 4.27 | 0.87 | 1.27 | 0.67 | 0.65 | 0.69 | 0.91 | 1.37 | 1.45 | 0.66 | 0.71 | 0.9 | 1.81 | 1.03 | 1.7 | 0.72 | 2.01 |
| Wyoming | 1.24 | 0.72 | 4.82 | 0.89 | 1.08 | 0.68 | 0.91 | 0.74 | 1.02 | 1.29 | 1.23 | 0.25 | 0.74 | 0.85 | 2.18 | 1.14 | 2.36 | 0.65 | 1.97 |

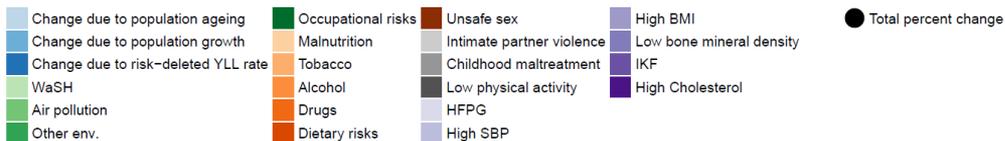
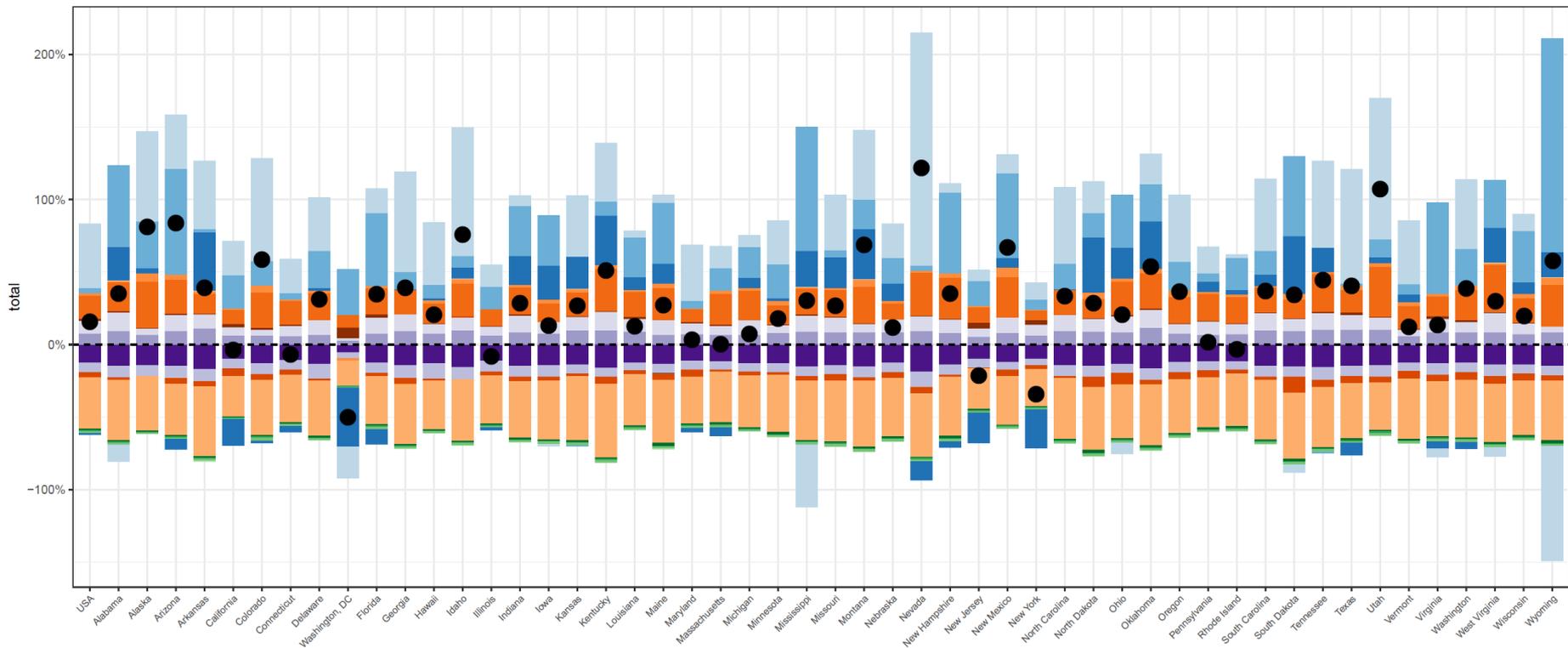


