Burden of disease scenarios by state in the USA, 2022–50: a forecasting analysis for the Global Burden of Disease Study 2021

*GBD 2021 US Burden of Disease and Forecasting Collaborators**

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Summary

Background The capacity to anticipate future health issues is important for both policy makers and practitioners in the USA, as such insights can facilitate effective planning, investment, and implementation strategies. Forecasting trends in disease and injury burden is not only crucial for policy makers but also garners substantial interest from the general populace and leads to a better-informed public. Through the integration of new data sources, the refinement of methodologies, and the inclusion of additional causes, we have improved our previous forecasting efforts within the scope of the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) to produce forecasts at the state and national levels for the USA under various possible scenarios.

Methods We developed a comprehensive framework for forecasting life expectancy, healthy life expectancy (HALE), cause-specific mortality, and disability-adjusted life-years (DALYs) due to 359 causes of disease and injury burden from 2022 to 2050 for the USA and all 50 states and Washington, DC. Using the GBD 2021 Future Health Scenarios modelling framework, we forecasted drivers of disease, demographic drivers, risk factors, temperature and particulate matter, mortality and years of life lost (YLL), population, and non-fatal burden. In addition to a reference scenario (representing the most probable future trajectory), we explored various future scenarios and their potential impacts over the next several decades on human health. These alternative scenarios comprised four risk elimination scenarios (including safer environment, improved behavioural and metabolic risks, improved childhood nutrition and vaccination, and a combined scenario) and three USA-specific scenarios based on risk exposure or attributable burden in the best-performing US states (improved high adult BMI and high fasting plasma glucose [FPG], improved smoking, and improved drug use [encompassing opioids, cocaine, amphetamine, and others]).

Findings Life expectancy in the USA is projected to increase from 78·3 years (95% uncertainty interval 78·1–78·5) in 2022 to 79·9 years (79·5–80·2) in 2035, and to 80·4 years (79·8–81·0) in 2050 for all sexes combined. This increase is forecasted to be modest compared with that in other countries around the world, resulting in the USA declining in global rank over the 2022–50 forecasted period among the 204 countries and territories in GBD, from 49th to 66th. There is projected to be a decline in female life expectancy in West Virginia between 1990 and 2050, and little change in Arkansas and Oklahoma. Additionally, after 2023, we projected almost no change in female life expectancy in many states, notably in Oklahoma, South Dakota, Utah, Iowa, Maine, and Wisconsin. Female HALE is projected to decline between 1990 and 2050 in 20 states and to remain unchanged in three others. Drug use disorders and low back pain are projected to be the leading Level 3 causes of age-standardised DALYs in 2050. The age-standardised DALY rate due to drug use disorders is projected to increase considerably between 2022 and 2050 (19·5% [6·9–34·1]). Our combined risk elimination scenario shows that the USA could gain 3·8 additional years (3·6–4·0) of life expectancy and 4·1 additional years (3·9–4·3) of HALE in 2050 versus the reference scenario. Using our USA-specific scenarios, we forecasted that the USA could gain 0·4 additional years (0·3–0·6) of life expectancy and 0·6 additional years (0·5–0·8) of HALE in 2050 under the improved drug use scenario relative to the reference scenario. Life expectancy and HALE are likewise projected to be 0·4–0·5 years higher in 2050 under the improved adult BMI and FPG and improved smoking scenarios compared with the reference scenario. However, the increases in these scenarios would not substantially improve the USA's global ranking in 2050 (from 66th of 204 in life expectancy in the reference scenario to 63rd–64th in each of the three USA-specific scenarios), indicating that the USA's best-performing states are still lagging behind other countries in their rank throughout the forecasted period. Regardless, an estimated 12·4 million (11·3–13·5) deaths could be averted between 2022 and 2050 if the USA were to follow the combined scenario trajectory rather than the reference scenario. There would also be 1·4 million (0·7–2·2) fewer deaths over the 28-year forecasted period with improved adult BMI and FPG, 2·1 million (1·3–2·9) fewer deaths with improved exposure to smoking, and 1·2 million (0·9–1·5) fewer deaths with lower rates of drug use deaths.

Interpretation Our findings highlight the alarming trajectory of health challenges in the USA, which, if left unaddressed, could lead to a reversal of the health progress made over the past three decades for some US states and a decline in global health standing for all states. The evidence from our alternative scenarios along with other published studies suggests that through collaborative, evidence-based strategies, there are opportunities to change the trajectory of health outcomes in the USA, such as by investing in scientific innovation, health-care access, preventive health care, risk exposure reduction, and education. Our forecasts clearly show that the time to act is now, as the future of the country's health and wellbeing—as well as its prosperity and leadership position in science and innovation—are at stake.

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Research in context

Evidence before this study

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) has been instrumental in forecasting the burden of diseases and injuries, offering forecasts of future health trends for the past 27 years. The inaugural GBD forecasting study (in 1997) provided baseline forecasts and two additional scenarios across various regions, sexes, and age groups, covering nine disease clusters for the period from 1990 to 2020. This pioneering study used regression models that factored in four key health determinants: per capita income, educational attainment, smoking intensity, and temporal changes. Subsequent analyses in 2006 extended the forecast to 2030. A noteworthy study by Hughes and colleagues in 2011 further lengthened these forecasts to 2060. The 2018 forecasts, which drew upon GBD 2016 estimates, represented the most thorough and expansive analysis at that time, examining mortality trends, risk factor exposure, and the burden of risk factors across 195 countries and territories. This analysis used 79 health determinants and offered a reference scenario alongside two alternatives: one optimistic and the other pessimistic. Notably, previous GBD forecasts did not explore trends in the burden of non-fatal disease and injury. In the case of the USA, which faces substantial health challenges including rising obesity, increased drug use, an ageing population, and mental health issues, the provision of current and future estimates of non-fatal disease and injury burdens enhances the understanding of population-level health studies. While GBD forecasts have been produced for numerous countries at the subnational level, these studies have not yet offered forecast scenarios tailored specifically to each country.

Added value of this study

This study builds upon the findings of GBD 2021 by introducing additional, USA-specific alternative scenarios at both the national and subnational levels. For the first time, it offers cause-specific forecasts for both fatal and non-fatal burdens—detailing mortality, years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs)—across age and sex for 359 diseases and injuries in all US states as well as Washington, DC, to 2050. Additionally, this research includes forecasts and estimates of the burden due to COVID-19 beginning in 2022, which complements published GBD estimates of the COVID-19 burden for 2020 and 2021. It delivers a thorough analysis of the current health challenges confronting the USA and projects health outcomes up to the year 2050 under eight potential future scenarios: a reference scenario, three alternative scenarios wherein exposure to key groups of risk factors is eliminated, a scenario that combines all three of these alternative scenarios, and three USA-specific alternative scenarios wherein exposure to specific risk factors is set to that of the best-performing US states. The alternative scenarios explore some of the possible advancements achievable by eradicating or reducing exposure to certain risk factors and risk factor groups, including metabolic risks, drug use, and air pollution. Through a critical examination of the effects of obesity, population ageing, mental health issues, and disparities across locations, age groups, and sexes, this study shows the intricate relationships among these risk factors and their impacts on population health outcomes and performance at both the national and state levels.