What caused the most deaths by sex for Americans under 70 in 2017

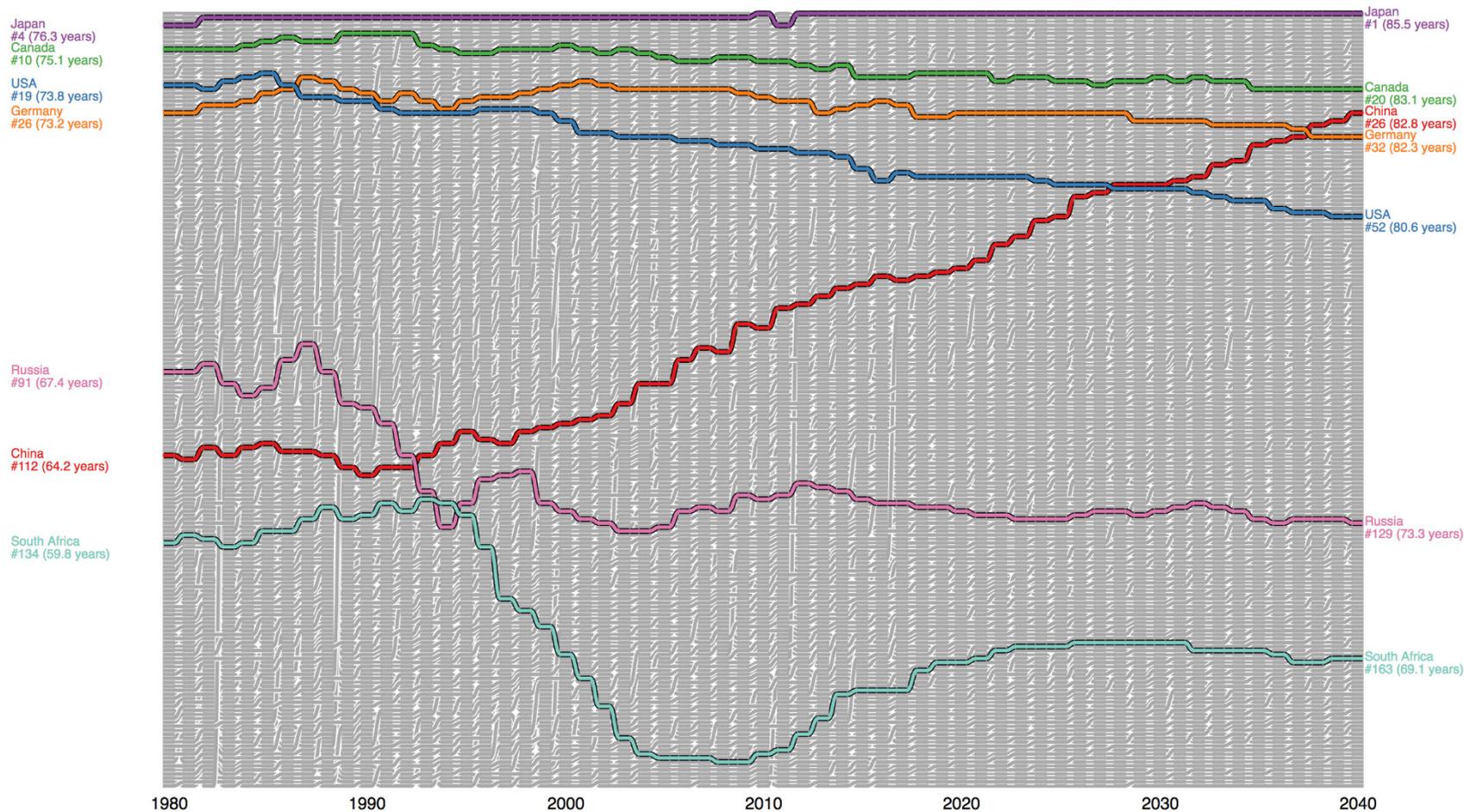


What caused the most DALYs by sex for Americans under 70 in 2017

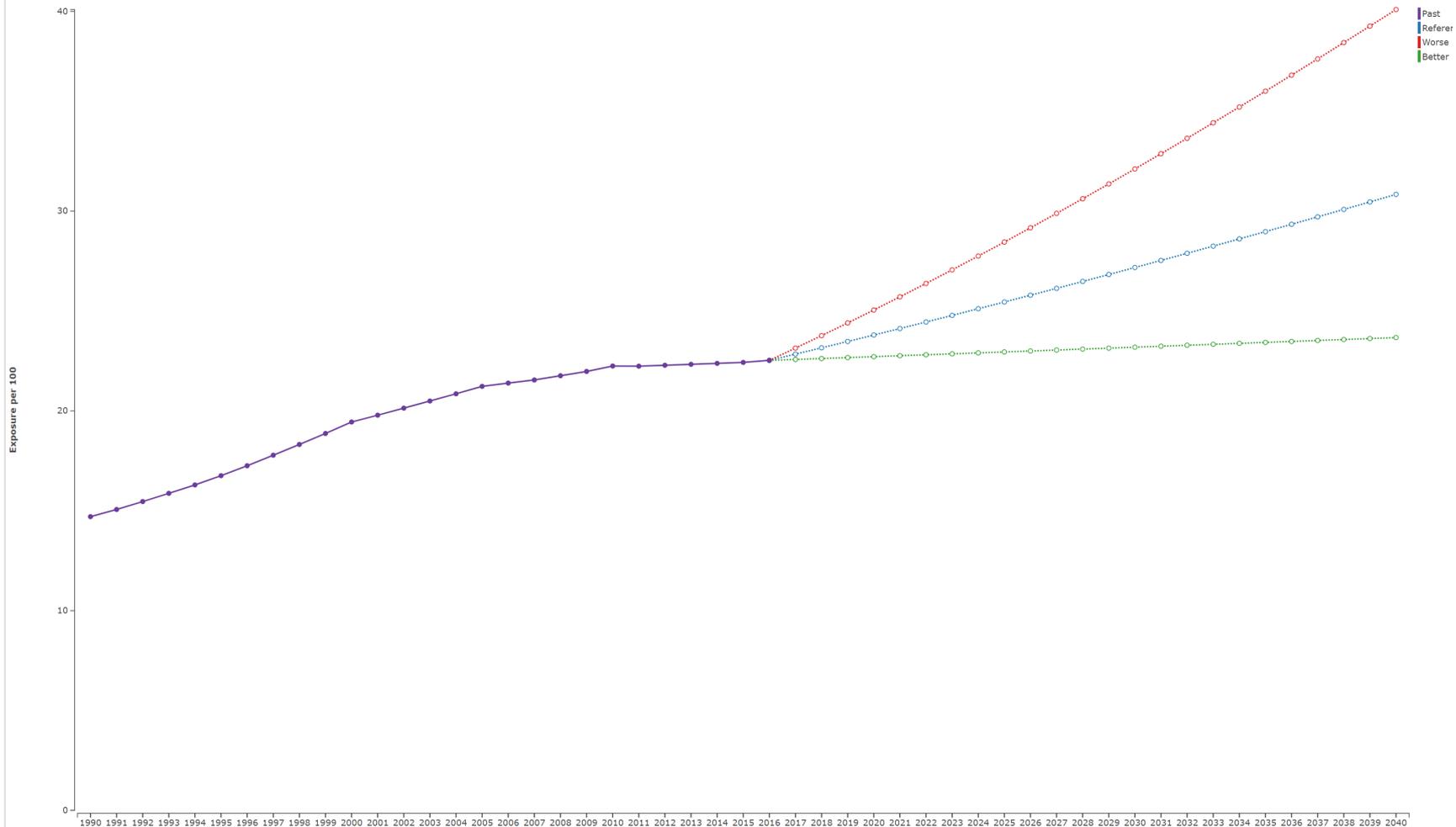


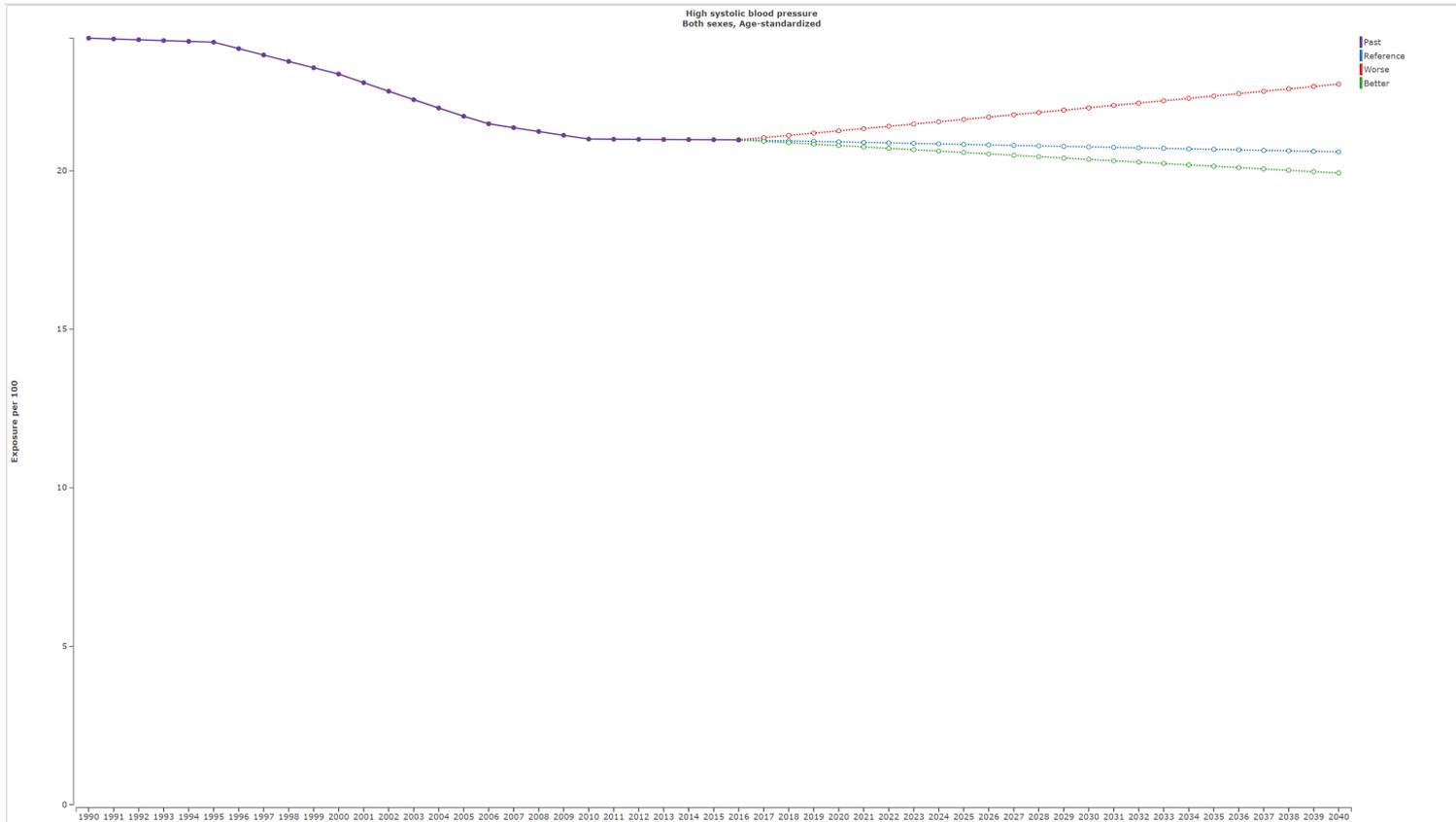


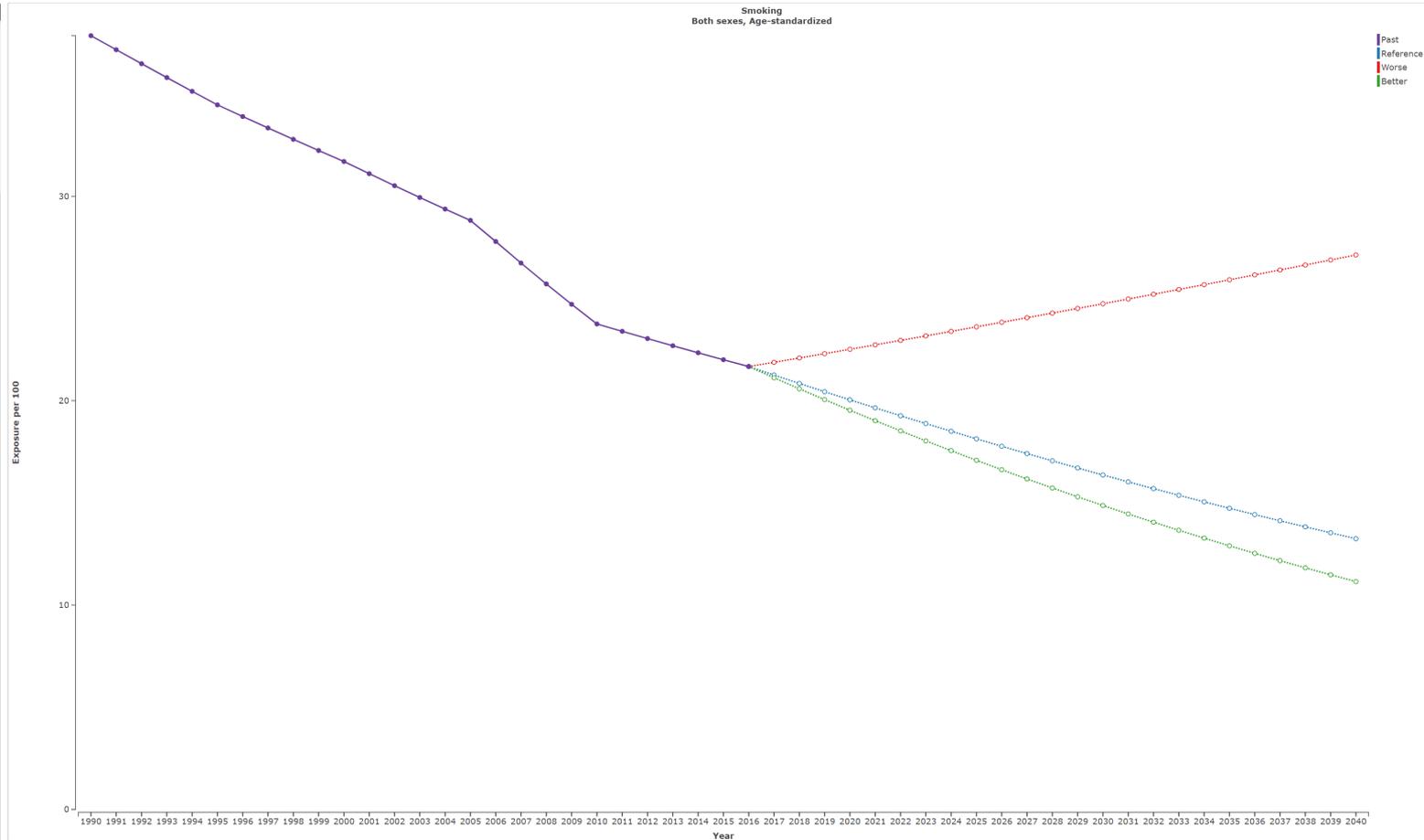
US ranking in life expectancy dropping and will continue to drop



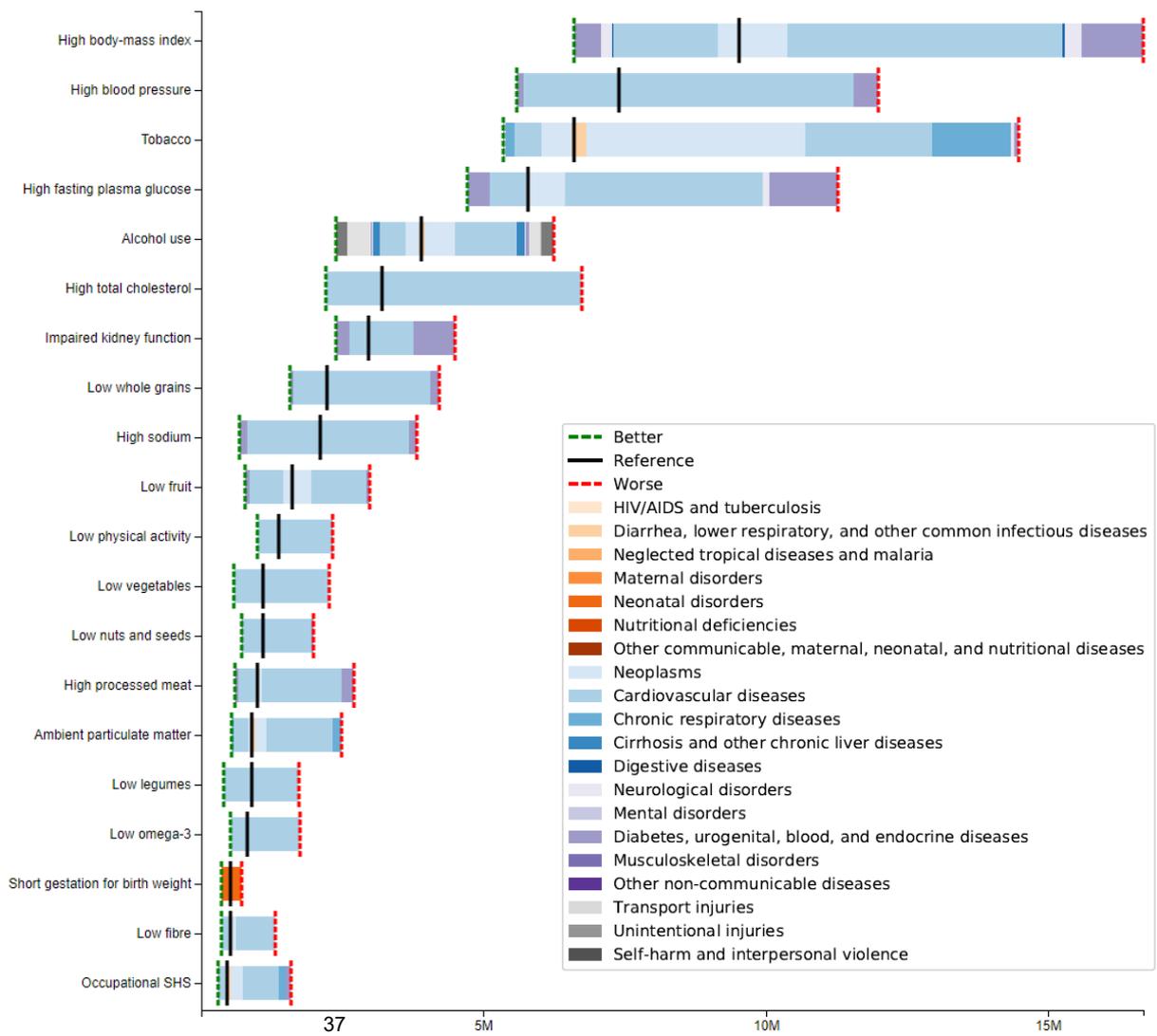
High body-mass index
Both sexes, Age-standardized







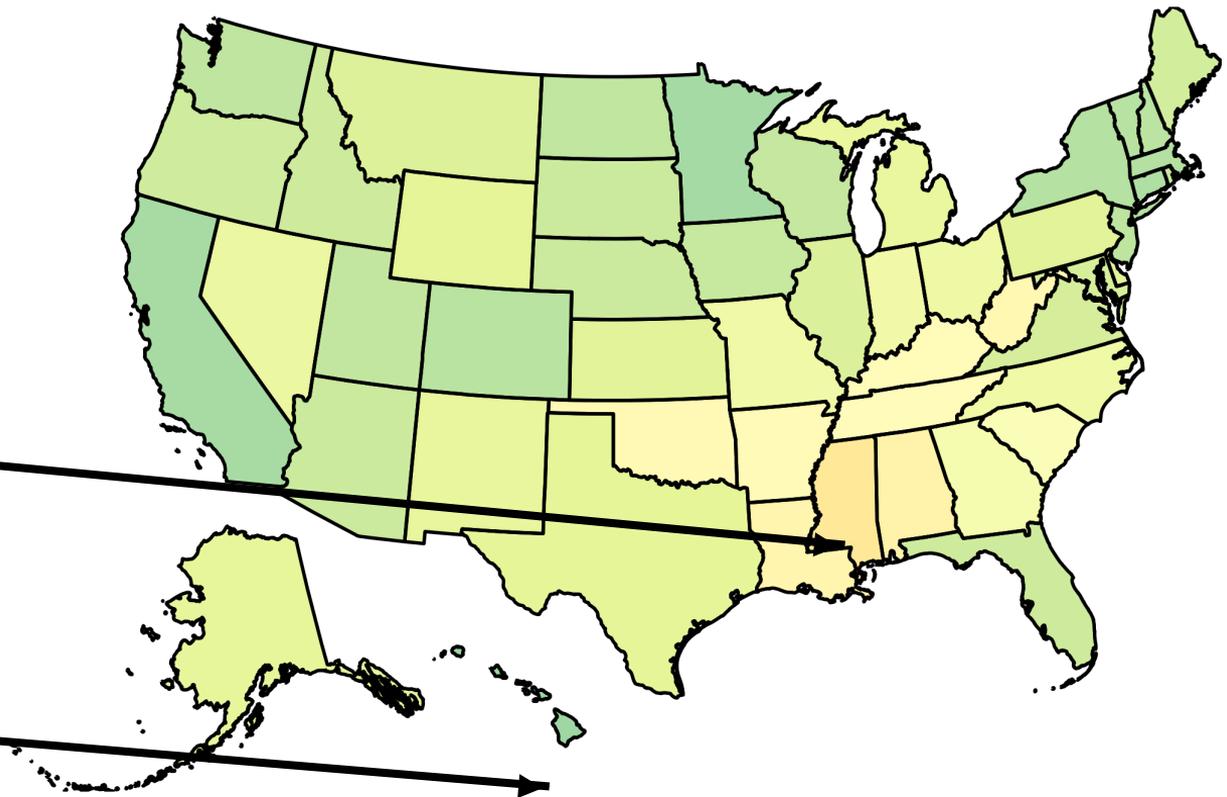
Leading 20 risk factors in the US contributing to the difference in years of life lost between reference, better health, and worse health scenarios, 2040



Life expectancy (by state, 2014)

75 years in
Mississippi

81 years in
Hawaii



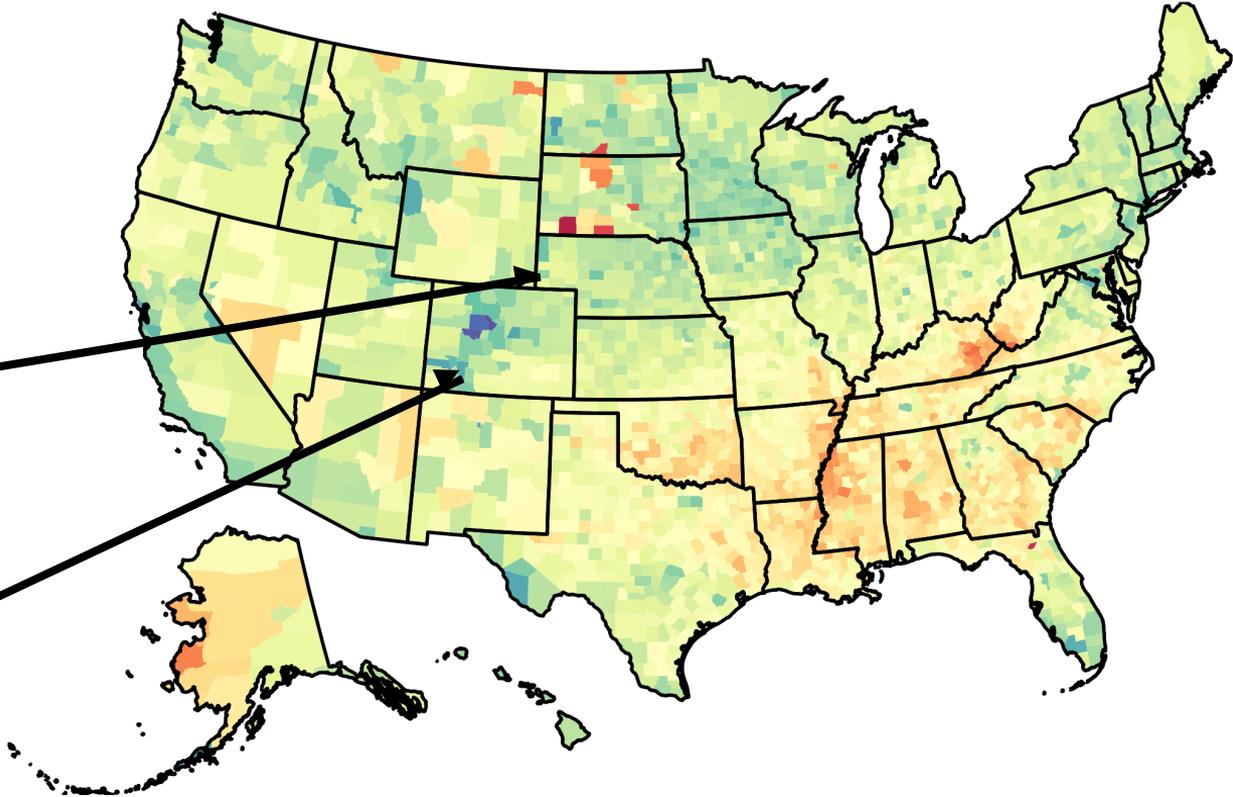
Life expectancy at birth (years):