Implications of all the available evidence

The evidence presented in this study highlights the need for the USA to address its current and future health challenges through targeted interventions, supported by policy changes, and collaborative efforts across sectors to reduce the myriad risks to public health. By using the forecasts produced for this study and insights gathered, we can develop evidence-based strategies to reduce risk-attributable burden and thus effectively allocate resources and priorities. The USA faces serious health challenges in the coming decades, with smaller forecasted improvements in life expectancy and HALE than many other countries around the world and with some states even having declines for females. For certain leading diseases and injuries, most notably drug use disorders, health loss is forecasted to increase considerably through 2050, as is exposure to key risk factors including high BMI and high fasting plasma glucose. However, our alternative scenarios show that with concerted efforts to reduce exposure to key modifiable risks, the country has the potential to change its health trajectory and improve the wellbeing of its citizens.
The USA should foster a collective effort between policy makers, public health agencies, health-care providers, researchers, and citizens to work together in addressing these challenges. Focusing on preventing known risk factors to health, increasing scientific innovation, investing in education and research, and promoting equitable health-care access can help to reshape the future and create a healthier, more prosperous society. The available evidence serves as a call to action, emphasising the need for the USA to take responsibility for its citizens' wellbeing and work towards a better future. By harnessing the power of science, collaboration, and shared values in the USA's public health policies and systems, the nation can overcome its worst health challenges and continue to thrive as a global leader in innovation and prosperity for all.

Introduction

Forecasting future health trends and scenarios through rigorous scientific modelling, based on comprehensive estimates of health and health loss from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD), enables policy makers, practitioners, and the general public to allocate resources, develop interventions, and refine communication strategies more effectively. This is particularly relevant as the USA faces increasing burden of non-communicable diseases (NCDs) such as diabetes and chronic kidney disease—conditions that are costly to manage.[1–3] The ability of the health-care system to effectively address these diseases is crucial for ensuring the sustainability of health care and maintaining a healthy, productive population. To plan for the impact of disease, injury, and risk factor changes on the health outcomes of an ageing population, model-based estimates of future disease and demographic scenarios are essential.[4] Federal and state policy makers can use these forecasts to navigate the challenges posed by declining fertility rates on education, social safety nets, and the demographic composition and strength of the workforce. Additionally, changes in risk factor exposure, such as those related to substance use, diet, and air pollution, have important implications for future disease and injury burden, with an increase in mortality and disability unless these leading risk factors are effectively mitigated.[5] The COVID-19 pandemic has highlighted the importance of planning and preparation for known health threats, and has shown that advances in population health are fragile.[2,6,7]

Several forecasting studies based on historical estimates of disease and injury burden from GBD have been published.[8–11] These forecasts have provided valuable insights into mortality and disability-adjusted life-years (DALYs) at regional and country levels, helping to guide policies and interventions in response to various future health challenges. Forecasts for 195 countries and territories through the year 2100 included estimates of population size, age structure, fertility, migration, and all-cause mortality.[12] As we continue to refine our forecasting methods and expand our knowledge of health trends, the importance of understanding the potential future scenarios facing the USA becomes increasingly apparent.

In this study, we aim to provide an in-depth analysis of potential health scenarios for the USA, building upon previous GBD forecasts and incorporating non-fatal disease and injury burden estimates for the first time. We present forecasts of years lived with disability (YLDs), DALYs, and healthy life expectancy (HALE) for 50 states and Washington, DC, in the USA through the year 2050, in addition to measures of fatal disease and injury burden, such as mortality, years of life lost (YLLs), and life expectancy, under various scenarios. This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD Protocol.[13]

Methods

Overview

As previously published, we developed a comprehensive, multistaged modelling framework[1] for projecting 359 causes of fatal and non-fatal disease and injury burden from 2022 to 2050 for the USA and its states using GBD 2021 estimates.[2,5,6] The major components of this framework are depicted visually in appendix 1 (p 4). In this Article, we highlight the key aspects of our forecasting methodology, the full details of which were published previously.[1]

See **Online** for appendix 1

Health outcome forecasts were produced for a reference scenario, three alternative scenarios wherein exposure to key groups of risk factors is eliminated by 2050, a combined scenario encompassing the three previous scenarios, and three alternative scenarios wherein exposure or risk-attributable burden to several specific risk factors is set to that of the best-performing US states. These alternative scenarios evaluate the influence of changes in exposure to different risks and clusters of risks on future health outcomes.

This Article complies with the GATHER statement (appendix 1 p 72).[14]

Data sources

We used GBD estimates for past years as inputs for our forecasting models (available for download from the GBD Results Tool).[2,5,6,15,16] Additional data sources for select model components are detailed below.

For the **GBD Results Tool** see https://vizhub.healthdata.org/gbd-results

Forecasting independent drivers

Demographic drivers and vaccine coverage

The independent demographic drivers of disease and injury burden used in our forecasting model include contraceptive met need, educational attainment, age-specific fertility rates (ASFRs), and lag-distributed income (LDI) per capita. In short, contraceptive met need and educational attainment were forecasted using weighted annualised rates of change from Foreman and colleagues.[8] Parameters were selected using cross-validation. ASFRs were forecasted by first forecasting completed cohort fertility by age 50 years and then deriving implied ASFRs from these forecasts; complete methods have been published previously.[16] Forecasted LDI per capita was modelled using the methods described in an Article by the GBD 2021 Forecasting Collaborators.[1] Finally, the Socio-demographic Index (SDI) was forecasted by standardising and taking the geometric mean of educational attainment, LDI, and the total fertility rate among those younger than 25 years. See appendix 1 (pp 13–64) for forecasts of SDI and its three components for the USA and by US state. Educational attainment and LDI forecasts reflect the impacts of the COVID-19 pandemic on these drivers.[1]

Vaccine coverage for third-dose diphtheria, tetanus, and pertussis (DTP3) vaccine; measles conjugate vaccine doses 1 (MCV1) and 2 (MCV2); *H influenzae* type b (Hib) vaccine;

third-dose pneumococcal conjugate (PCV3) vaccine; and rotavirus vaccine were forecasted using linear mixed-effects models, as detailed in GBD 2021 Forecasting Collaborators.[1] Vaccine estimates include disruptions to vaccination campaigns during the COVID-19 pandemic. Vaccine coverage forecasts by vaccine, year, and US state are presented in appendix 1 (pp 65–69).

Risk factors

Summary exposure values (SEVs) for 68 GBD risk factors were forecasted using an ensemble model that included six annualised rate of change models and six meta-regression—Bayesian, regularised, trimmed (MR-BRT) spline models driven by SDI.[17] Future population attributable fractions (PAFs) were computed by cause and risk using forecasted SEVs and GBD estimates of the relative risk.[5] A novel risk factor mediation methodology was used to account for the secondary impacts of changes in diet, smoking, and BMI on mediator risks, such as systolic blood pressure, LDL cholesterol, and plasma glucose levels. Additional details on forecasting risk factors have been published previously.[5]

Temperature and particulate matter pollution

A distinct modelling approach was used to forecast the effect of temperature and particulate matter pollution on cause-specific mortality. We forecasted PAFs for each relevant cause due to non-optimal temperature using GBD estimates of relative risk[18] and Coupled Model Intercomparison Project Phase 6 (CMIP6) forecasted gridded global temperatures. We likewise forecasted PAFs for each relevant cause due to ambient particulate matter pollution using GBD estimates of relative risk and data from Turnock and colleagues[19] of CMIP6 forecasted gridded ambient particulate matter concentrations. For the reference scenario, we used CMIP6's forecasted estimates for the Shared Socioeconomic Pathways (SSP) 2–4·5 scenario, which reflects a "middle of the road" future with respect to reducing carbon emissions. By 2100, this SSP scenario suggests global surface temperature will rise by 2·7°C.[20] Complete methods have been published previously.[1]

For **CMIP6** see https://pcmdi.llnl.gov/CMIP6

Forecasting mortality and YLLs

Using the modelling framework from the GBD 2021 forecasting analysis[1]—which follows the methods from Foreman and colleagues[8] and Vollset and colleagues[12]—we forecasted mortality for 220 mutually exclusive and collectively exhaustive causes independently using a three-component model that included underlying mortality modelled as a function of time, SDI, and cause-specific covariates; a risk factor scalar; and a random walk with attenuated drift. To forecast residual trends not captured elsewhere in the model, we used an autoregressive integrated moving average (ARIMA; 0,1,0) with attenuated drift on all-cause mortality, and for all other causes, we used ARIMA (0,1,0) without drift. The resulting mortality estimates were then used to produce forecasted life tables and as inputs for population forecasts and non-fatal burden forecasts.[1]

Forecasted YLLs were computed by multiplying forecasted cause-specific mortality rates by standard life expectancy at each age.