Life expectancy (by state, 2014)

67 years in Oglala Lakota

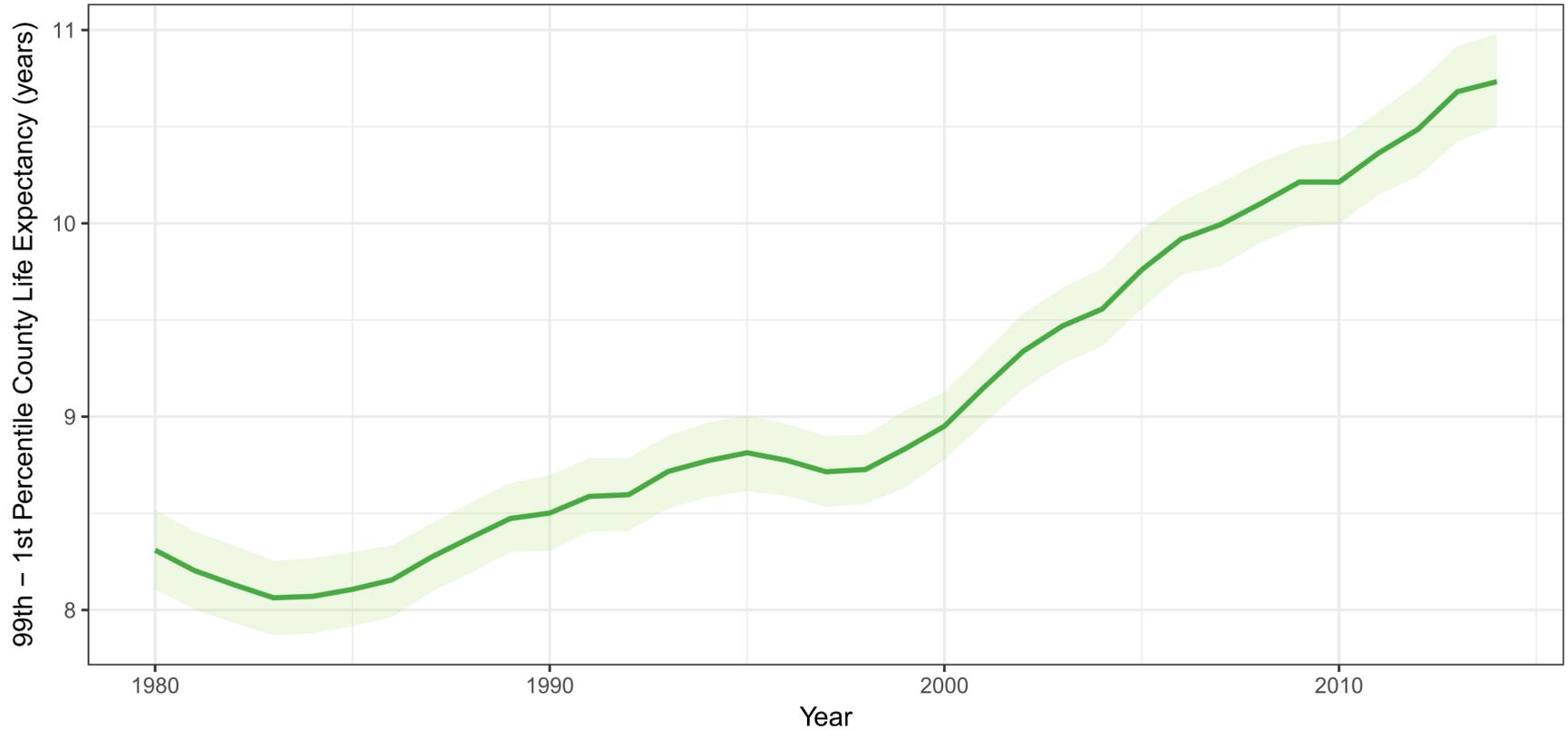
87 years in Summit



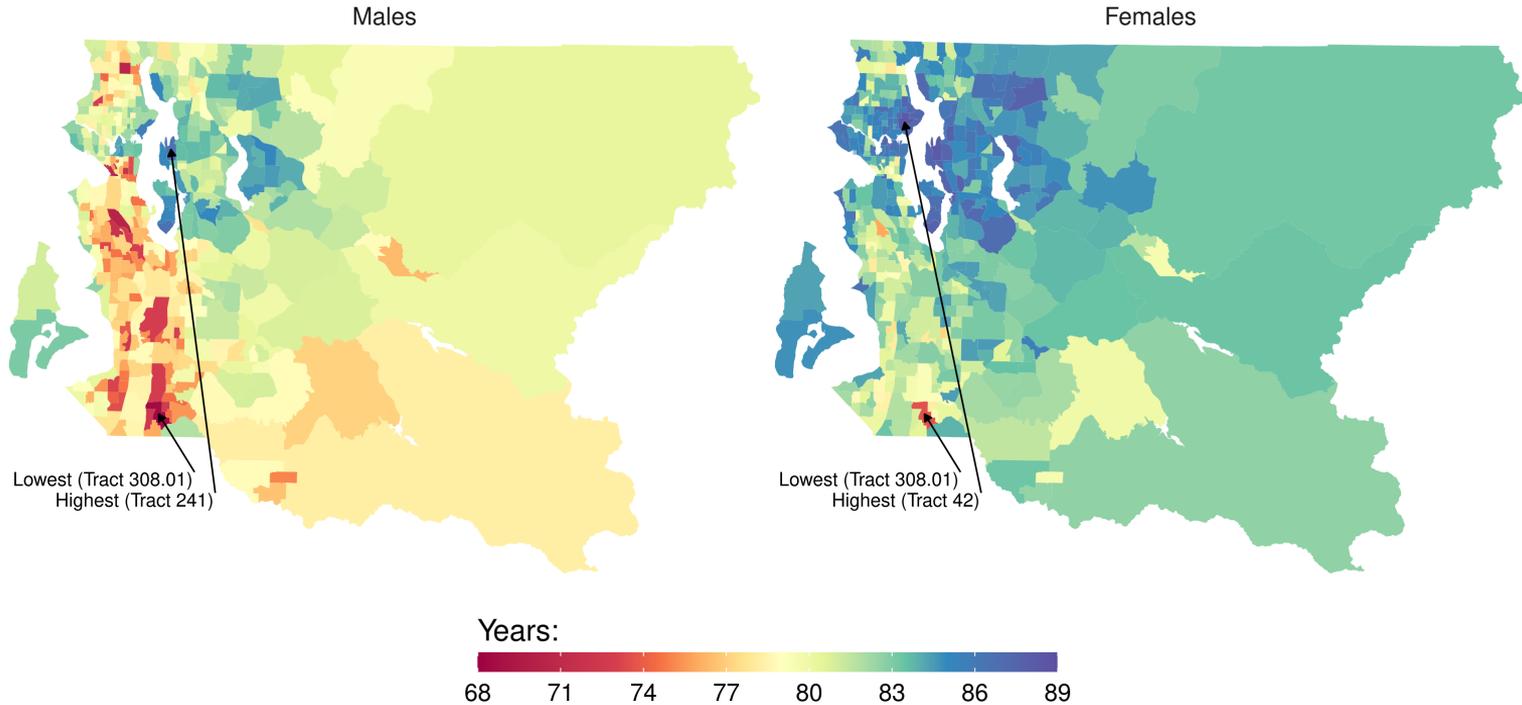
Life expectancy at birth (years):



Geographic inequality: life expectancy

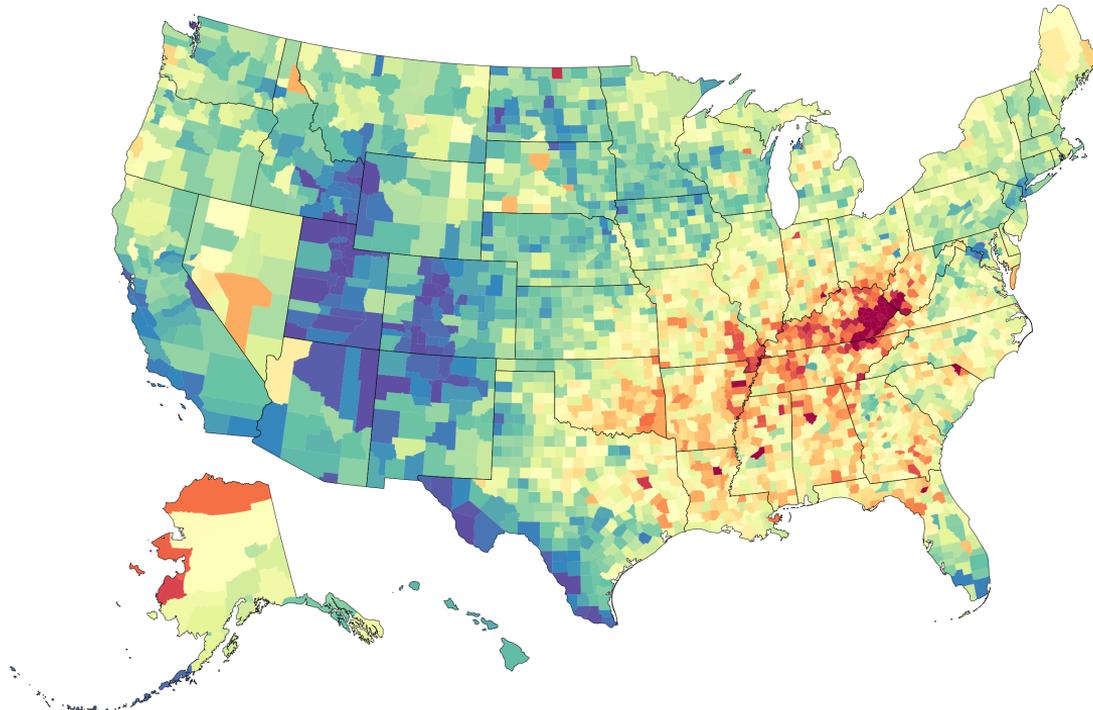


Tract-level life expectancy in King County, WA

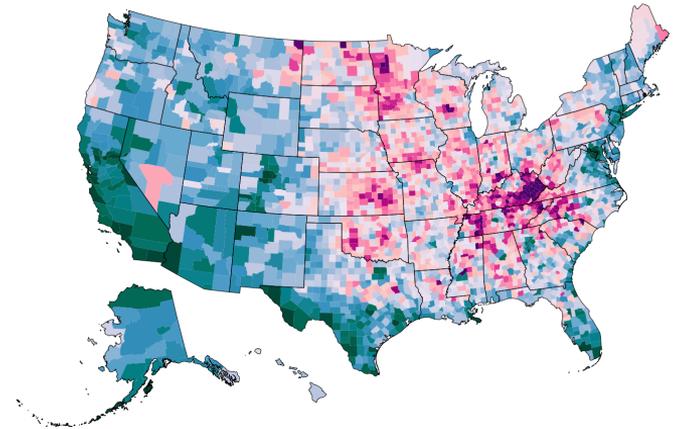


[http://www.thelancet.com/journals/lanpub/article/PIIS2468-2667\(17\)30165-2/fulltext](http://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(17)30165-2/fulltext)

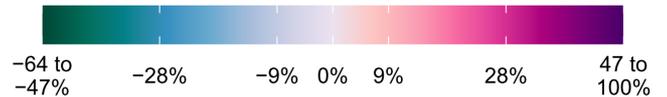
Tracheal, bronchus, and lung cancer



Age-standardized mortality rate (deaths per 100,000 population):

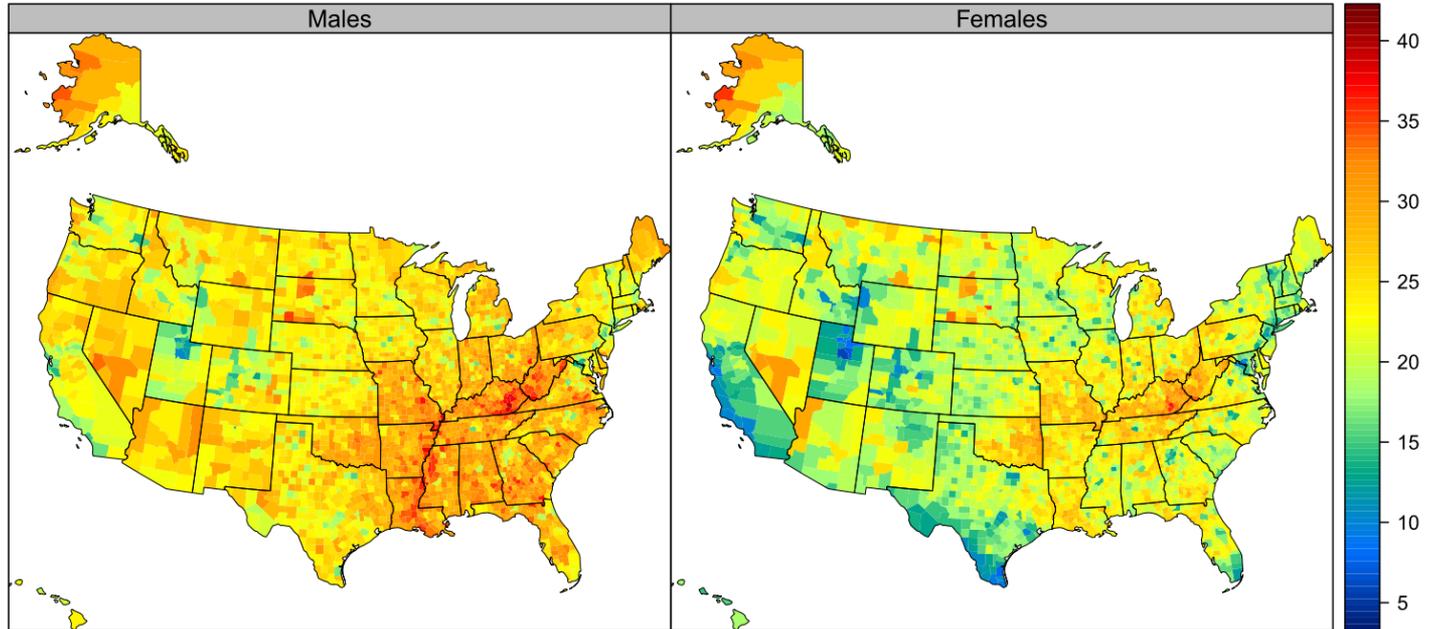


Change in age-standardized mortality rate (%):

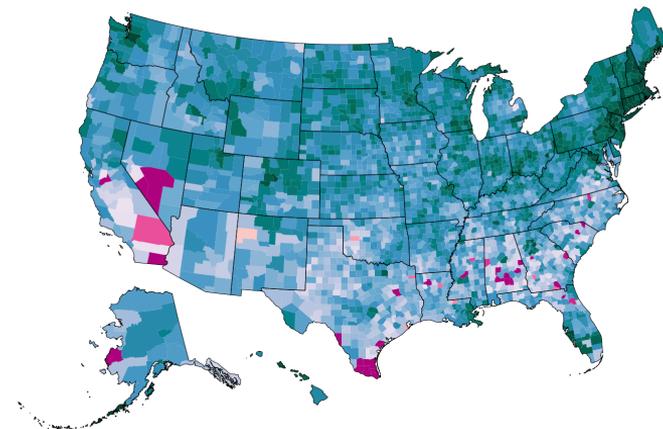
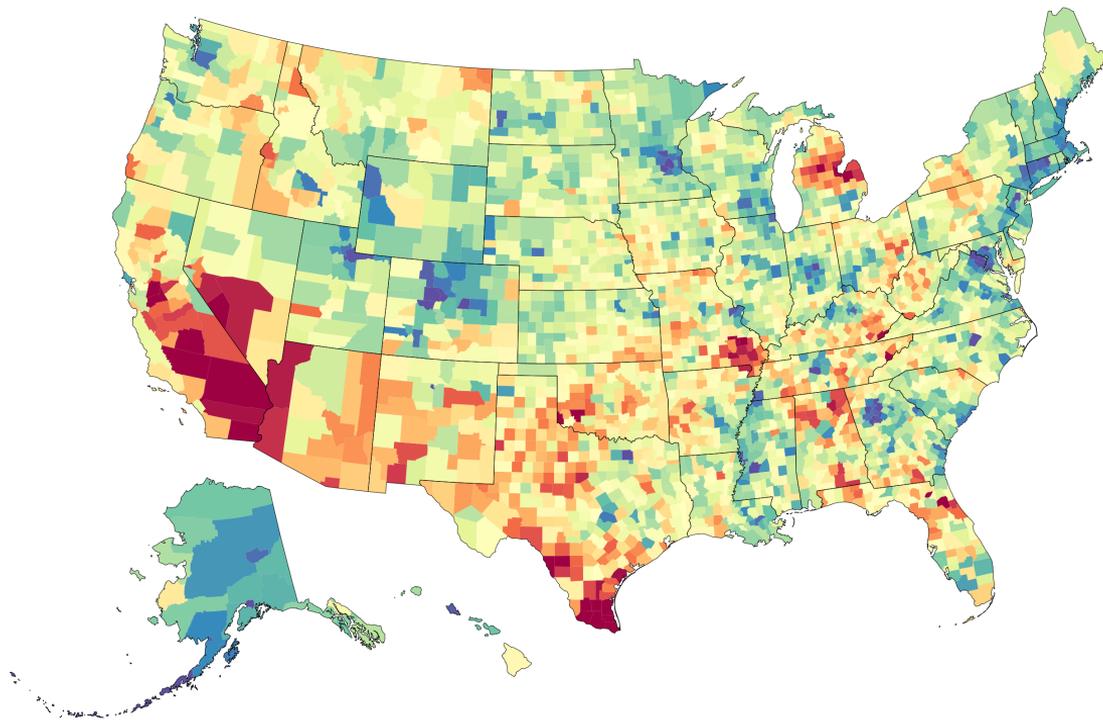