Forecasting population

To forecast population, we first forecasted net migration rates for the USA using past migration estimates from the UN's Population Division of the Department of Economic and Social Affairs *World Population Prospects 2022* report.[21] We used forecasted migration rates, forecasted all-cause mortality rates, and forecasted age-specific fertility rates to forecast population, using a cohort-component method as detailed in previous articles by the GBD 2021 Forecasting Collaborators[1] and Vollset and colleagues.[12]

Forecasting non-fatal burden

We forecasted YLDs by first forecasting incidence and prevalence for 290 causes independently, as detailed previously[1] (see appendix 1 p 5 for further details on modelling strategies by cause). For nearly all causes, we then calculated the average disability weight across sequelae for each cause from GBD 2019 and multiplied these disability weights by the forecasts of prevalence to compute forecasted YLDs. We added YLDs to YLLs to obtain DALYs. We produced forecasted HALE using forecasted YLD rates and forecasted age-specific mortality rates.

Modelling alternative scenarios

In addition to a reference scenario, we produced seven alternative future scenarios to explore the potential impacts of changes in risk factor exposure on human health in the USA over the next several decades. These alternative scenarios illustrate what could be possible if exposure to a group of key modifiable risk factors were eliminated (four scenarios, as described previously),[1] or more plausibly, for three USA-specific scenarios, if exposure to specific contributors to health loss declined across all US states to exposure levels in the best-performing states (appendix 1 p 69). These scenarios are illustrative of potential futures, but do not consider cost, feasibility, or likelihood.

Safer environment (risk elimination scenario)

This scenario envisions the elimination of exposure to unsafe water, unsafe sanitation, and unsafe hygiene, as well as household air pollution, by 2050. This scenario likewise assumes that particulate matter pollution and non-optimal temperature will reflect CMIP6's climate projections using the SSP1–1·9 scenario (instead of the SSP2–4·5 scenario used in the reference forecasts), reflecting an aggressive decrease in carbon emissions to reach net 0 carbon emissions by 2050. By 2100, the SSP1–1·9 scenario suggests that global surface temperature will rise 1·9°C.[20] As with the reference scenario, we used particulate matter concentration forecasts from Turnock and colleagues,[19] but for the SSP1–1·9 scenario.

Improved behavioural and metabolic risks (risk elimination scenario)

This scenario involves the elimination of exposure to high adult BMI, high systolic blood pressure, high LDL cholesterol, and high fasting plasma glucose (FPG) by 2050. It also assumes optimal dietary habits for all dietary risks included in GBD, a reduction in the number of people who smoke tobacco to zero by 2050, and no new smokers after 2022.

Improved childhood nutrition and vaccination (risk elimination scenario)

This scenario envisions an end to child growth failure, vitamin A and iron deficiencies, and suboptimal breastfeeding by 2050. It also assumes 100% vaccine coverage for DTP3, MCV1, MCV2, Hib, PCV3, and rotavirus by 2050.

Combined (risk elimination scenario)

This scenario incorporates the trends from the safer environment, improved behavioural and metabolic risks, and improved childhood nutrition and vaccination scenarios.

USA-specific scenarios: improved adult BMI and FPG, improved smoking, and improved drug use

For this Article, we developed three specific US scenarios based on exposure to or mortality rates due to (1) high adult BMI and high FPG combined (improved adult BMI and FPG scenario), (2) tobacco smoking (improved smoking scenario), and (3) four categories of drug use (opioids, cocaine, amphetamines, and others; improved drug use scenario) in the three best-performing US states (from among all 50 states and Washington, DC). For each scenario and each age and sex, we took the mean of the SEVs (or mortality rates in the case of drug use) for the top three performing states in 2027. This average was set as the target level for all states, such that all other states were linearly forced to reach that level over 5 years, from 2022 to 2027. States with SEVs or mortality rates already better than the best-performing average were not forced upwards to a higher SEV or mortality rate. This approach assumes that each state could achieve such a level in 5 years and then continue on the average trajectory of the top three performing states thereafter.

Model performance

We used a skill metric based on root mean squared error (RMSE), as described previously,[1] to evaluate the accuracy of our forecasting model over the 2010–19 validation period. For our model and the baseline model (a simple model in which we held 2009 values constant during 2010–19), we calculated squared errors between the observed (based on GBD estimates) and predicted (based on the forecasting model) death and DALY values for each cause-sex-location-year. We then winsorised the squared errors at the 95% level. For USA model performance, we calculated RMSE values by taking the square root of the average of winsorised squared errors across US state-years for all causes combined and GBD Level 1 and 2 causes by sex, for both deaths and DALYs (appendix 1 pp 70–72). A positive value for the resulting skill metric indicates that our model performed better than the baseline model, while a negative value indicates that it performed worse. See appendix 1 (p 70) for detailed methods.

Presentation of estimates

Forecasts of disease and injury burden for 2022, 2035, and 2050 are given as counts and age-standardised rates per 100 000 population. For changes in burden over time, we provide percentage change between 2022 and 2050. All final estimates were computed using the mean estimate across 500 draws, and 95% uncertainty intervals (95% UIs) are given as the 2·5th and 97·5th percentiles of ranked values across all 500 draws (appendix 1 p 73). For readability, figures only include 95% UIs for the past and the future reference scenarios.

Cause-specific and risk-specific estimates are given for GBD causes and risk factors at several levels of the GBD cause and risk hierarchies. GBD causes are organised into four levels, with all causes at each level mutually exclusive and collectively exhaustive, and each subsequent level more detailed. For example, Level 1 causes include three broad cause categories: (1) NCDs, (2) communicable, maternal, neonatal, and nutritional (CMNN) diseases, and (3) injuries. Level 2 includes clusters of causes that each fit within one of the Level 1 aggregate categories. Level 3 includes causes and cause groups, while Level 4 includes causes further disaggregated from Level 3 cause groups, as well as Level 3 causes not disaggregated at Level 4. GBD risk factors are likewise organised into four Levels. Level 1 includes three broad risk categories: (1) behavioural, (2) metabolic, and (3) environmental and occupational. Level 2 includes risks or clusters of risks. Level 3 includes risks or risk clusters further disaggregated from Level 2 risks as well as risks not disaggregated beyond Level 2. Level 4 includes specific risk factors disaggregated from Level 3 risks, as well as risks not disaggregated beyond Level 2 or Level 3.

Analyses were done with Python version 3.10. The statistical code used is publicly available online on GitHub.

For the **statistical code used in this analysis** see https://github.com/ihmeuw/ihme-modeling/tree/main/gbd_2021/disease_burden_forecast_code

Role of the funding source

The funders of this study had no role in study design, data collection, data analysis, data interpretation, or the writing of the report.

	Life expectancy, years			Healthy life expectancy, years		
	2022	2035	2050	2022	2035	2050
USA	78·3 (78·1–78·5)	79·9 (79·5–80·2)	80·4 (79·8–81·0)	65·4 (61·7–68·5)	66·7 (63·1–69·8)	67·0 (63·3–70·1)
Alabama	74·8 (73·2–76·2)	76·2 (74·6–77·8)	76·9 (75·2–78·4)	62·5 (59·3–65·6)	63·6 (60·1–66·7)	64·0 (60·3–67·1)
Alaska	77·6 (76·3–78·9)	79·7 (78·4–81·1)	80·4 (78·9–81·9)	64·8 (61·1–68·1)	66·5 (62·7–69·9)	67·0 (63·1–70·3)
Arizona	77·6 (76·0–79·1)	79·7 (78·2–81·3)	80·2 (78·6–81·9)	64·5 (60·9–68·0)	66·1 (62·4–69·6)	66·3 (62·6–69·9)
Arkansas	74·8 (73·3–76·3)	76·3 (74·7–78·0)	76·9 (75·2–78·6)	63·1 (59·7–66·1)	64·2 (60·8–67·5)	64·6 (61·0–67·9)
California	80·6 (79·4–81·8)	82·1 (80·9–83·4)	82·5 (81·2–83·8)	67·7 (64·1–71·1)	69·0 (65·4–72·3)	69·2 (65·7–72·6)
Colorado	79·7 (78·2–81·1)	80·9 (79·3–82·4)	81·3 (79·8–82·8)	66·5 (62·6–69·8)	67·6 (63·6–70·9)	67·9 (64·0–71·3)
Connecticut	80·6 (79·1–82·2)	82·0 (80·5–83·6)	82·4 (80·9–83·9)	67·3 (63·3–70·7)	68·6 (64·5–72·1)	68·9 (64·8–72·5)
Delaware	77·5 (76·4–78·6)	79·2 (78·0–80·4)	79·8 (78·6–81·1)	64·5 (60·8–67·8)	65·8 (62·1–69·2)	66·2 (62·4–69·7)
Florida	78·5 (77·1–79·9)	80·1 (78·7–81·5)	80·6 (79·2–82·1)	65·3 (61·7–68·5)	66·5 (62·8–69·8)	66·8 (63·1–70·1)
Georgia	76·9 (75·5–78·4)	78·8 (77·2–80·3)	79·4 (77·8–81·0)	64·5 (61·0–67·8)	65·9 (62·3–69·3)	66·3 (62·5–69·8)
Hawaii	81·4 (79·9–82·8)	82·4 (80·9–83·8)	82·8 (81·3–84·3)	68·5 (64·7–71·8)	69·3 (65·5–72·7)	69·5 (65·6–73·0)
Idaho	79·3 (78·0–80·7)	80·5 (79·2–81·9)	80·9 (79·5–82·4)	66·3 (62·7–69·7)	67·2 (63·7–70·6)	67·5 (63·9–71·0)
Illinois	78·3 (76·9–79·6)	80·2 (78·8–81·7)	80·8 (79·3–82·3)	65·7 (62·1–69·0)	67·3 (63·7–70·6)	67·7 (64·0–71·1)
Indiana	76·5 (75·1–77·8)	77·8 (76·2–79·2)	78·3 (76·8–79·9)	63·7 (60·3–66·9)	64·6 (61·0–67·9)	64·9 (61·2–68·4)
Iowa	79·1 (77·6–80·6)	80·1 (78·5–81·7)	80·5 (78·9–82·1)	66·4 (62·8–69·6)	67·2 (63·7–70·5)	67·4 (63·8–70·7)
Kansas	77·8 (76·2–79·4)	78·9 (77·4–80·6)	79·4 (77·9–81·1)	65·2 (61·5–68·3)	66·1 (62·4–69·2)	66·3 (62·7–69·6)
Kentucky	74·4 (72·7–75·9)	75·9 (74·1–77·5)	76·5 (74·7–78·1)	61·7 (58·2–65·0)	62·7 (59·0–66·1)	63·0 (59·2–66·5)
Louisiana	74·9 (73·3–76·4)	76·4 (74·8–78·0)	77·1 (75·2–78·7)	62·5 (59·1–65·8)	63·6 (59·9–67·1)	63·9 (60·1–67·4)
Maine	77·7 (76·3–79·2)	79·1 (77·6–80·6)	79·5 (78·1–81·0)	64·8 (61·0–68·2)	65·8 (62·1–69·4)	66·1 (62·3–69·6)
Maryland	78·3 (76·8–79·9)	80·2 (78·7–81·9)	80·7 (79·3–82·5)	65·8 (62·2–69·1)	67·3 (63·7–70·7)	67·7 (64·0–71·1)
Massachusetts	81·2 (79·7–82·7)	82·3 (80·8–83·8)	82·6 (81·2–84·1)	67·6 (63·8–71·0)	68·6 (64·6–72·0)	68·8 (64·9–72·3)
Michigan	77·7 (76·3–79·1)	79·1 (77·5–80·6)	79·6 (78·0–81·1)	64·6 (60·7–67·7)	65·6 (61·8–68·8)	65·9 (62·0–69·3)
Minnesota	80·5 (79·2–81·9)	81·6 (80·3–82·9)	82·0 (80·7–83·4)	67·7 (64·0–71·1)	68·7 (65·1–72·0)	69·0 (65·3–72·4)
Mississippi	73·4 (71·8–75·0)	75·1 (73·2–76·7)	75·8 (73·8–77·6)	62·1 (58·8–65·2)	63·4 (59·9–66·6)	63·9 (60·2–67·0)
Missouri	76·4 (74·9–78·0)	77·9 (76·3–79·7)	78·6 (77·0–80·3)	63·8 (60·3–66·9)	64·9 (61·3–68·1)	65·3 (61·5–68·6)
Montana	78·6 (76·9–80·1)	79·6 (78·1–81·3)	80·1 (78·5–81·7)	65·6 (61·4–68·8)	66·4 (62·3–69·7)	66·8 (62·7–70·1)
Nebraska	78·8 (77·6–80·2)	80·1 (78·8–81·6)	80·5 (79·2–82·0)	66·2 (62·5–69·4)	67·3 (63·5–70·6)	67·5 (63·7–71·0)
Nevada	77·6 (76·3–79·0)	80·0 (78·4–81·5)	80·8 (79·2–82·4)	64·9 (61·3–68·3)	66·8 (63·1–70·4)	67·3 (63·6–71·1)

(Table 1 continues on next page)

Results

Reference scenario: life expectancy, HALE, and mortality

Life expectancy in the USA is projected to increase from 78·3 years (95% UI 78·1–78·5) in 2022 to 79·9 years (79·5–80·2) in 2035, and to 80·4 years (79·8–81·0) in 2050 for all sexes combined (table 1). US life expectancy for males will increase from 75·7 years (75·4–75·9) in 2022 to 78·4 years (77·8–79·0) in 2050, and for females, from 80·9 years (80·7–81·1) to 82·4 years (81·8–83·1; appendix 1 p 78). This is a modest increase compared with other countries around the world, which will result in the USA declining in rank among 204 countries and territories over the 2022–50 forecasted period, from 49th to 66th for all sexes combined, from 51st to 65th for males, and from 51st to 74th for females (figure 1A). The USA's world ranking for life expectancy at age 70 years—a population with access to a form of universal health care through Medicare—is likewise forecasted to decline from 45th (15·4 additional years expected until death [15·3–15·5]) in 2022 to 60th (16·5 additional years [16·2–16·9]) in 2050 (appendix 1 p 1416).

HALE in the USA is projected to increase from 65·4 years (95% UI 61·7–68·5) in 2022 to 66·7 years (63·1–69·8) in 2035 and 67·0 years (63·3–70·1) in 2050 for all sexes combined (table 1). HALE is expected to increase from 64·3 years (61·2–67·0) in 2022 to 66·6 years (63·0–69·1) in 2050 for males and from 66·5 years (62·4–70·0) to 67·7 years (63·6–71·2) for females (appendix 1 p 78). The USA's global HALE ranking is also projected to decline during the 2022–50 period, from 80th to 108th for all sexes combined, from 77th to 96th for males, and from 84th to 103rd for females (figure 1B).