Results: Smoking

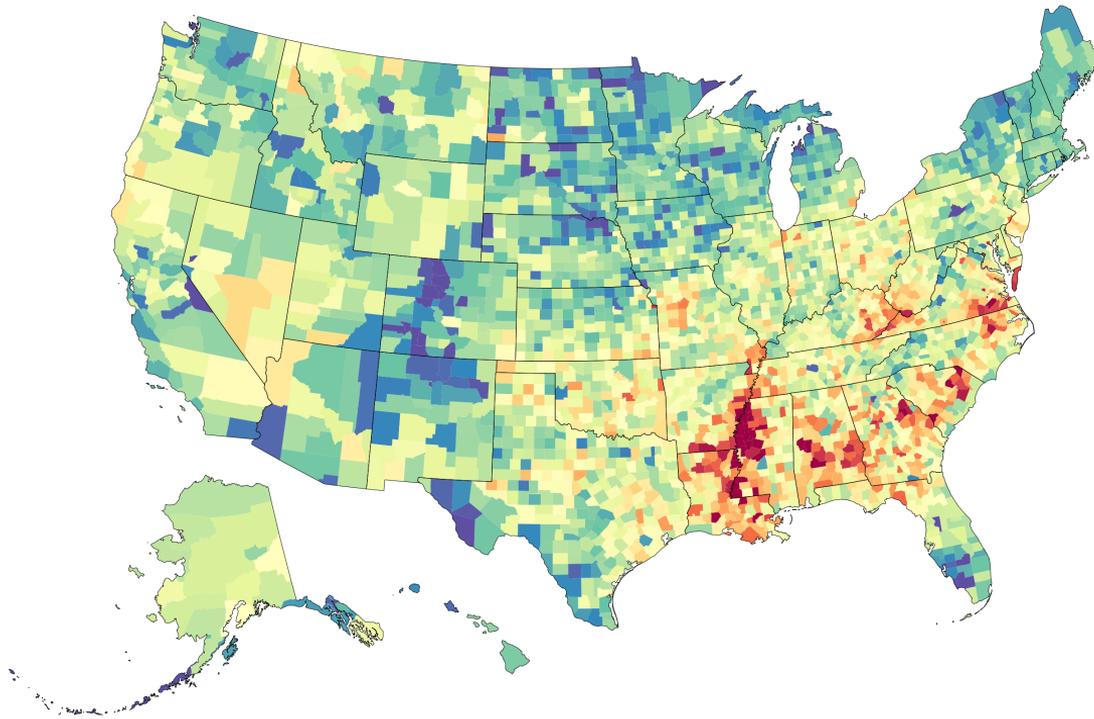
Current smoking prevalence, 2012



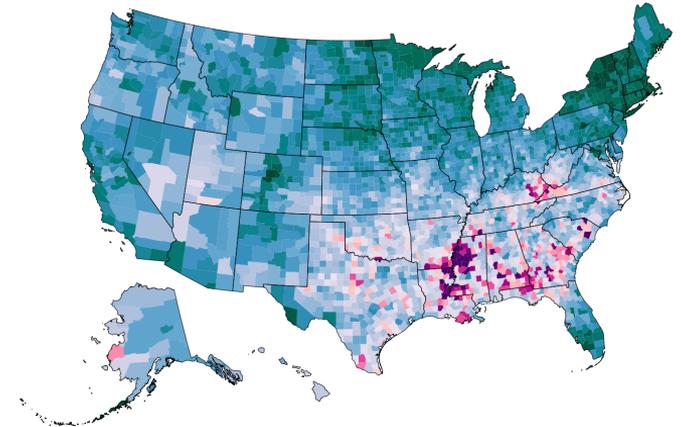
Testicular cancer (males only)



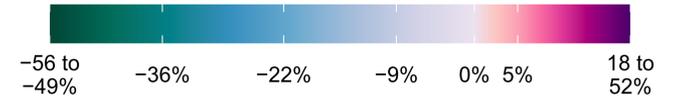
Breast cancer (females only)



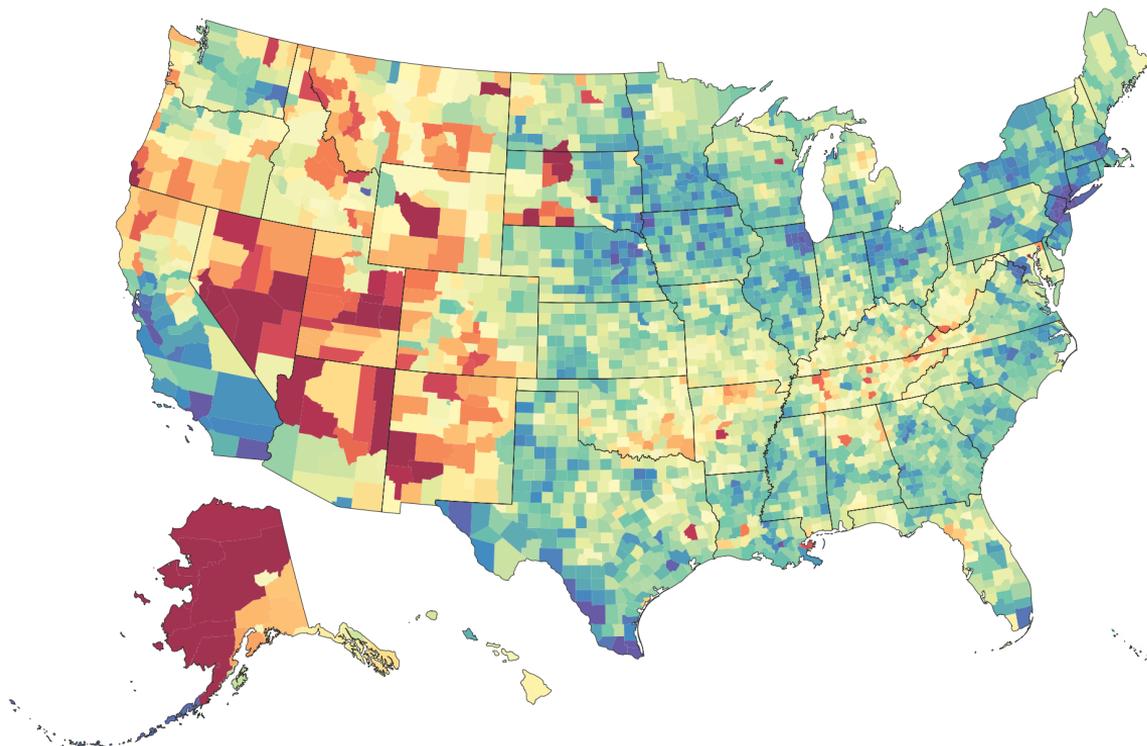
Age-standardized mortality rate (deaths per 100,000 population):



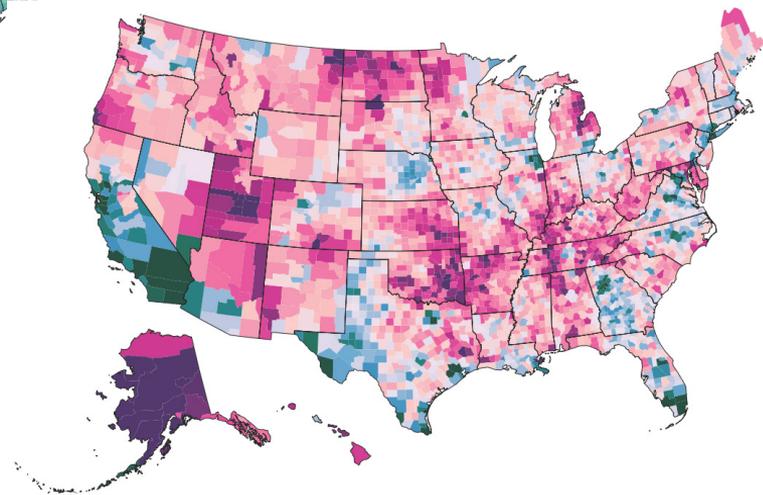
Change in age-standardized mortality rate (%):