Age-standardised mortality rates in the USA are projected to decrease from 2022 to 2050, albeit at a slower rate than from 1990 to 2010 (appendix 1 p 130). The major cause for this decline is the decrease in cardiovascular disease mortality rates. Age-standardised YLL rates follow the same patterns, with a rapid decline from 1990 to 2010, a slow increase after 2010 and during the COVID-19 pandemic, and slower decline in the future. The leading Level 3 cause of age-standardised mortality for all sexes combined in 2050 is forecasted to be ischaemic heart disease, followed by chronic kidney disease and Alzheimer's disease and other dementias (appendix 1 p 182). Our forecasts show a large decline of 49·4% (95% UI 38·3 to 58·0) in age-standardised mortality rates from 2022 to 2050 for ischaemic heart disease, but a large increase in chronic kidney disease (42·0% [21·0 to 65·1]) and a small increase for Alzheimer's (2·5% [–1·5 to 7·1]). We also forecasted large declines in age-standardised mortality rates between 2022 and 2050 for several other top 25 causes, most notably stroke (40·5% [33·6 to 46·9] decline; decrease in rank from fifth to seventh) and diabetes (35·7% [24·6 to 46·0] decline; decrease in rank from

12th to 17th). On the other hand, we forecasted a large rise in age-standardised mortality due to drug use disorders (34·2% [12·8 to 60·1] increase; increase in rank from eighth to fifth). This rate is forecasted to be the highest in the world, more than twice as high as the next-highest country (Canada).[1]

For males, ischaemic heart disease is forecasted to be the leading cause of age-standardised mortality in 2050, followed by drug use disorders and chronic kidney disease (see online GBD Foresight visualisation tool). The male ischaemic heart disease rate is projected to decrease over the forecasted period (50·6% [95% UI 38·8 to 59·4] decline) while the mortality rate is expected to increase for both drug use disorders (29·7% [5·6 to 62·1]) and chronic kidney disease (25·1% [4·8 to 48·6]). For females, Alzheimer's disease is forecasted to be the leading cause of age-standardised mortality in 2050 (1·9% [–3·5 to 8·7] increase from 2022), followed by chronic obstructive pulmonary disease (COPD; 5·0% [–13·9 to 25·7] increase) and chronic kidney disease (58·7% [33·4 to 88·2] increase). For ages 15–49, the three leading causes of age-standardised mortality for all sexes combined in both 2022 and 2050 are forecasted to be, in descending order, drug use disorders (35·8% [8·6 to 67·3] increase), self-harm (9·7% [–2·5 to 20·6] decrease), and road injuries (5·7% [–18·3 to 33·3] increase; GBD Foresight).

Life expectancy and HALE are projected to vary by state over our forecasted study period (table 1). West Virginia is forecasted to have the lowest life expectancy for males (73·4 years [95% UI 70·7–76·0]) and females (77·7 years [75·3–80·0]) in 2050, while New York is expected to have the highest for males (81·0 years [79·0–83·2]) and Hawaii the highest for females (85·5 years [84·1–86·8]; figure 1C). West Virginia is also projected to have the lowest HALE for males (61·2 years [57·3–64·9]) and females (62·8 years [58·5–66·9]) in 2050, while Hawaii is expected to have the highest for males (68·2 years [64·4–71·6]) and California the highest for females (70·0 years [66·0–73·7]; figure 1D). When comparing life expectancy and HALE in the best-performing and worst-performing US states with the other 203 countries and territories in GBD (excluding the USA as a whole), the ranking of the states declined over the forecasted period. The best-performing state for all sexes combined is forecasted to drop from 29th of 204 in 2022 (Hawaii) to 41st in 2050 (New York) for life expectancy and from 41st to 57th for HALE (Hawaii), while the worst-performing state is forecasted to drop from 102nd in 2022 (Mississippi) to 140th in 2050 (West Virginia) for life expectancy and from 141st to 179th (West Virginia) for HALE (figure 1C, D). There is projected to be a decline in female life expectancy in West Virginia from 1990 to 2050 and little change in Arkansas and Oklahoma, in contrast to all other states, which are expected to increase. After 2023, female life expectancy in many states is expected to plateau, notably in Oklahoma, South Dakota,

	Life expectancy, years			Healthy life expectancy, years		
	2022	2035	2050	2022	2035	2050
(Continued from previous page)						
New Hampshire	79·4 (78·0–80·9)	80·5 (79·1–82·1)	80·9 (79·5–82·4)	65·9 (61·9–69·5)	66·9 (62·9–70·6)	67·1 (63·2–70·9)
New Jersey	80·2 (78·7–81·6)	82·0 (80·4–83·4)	82·4 (80·7–83·8)	67·0 (63·3–70·3)	68·5 (64·7–71·8)	68·8 (64·9–72·1)
New Mexico	75·6 (73·9–77·2)	78·0 (76·0–79·7)	78·6 (76·6–80·4)	62·9 (59·2–66·4)	64·6 (60·7–68·2)	65·0 (60·9–68·5)
New York	80·6 (79·3–81·9)	82·6 (81·2–84·0)	83·0 (81·7–84·4)	66·9 (63·2–70·6)	68·5 (64·8–71·9)	68·8 (64·9–72·3)
North Carolina	77·0 (75·6–78·4)	78·6 (77·1–80·2)	79·2 (77·6–80·8)	64·5 (60·8–68·0)	65·8 (61·9–69·3)	66·1 (62·2–69·6)
North Dakota	80·6 (79·2–81·9)	81·3 (79·9–82·7)	81·6 (80·2–83·0)	67·1 (63·3–70·7)	67·7 (63·8–71·2)	67·8 (63·9–71·3)
Ohio	76·4 (74·9–77·7)	77·6 (76·0–79·0)	78·1 (76·5–79·5)	63·4 (59·6–66·7)	64·3 (60·5–67·6)	64·6 (60·7–68·0)
Oklahoma	74·8 (73·2–76·1)	76·3 (74·5–77·8)	76·8 (75·0–78·5)	62·3 (58·8–65·5)	63·4 (59·6–66·8)	63·7 (59·8–67·1)
Oregon	79·4 (77·7–80·8)	80·8 (79·0–82·3)	81·2 (79·5–82·9)	66·5 (63·0–69·9)	67·7 (64·0–71·1)	68·1 (64·4–71·5)
Pennsylvania	78·3 (76·8–79·7)	79·4 (77·9–80·9)	79·9 (78·4–81·4)	64·8 (61·0–68·0)	65·8 (61·9–68·9)	66·0 (62·2–69·3)
Rhode Island	80·5 (78·9–82·0)	81·5 (79·9–83·0)	81·9 (80·3–83·4)	67·0 (63·1–70·4)	67·9 (64·1–71·4)	68·2 (64·4–71·7)
South Carolina	76·0 (74·6–77·5)	77·6 (76·1–79·2)	78·1 (76·6–79·9)	63·4 (59·9–66·6)	64·6 (60·9–68·0)	64·9 (61·1–68·4)
South Dakota	78·9 (77·5–80·2)	79·8 (78·4–81·3)	80·2 (78·8–81·6)	66·1 (62·4–69·4)	66·8 (63·0–70·2)	67·0 (63·1–70·4)
Tennessee	75·0 (73·5–76·4)	76·5 (74·9–78·2)	77·1 (75·5–78·8)	62·6 (59·1–65·8)	63·7 (60·1–67·0)	64·0 (60·4–67·4)
Texas	78·2 (76·9–79·6)	79·8 (78·5–81·2)	80·4 (79·0–81·9)	65·7 (62·2–69·0)	67·0 (63·4–70·3)	67·4 (63·6–70·8)
Utah	79·7 (78·4–80·9)	80·6 (79·2–81·8)	80·9 (79·5–82·2)	66·5 (62·7–69·8)	67·2 (63·3–70·6)	67·4 (63·4–70·8)
Vermont	78·7 (77·5–79·8)	80·9 (79·6–81·9)	81·2 (79·9–82·4)	66·2 (62·6–69·3)	67·9 (64·3–71·0)	68·1 (64·5–71·3)
Virginia	78·6 (77·1–80·1)	80·3 (78·8–81·9)	80·9 (79·3–82·4)	65·8 (62·3–69·3)	67·2 (63·5–70·8)	67·6 (63·8–71·2)
Washington	80·2 (78·9–81·7)	81·5 (80·1–83·0)	81·9 (80·5–83·4)	67·0 (63·1–70·5)	68·1 (64·3–71·6)	68·4 (64·6–71·9)
Washington, DC	78·4 (76·9–80·0)	79·7 (78·3–81·2)	80·5 (79·0–82·0)	65·9 (62·3–69·0)	67·2 (63·7–70·2)	67·7 (64·2–70·8)
West Virginia	73·5 (71·8–75·0)	74·9 (73·0–76·8)	75·5 (73·4–77·4)	60·8 (56·9–64·0)	61·7 (57·7–65·2)	62·0 (58·0–65·4)
Wisconsin	79·0 (77·5–80·7)	80·3 (78·6–81·9)	80·7 (79·1–82·2)	66·0 (62·3–69·4)	67·1 (63·3–70·7)	67·4 (63·5–71·1)
Wyoming	78·1 (76·8–79·2)	79·2 (77·9–80·3)	79·6 (78·3–80·8)	65·2 (61·7–68·5)	66·2 (62·7–69·4)	66·5 (62·8–69·8)

Estimates are mean (95% uncertainty interval).

Table 1: **Life expectancy and healthy life expectancy for the USA and for US states and Washington, DC, under the reference scenario, 2022, 2035, and 2050**

Utah, Iowa, Maine, and Wisconsin (appendix 1 p 78). In addition, female HALE is projected to decline between 1990 and 2050 in 20 states (appendix 1 p 77), and not improve in Arizona, Idaho, or North Dakota (appendix 1 p 78). The gap in life expectancy and HALE between males and females is projected to decrease over the forecasted period, mainly due to the slow increases or

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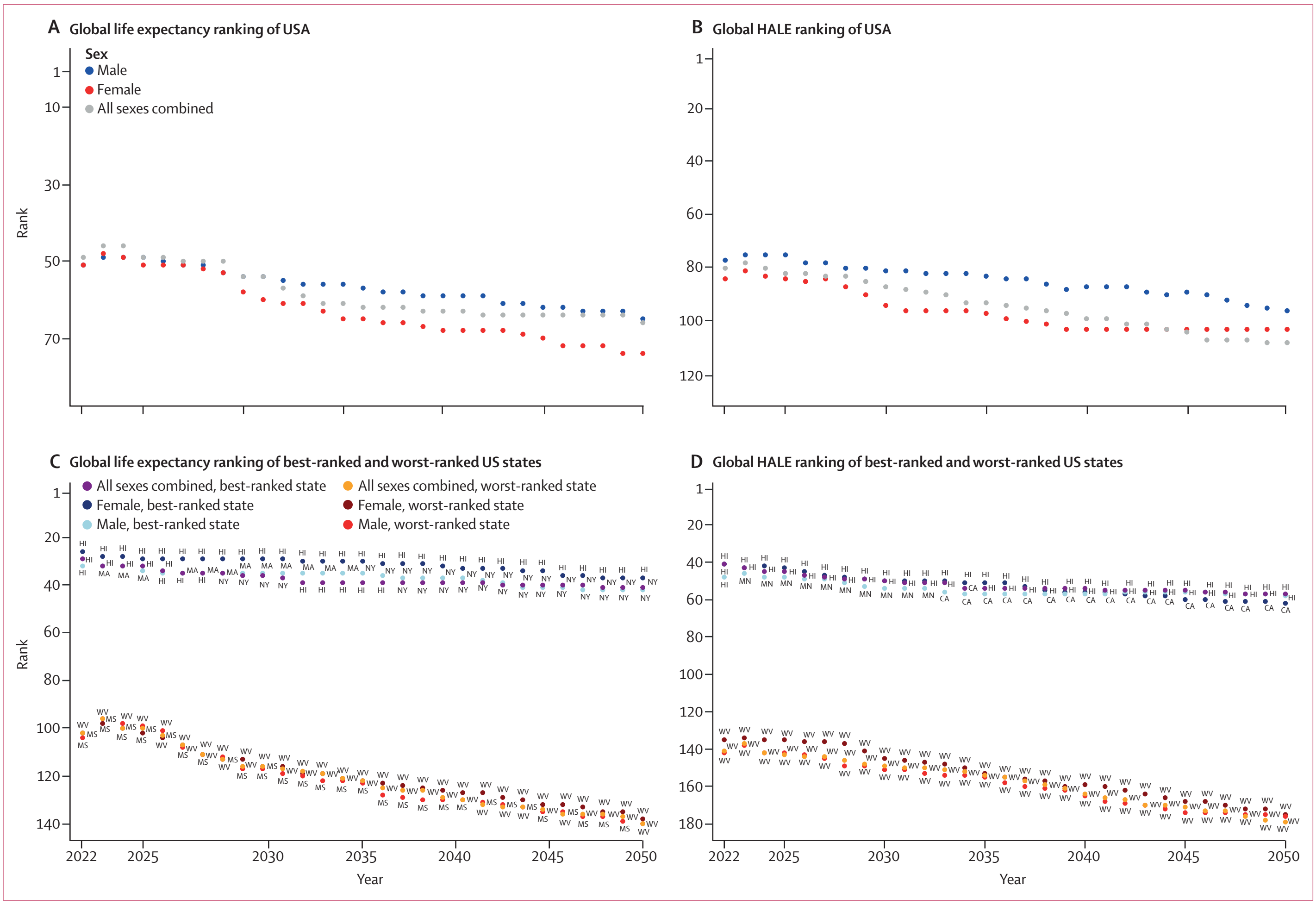

Figure 1: **Global ranking of USA and best-ranked and worst-ranked US states for life expectancy and HALE under the reference scenario, 2022–50**
Forecasts are shown for males, females, and all sexes combined. The global life expectancy ranking (A) and HALE ranking (B) of the USA are shown among all 204 countries and territories. The global life expectancy ranking (C) and HALE ranking (D) of the best-ranked and worst-ranked US states (and Washington, DC) in each year of the forecasted period are shown among all 203 other countries and territories in the Global Burden of Disease Study (excluding the USA). HALE=healthy life expectancy. CA=California. HI=Hawaii. MA=Massachusetts. MN=Minnesota. MS=Mississippi. NY=New York. WV=West Virginia.

no changes in female life expectancy and HALE rather than due to major improvements in males.

Age-standardised mortality varied by state throughout our study period but reflected the same broad patterns observed at the national level (appendix 1 p 130). The improvement observed in mortality rates from 1990 to 2010 slowed down remarkably after 2010, with an increase during the years leading up to the COVID-19 pandemic in some states, and during the pandemic (2020–22) in all states. The subsequent decline after 2022 is projected to be slower than before the pandemic, and with little improvement to 2050 in Arizona, Arkansas, Colorado, Iowa, Kansas, Kentucky, North Dakota, Ohio, Oklahoma, Utah, and West Virginia (appendix 1 p 130). The slower reductions in age-standardised mortality rates after 2010 and from 2022 to 2050 are seen even in the best-performing states, such as Hawaii. Appendix 1 (p 182) shows the leading Level 3 causes of age-standardised mortality rates from 2022 to 2050 for all states. The projected leading causes of deaths vary by state in 2050, with drug use disorders the leading cause in West Virginia, compared with Alzheimer's disease and other dementias for Hawaii.