Causes of Death: Self-Harm



Deaths per 100000 population

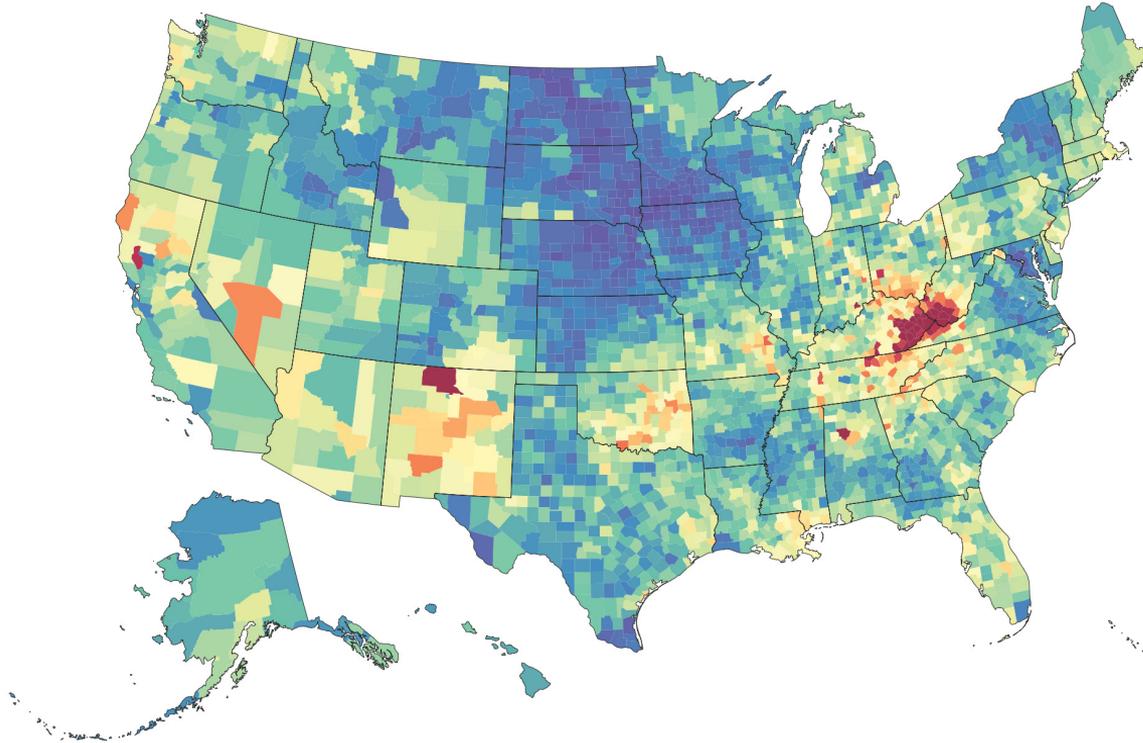


% Change

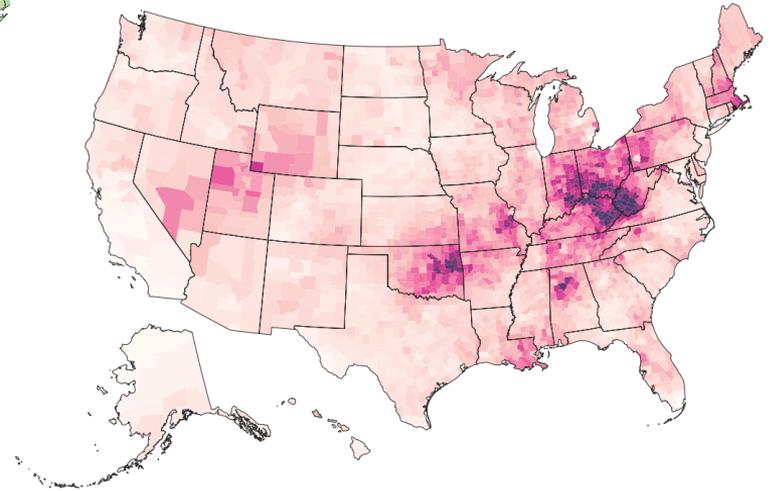


Institute for Health Metrics and Evaluation

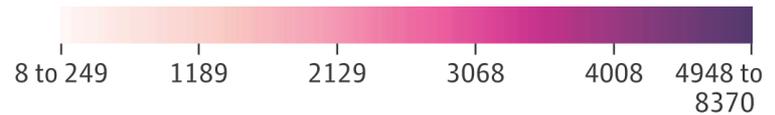
Causes of Death: Drug Use Disorders



Deaths per 100000 population

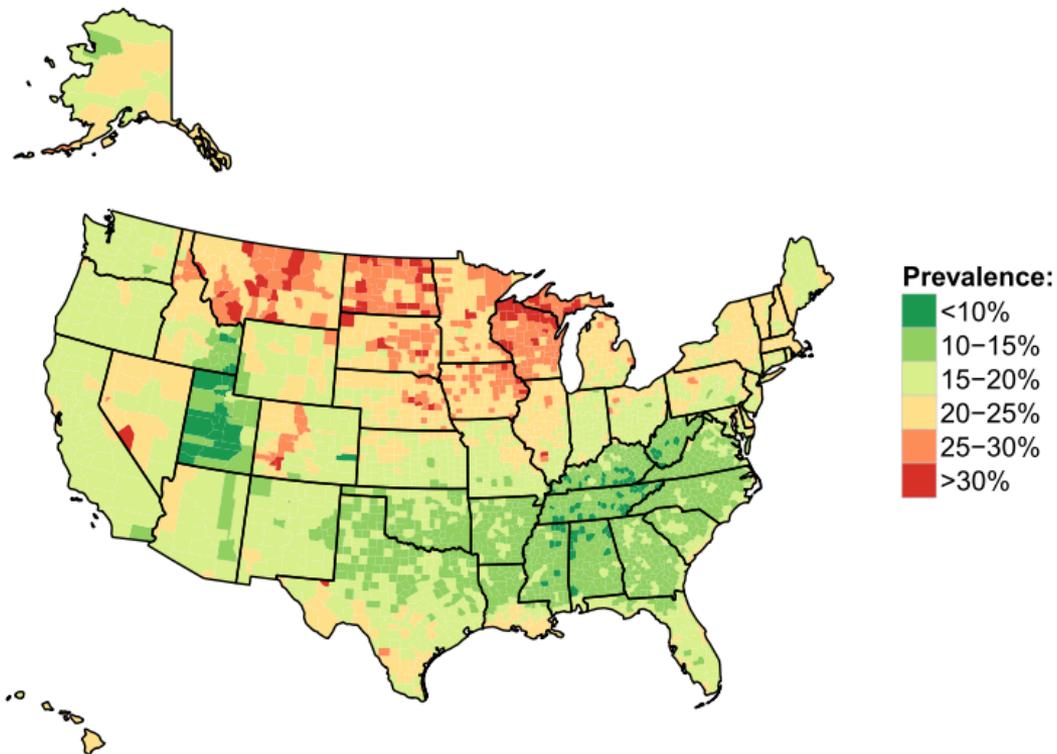


% Change



Institute for Health Metrics and Evaluation

Binge drinking: Prevalence, 2012



What are the drivers of these disparities?

Socio-economic inequalities

Lack of financial access to health care

Poor quality of care

Preventable causes of death

Potential drivers of inequality in life expectancy

Socioeconomic & race/ethnicity factors

Poverty (%)

Median income (log \$)

High school education (%)

College education (%)

Unemployment (%)

Black (%)

American Indian/Alaska
Native (%)

Hispanic (%)

Behavioral & metabolic risk factors

Obesity (%)

Physical inactivity (%)

Smoking (%)

Hypertension (%)

Diabetes (%)

Health care access & quality factors

Insurance (%)

Quality

Medical doctors (per 1,000
population)

Potential drivers of inequality in life expectancy

| Category | SES only | Risks only | Care only | Combined |
|-------------|---------------|---------------|---------------|---------------|
| (Intercept) | 70.60* (0.10) | 70.40* (0.08) | 73.21* (0.13) | 70.07* (0.09) |
| SES index | 13.13* (0.19) | | | -0.10 (0.37) |
| Risk index | | 13.73* (0.15) | | 13.04* (0.33) |
| Care index | | | 7.88* (0.23) | 1.37* (0.17) |
| R-squared | 0.60 | 0.74 | 0.27 | 0.74 |

*p < 0.05

Big Picture in the US

1. Regardless of the metric of population health, the US performs poorly relative to other high-income countries.
2. Most communities in the US are steadily falling behind each year compared to high-income nations.
3. Females are falling behind faster than males in most parts of the country
4. We have lots of health disparities in the US, WA, and King County
5. Large number of deaths and a large component of disparities could be addressed through modification of major risk factors through primary care and community interventions.

Key questions for Americans health

- What is the future magnitude and trends of disease burden?
- Are there disparities amongst certain population groups?
- What are the health care costs, health spending, and fiscal impact—plus other non-health care costs (disability, early retirement, absenteeism, etc.)?
- What are the key drivers of both the increased disease burden and the increased health expenditure?
- What are potential interventions or campaigns for addressing these shifts in disease?

Qualitative approaches: GRADE

GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) is a transparent framework for developing and presenting summaries of evidence and provides a systematic approach for making clinical practice recommendations.

It is the most widely adopted tool for grading the quality of evidence and for making recommendations, with over 100 organizations worldwide officially endorsing GRADE.

GRADE is subjective.

Table 1. GRADE certainty ratings

| Certainty | What it means |
|-----------------|--|
| Very low | The true effect is probably markedly different from the estimated effect |
| Low | The true effect might be markedly different from the estimated effect |
| Moderate | The authors believe that the true effect is probably close to the estimated effect |
| High | The authors have a lot of confidence that the true effect is similar to the estimated effect |

GBD to date uses World Cancer Research Fund criteria to assess evidence.

Highly subjective

| | | WCRF Criteria | |
|--------------------------|----------------------------|--|--|
| | | Convincing | Probable |
| Bradford Hill's Criteria | Consistency | Evidence from more than one study type. No substantial unexplained heterogeneity within or between study types or in different populations relating to the presence or absence of an association, or direction of effect. | No substantial unexplained heterogeneity between or within study types in the presence or absence of an association, or direction of effect. |
| | Temporality | Evidence from at least two independent cohort studies | Evidence from at least two independent cohort studies, or at least five case-control studies. |
| | Experiment | Strong and plausible experimental evidence, either from human studies or relevant animal models, that typical human exposures can lead to relevant cancer outcomes. | |
| | Biological gradient | Presence of a plausible biological gradient ('dose response') in the association. Such a gradient need not be linear or even in the same direction across the different levels of exposure so long as this can be explained plausibly. | |
| | Plausibility | - | Evidence for biological plausibility |
| | Strength | - | - |
| | Analogy | - | - |
| | Coherence | - | - |
| | Specificity | - | - |
| | | Good quality studies to exclude with confidence the possibility that the observed association results from random or systematic error, including confounding, measurement error, and selection bias. | Good quality studies to exclude with confidence the possibility that the observed association results from random or systematic error, including confounding, measurement error, and selection bias. |

Star rating system

- Convert the probability of a null effect, taking into account between-study heterogeneity that cannot be explained by risk of bias to a categorical rating for ease of communication.
 - **5 stars** – $p < 0.001$
 - **4 stars** – $p < 0.01$
 - **3 stars** – $p < 0.05$
 - **2 stars** – $p < 0.2$
 - **1 star** – $p < 0.5$

Exact thresholds may be revised based on more experience with analyzing a wider range of risk-outcome pairs.

These are very ‘inclusive’ criteria. Pros mean that risk-outcome pairs people expect are included. Cons mean that risk-outcome pairs that are effectively a coin toss for causal relationships may be included.