Reference scenario: disability

Musculoskeletal disorders are forecasted to be the leading Level 2 cause of age-standardised DALYs in 2050 in the USA, followed by neoplasms (appendix 1 p 130). The leading Level 2 causes for males are projected to be substance use disorders and neoplasms, and for females will be musculoskeletal disorders and mental disorders (GBD Foresight). For Level 3 causes, drug use disorders and low back pain are projected to be the leading causes of age-standardised DALYs in 2050 (appendix 1 p 234). The age-standardised DALY rate due to drug use disorders is projected to increase considerably between 2022 and 2050

	2022	2035	2050	Percentage change, 2022 to 2050
Unsafe water source	0·3 (0·2 to 0·4)	0·2 (0·1 to 0·3)	0·1 (0·1 to 0·2)	–64·2 (–74·6 to –35·4)
Unsafe sanitation	2·7 (1·6 to 4·1)	2·1 (1·1 to 3·6)	1·7 (0·8 to 3·2)	–36·6 (–57·6 to –20·1)
No access to handwashing facility	3·1 (2·9 to 3·2)	3·0 (2·8 to 3·2)	2·9 (2·7 to 3·1)	–5·3 (–8·2 to –2·2)
Ambient particulate matter pollution	4·5 (2·4 to 6·9)	3·2 (1·5 to 5·6)	2·2 (0·8 to 4·8)	–52·6 (–67·2 to –24·1)
Household air pollution from solid fuels	0·0 (0·0 to 0·0)	0·0 (0·0 to 0·0)	0·0 (0·0 to 0·0)	–51·8 (–69·0 to –24·7)
Ambient ozone pollution	42·6 (18·7 to 65·3)	34·3 (13·0 to 58·6)	26·5 (7·6 to 53·4)	–39·5 (–67·0 to –11·7)
Residential radon	19·8 (12·8 to 29·2)	19·7 (12·7 to 29·2)	19·6 (12·6 to 29·1)	–1·0 (–1·5 to –0·3)
Lead exposure in bone	18·4 (5·1 to 35·9)	11·6 (2·9 to 29·2)	6·9 (1·1 to 24·3)	–62·7 (–86·1 to –21·8)
Occupational exposure to asbestos	3·6 (3·0 to 4·2)	3·2 (2·7 to 3·9)	2·9 (2·3 to 3·7)	–19·1 (–27·8 to –7·9)
Occupational exposure to arsenic	0·5 (0·0 to 1·2)	0·5 (0·0 to 1·2)	0·5 (0·0 to 1·2)	37·4 (0·9 to 907·1)
Occupational exposure to benzene	1·1 (0·1 to 3·4)	1·1 (0·1 to 3·4)	1·2 (0·1 to 3·5)	27·2 (0·9 to 11·4)
Occupational exposure to beryllium	0·0 (0·0 to 0·0)	0·0 (0·0 to 0·0)	0·0 (0·0 to 0·0)	4·0 (0·9 to 7·5)
Occupational exposure to cadmium	0·1 (0·1 to 0·1)	0·1 (0·1 to 0·1)	0·1 (0·1 to 0·1)	3·6 (0·9 to 7·1)
Occupational exposure to chromium	0·2 (0·1 to 0·2)	0·2 (0·1 to 0·2)	0·2 (0·1 to 0·2)	4·0 (1·1 to 6·9)
Occupational exposure to diesel engine exhaust	0·8 (0·7 to 0·8)	0·8 (0·7 to 0·8)	0·8 (0·7 to 0·8)	4·0 (0·8 to 8·9)
Occupational exposure to formaldehyde	0·3 (0·3 to 0·3)	0·3 (0·3 to 0·3)	0·3 (0·3 to 0·3)	2·7 (0·3 to 6·5)
Occupational exposure to nickel	0·4 (0·0 to 1·6)	0·4 (0·0 to 1·6)	0·4 (0·0 to 1·6)	112·1 (–0·2 to 982·1)
Occupational exposure to polycyclic aromatic hydrocarbons	0·3 (0·3 to 0·3)	0·3 (0·3 to 0·3)	0·3 (0·3 to 0·4)	4·3 (1·1 to 6·9)
Occupational exposure to silica	3·4 (0·5 to 10·7)	3·4 (0·5 to 10·7)	3·4 (0·5 to 10·6)	11·2 (–2·5 to 6·9)
Occupational exposure to sulphuric acid	1·0 (0·2 to 3·0)	1·0 (0·2 to 3·0)	1·1 (0·2 to 3·1)	4·6 (0·1 to 14·3)
Occupational exposure to trichloroethylene	0·1 (0·1 to 0·1)	0·1 (0·1 to 0·1)	0·1 (0·1 to 0·1)	12·0 (1·1 to 7·3)
Occupational asthmagens	16·1 (14·1 to 18·4)	16·0 (14·0 to 18·3)	15·9 (13·9 to 18·1)	–1·1 (–2·8 to 2·1)
Occupational particulate matter, gases, and fumes	6·5 (5·1 to 8·2)	6·2 (4·8 to 7·8)	5·8 (4·5 to 7·6)	–9·9 (–14·8 to –3·6)
Occupational noise	7·0 (6·7 to 7·4)	6·8 (6·4 to 7·2)	6·6 (6·1 to 7·2)	–5·8 (–9·5 to –1·8)
Occupational ergonomic factors	9·1 (7·7 to 11·1)	9·1 (7·7 to 11·1)	9·1 (7·7 to 11·1)	–0·2 (–1·6 to 3·6)
Non-exclusive breastfeeding	24·6 (21·0 to 28·8)	23·8 (20·2 to 27·8)	23·0 (19·4 to 26·9)	–6·5 (–9·0 to –4·2)
Discontinued breastfeeding	25·6 (24·6 to 26·4)	25·6 (24·6 to 26·4)	25·6 (24·6 to 26·4)	0·0 (0·0 to 0·0)
Child underweight	0·9 (0·5 to 1·3)	0·9 (0·5 to 1·3)	0·9 (0·5 to 1·3)	0·0 (0·0 to 0·0)
Child wasting	0·7 (0·5 to 1·0)	0·7 (0·5 to 1·0)	0·7 (0·5 to 1·0)	0·0 (0·0 to 0·0)
Child stunting	1·9 (0·9 to 2·7)	1·9 (0·9 to 2·7)	1·9 (0·9 to 2·7)	0·0 (0·0 to 0·0)
Short gestation	23·6 (22·0 to 25·4)	22·3 (20·6 to 24·2)	20·9 (18·9 to 23·4)	–11·5 (–15·6 to –3·6)
Low birthweight	11·6 (11·0 to 12·3)	11·5 (10·9 to 12·2)	11·4 (10·7 to 12·1)	–1·8 (–4·7 to –0·6)
Iron deficiency	12·3 (10·5 to 14·3)	12·4 (10·6 to 14·3)	12·5 (10·7 to 14·5)	1·8 (0·1 to 2·9)
Vitamin A deficiency	1·1 (0·6 to 1·9)	1·1 (0·6 to 1·9)	1·1 (0·6 to 1·9)	0·0 (0·0 to 0·0)
Zinc deficiency	1·2 (0·0 to 3·7)	1·2 (0·0 to 3·7)	1·2 (0·0 to 3·7)	0·0 (0·0 to 0·0)
Smoking	13·9 (12·4 to 15·4)	11·8 (10·5 to 13·2)	9·9 (8·7 to 11·2)	–28·9 (–32·2 to –23·5)
Chewing tobacco	2·0 (1·6 to 2·5)	2·0 (1·6 to 2·4)	1·9 (1·6 to 2·4)	–3·7 (–7·0 to –0·5)
Second-hand smoke	23·8 (22·5 to 25·2)	21·5 (18·2 to 23·8)	19·1 (13·7 to 22·6)	–19·9 (–39·7 to –8·6)
High alcohol use	13·9 (9·7 to 18·9)	14·8 (10·4 to 19·8)	15·8 (10·9 to 21·1)	13·7 (4·9 to 19·5)
Suicide due to drug use disorders	1·3 (1·0 to 1·6)	1·5 (1·1 to 2·2)	1·9 (1·2 to 3·2)	53·5 (20·8 to 113·3)
Diet low in fruits	45·4 (34·2 to 57·5)	44·3 (33·1 to 56·3)	43·3 (31·5 to 55·6)	–4·7 (–13·9 to –1·5)
Diet low in vegetables	38·0 (25·3 to 53·2)	38·5 (25·2 to 54·4)	38·9 (25·1 to 55·0)	2·4 (–6·8 to 21·3)
Diet low in legumes	75·7 (44·5 to 99·4)	76·3 (45·0 to 99·4)	76·9 (45·9 to 99·5)	1·7 (0·0 to 5·4)
Diet low in whole grains	80·6 (72·3 to 89·1)	81·0 (72·8 to 89·2)	81·4 (73·1 to 89·5)	1·0 (0·3 to 3·1)
Diet low in nuts and seeds	19·1 (5·6 to 52·5)	17·2 (4·9 to 48·5)	15·4 (4·3 to 44·9)	–20·5 (–39·8 to –5·0)
Diet low in milk	40·8 (20·3 to 60·1)	39·5 (19·1 to 58·9)	38·1 (18·0 to 57·4)	–6·9 (–14·6 to –2·0)
Diet high in red meat	46·6 (0·0 to 56·9)	46·5 (0·0 to 56·8)	46·4 (0·0 to 56·7)	–0·4 (–1·1 to –0·1)
Diet high in processed meat	86·3 (70·9 to 99·3)	86·8 (70·5 to 99·4)	87·4 (70·6 to 99·4)	1·4 (–1·3 to 7·1)
Diet high in sugar-sweetened beverages	66·4 (55·5 to 76·3)	68·3 (57·1 to 79·3)	70·4 (58·6 to 83·2)	6·0 (1·4 to 19·8)
Diet low in fibre	25·6 (14·9 to 36·2)	22·7 (13·1 to 33·9)	19·8 (10·5 to 32·4)	–23·1 (–38·0 to –7·6)

(Table 2 continues on next page)

	2022	2035	2050	Percentage change, 2022 to 2050
(Continued from previous page)				
Diet low in calcium	10·7 (4·9 to 19·9)	10·5 (4·5 to 19·9)	10·3 (4·1 to 20·0)	–5·2 (–20·5 to 4·6)
Diet low in seafood omega-3 fatty acids	80·8 (67·9 to 98·4)	79·9 (66·3 to 98·3)	79·0 (64·1 to 98·3)	–2·4 (–8·0 to –0·1)
Diet low in omega-6 polyunsaturated fatty acids	6·2 (2·2 to 25·4)	5·2 (1·7 to 21·5)	4·3 (1·3 to 19·0)	–33·7 (–55·4 to –12·3)
Diet high in trans fatty acids	85·1 (78·5 to 91·8)	83·6 (76·2 to 91·2)	81·7 (73·4 to 90·1)	–4·1 (–7·7 to –1·1)
Diet high in sodium	33·9 (8·3 to 57·1)	35·6 (9·0 to 60·0)	37·5 (9·6 to 63·1)	12·0 (3·1 to 42·7)
Intimate partner violence (exposure approach)	28·2 (19·8 to 36·4)	28·1 (19·6 to 36·2)	28·0 (19·5 to 36·0)	1·6 (–2·0 to 0·3)
Childhood sexual abuse against females	17·9 (13·4 to 24·7)	18·7 (13·8 to 26·0)	19·6 (14·0 to 27·4)	13·9 (0·5 to 25·1)
Childhood sexual abuse against males	6·7 (4·5 to 9·3)	6·6 (4·4 to 9·1)	6·4 (4·3 to 9·0)	–3·9 (–5·9 to –0·4)
Bullying victimisation	8·7 (3·3 to 16·7)	9·2 (3·6 to 17·8)	9·8 (3·9 to 18·9)	13·6 (5·6 to 22·8)
Low physical activity	3·9 (1·9 to 7·4)	4·2 (2·0 to 8·2)	4·5 (2·1 to 8·6)	16·3 (3·7 to 45·5)
High fasting plasma glucose	17·1 (15·7 to 18·5)	19·2 (17·0 to 21·5)	21·9 (18·1 to 25·8)	28·3 (11·9 to 44·8)
High systolic blood pressure	19·2 (16·7 to 21·6)	20·0 (17·4 to 22·9)	20·9 (17·8 to 24·5)	8·9 (–1·9 to 19·8)
Low bone mineral density	15·5 (10·5 to 22·2)	16·6 (11·1 to 24·2)	17·9 (11·3 to 27·0)	15·7 (3·2 to 42·0)
Kidney dysfunction	21·4 (15·9 to 28·4)	21·6 (16·0 to 28·7)	21·8 (16·1 to 29·0)	1·7 (0·5 to 3·3)
High LDL cholesterol	30·3 (27·2 to 33·8)	26·7 (22·5 to 30·9)	23·5 (18·1 to 29·2)	–22·3 (–38·5 to –8·6)
High BMI in adults	27·7 (23·0 to 31·4)	29·2 (24·3 to 33·6)	31·0 (25·3 to 37·1)	11·6 (3·8 to 27·5)
High BMI in children	34·4 (30·7 to 38·3)	37·1 (32·5 to 42·5)	40·2 (33·4 to 50·1)	16·8 (5·1 to 40·7)

Estimates are mean (95% uncertainty interval). Summary exposure values are provided for the most specific risk factors in the Global Burden of Diseases, Injuries, and Risk Factors Study hierarchy.

Table 2: **Age-standardised summary exposure values for the USA in 2022, 2035, and 2050, and percentage change between 2022 and 2050, by risk factor, under the reference scenario**

(19·5% [95% UI 6·9–34·1] increase) while that of low back pain will decrease only slightly (1·2% [1·2–1·3] decrease). In the 15–49-year age group, drug use disorders and low back pain are forecasted to be the leading Level 3 causes of DALYs in 2050 for all sexes combined (GBD Foresight). For males in this age group, the leading causes are forecasted to be drug use disorders, road injuries, and self-harm, compared with drug use disorders, other musculoskeletal disorders, and depressive disorders for females.

Low back pain is projected to be the leading cause of age-standardised YLDs for all sexes combined in 2050, although with a 1·2% (95% UI 1·2–1·3) decrease from 2022 (appendix 1 p 286). Low back pain will likewise be the leading age-standardised YLD cause for females in 2050, while drug use disorders will be the leading cause for males. YLDs also vary by age group, with drug use disorders being the leading cause for ages 15–49 years, followed by low back pain (GBD Foresight).

Age-standardised DALY rates are projected to decrease in all US states from 1990 to 2050 except in Kentucky and West Virginia (appendix 1 p 130). In both states, these rates decline after 2030 but remain above the 1990 levels in 2050. Similar patterns are observed in the majority of states, where the largest health outcome improvements occurred in the past, mainly from 1990 to 2010. As shown in appendix 1 (p 130), the best-performing states in 2050, such as Hawaii and New York, are projected to have greater improvements in reducing the burden from cardiovascular diseases, while the worst-performing states will have larger substance use disorder problems, in addition to higher rates of other causes. Drug use disorders are projected to be the leading Level 3 cause of age-standardised DALYs in 2050 in all US states but Nebraska (low back pain) and North and South Dakota (other musculoskeletal disorders), although rates vary by state (appendix 1 p 235). The leading cause of age-standardised YLD rates by state varies more, although low back pain or drug use disorders lead for most states (appendix 1 p 286).

Reference scenario: risk factors

Among the 30 leading risk factors for age-standardised SEVs, the largest increases are projected to occur for high BMI in children (16·8% [95