Future area of research for Americans

- **Conduct situational analysis by forecasting burden of disease and health expenditure to 2050**
- **Gather all Available Literature**
- **Develop Evidence Syntheses**
- **Develop a Predictive Intervention Model**
- **Provide a Visualization for Translation of Results**

Concept

Leverage GBD work and forecasting to identify priorities

Comprehensive approach: review and synthesize all interventions evidence and cost

Prioritize budget allocation for maximum impact with best strategies given local situation



DONE



MISSING



PILOTED

IHME
Translation Model

Settings

Display

Cause Risk Disparity

Cause

Diarrhea

Measure

Deaths YLLs YLDs DALYs

Locations

Nigeria

Age

All <5 5-14
15-49 50-69 70+
Age-standardized

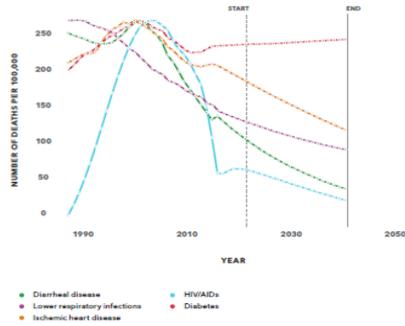
Sex

Male Female Both

Units

Rate %

Trends Observed



Interventions

- Diarrhea Risk Factors
- Zinc deficiency
 - Vitamin A deficiency
 - Unsafe water source
 - Unsafe sanitation
 - No access to handwashing
 - Discontinued breastfeeding
 - Lack of rotavirus vaccine
 - Others

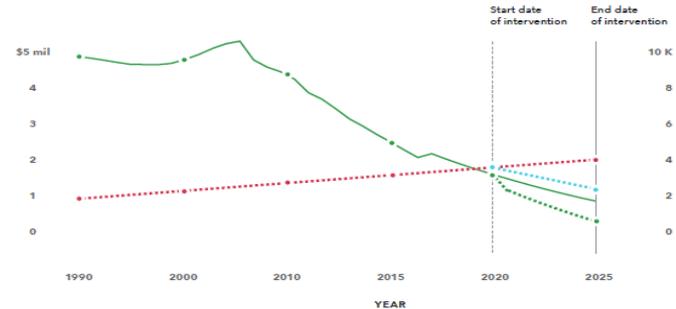
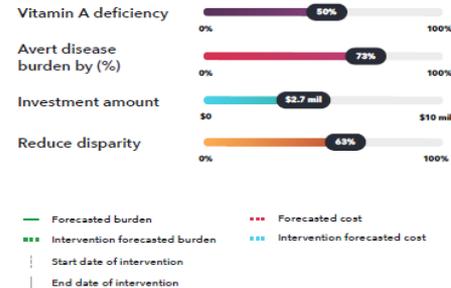
- Interventions
- Fortification of staple foods
 - Multi-micronutritional powders
 - Selective breeding and biofortification
 - Dietary diversification and improvement
 - Vitamin A supplementation
 - Others

- Groups/age
- Newborn
 - Infants 1-5 months
 - Infants and children 5-59 months
 - Pregnant women
 - HIV-positive pregnant women
 - Post-partum
 - Others

- Administration
- Clinic
 - Outreach
 - Others

| | Evidence score | Sustainability score | Cost per DALYs |
|----------------|----------------|----------------------|----------------|
| Intervention 1 | - | - | - |
| Intervention 2 | - | - | - |
| Intervention 3 | - | - | - |
| Intervention 4 | - | - | - |
| Other | - | - | - |

Outcomes | DALYs saved: 45,000 Cost difference: -\$1.4 mil





Thank you!

Ali H. Mokdad, Ph.D.

Chief Strategy Officer, Population Health

Professor, Health Metrics Sciences

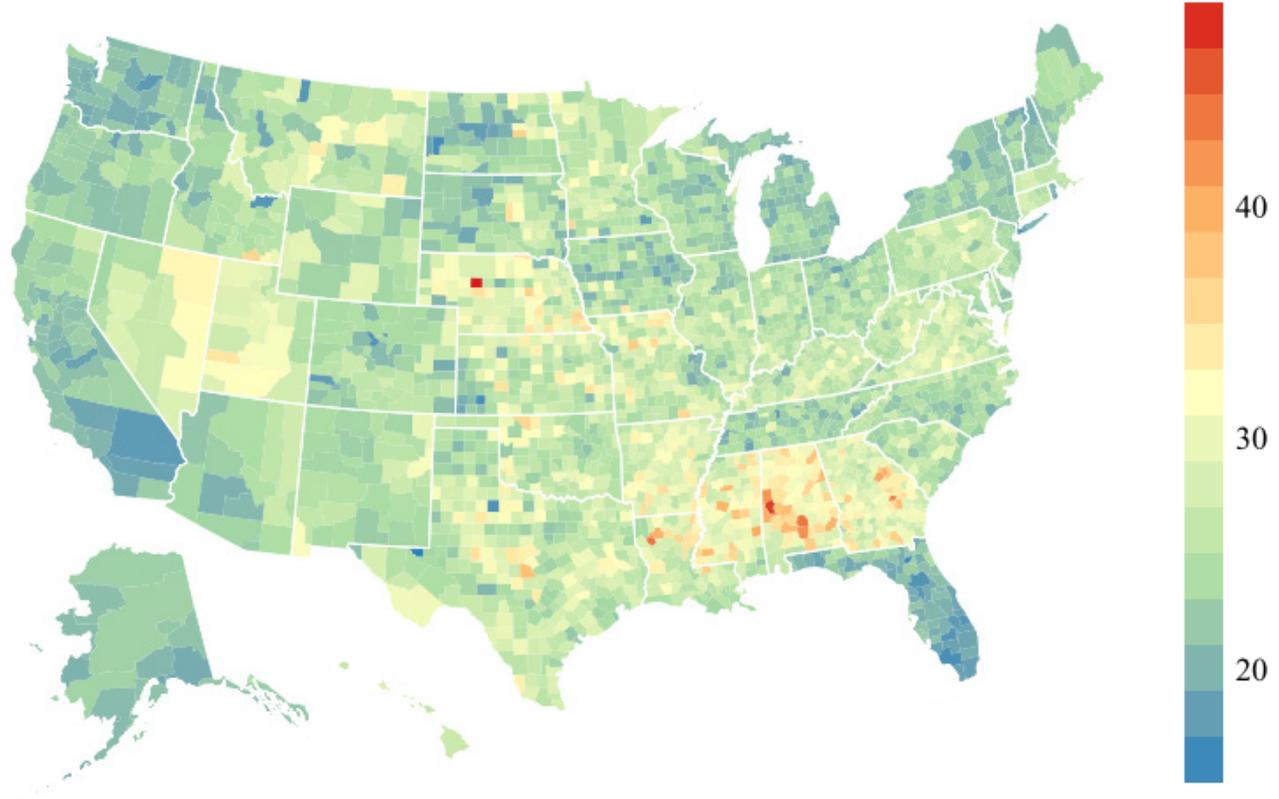
mokdaa@uw.edu

W UNIVERSITY of WASHINGTON

Institute for Health Metrics and Evaluation

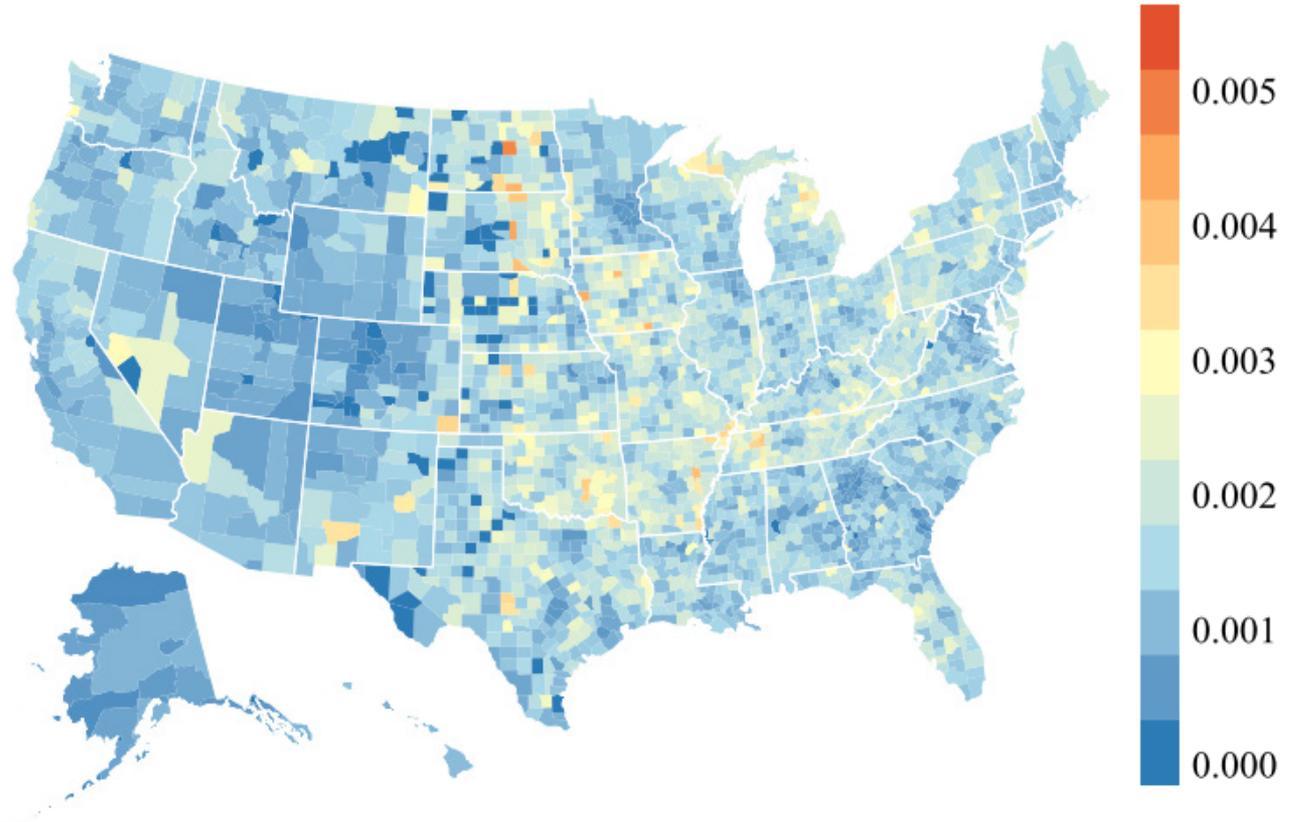
Garbage code redistribution

Percent of deaths assigned a 'garbage' ICD code:



Garbage code redistribution

Crude death rate
from IHD **prior to**
redistribution:



Garbage code redistribution

Crude death rate
from IHD **after**
redistribution:

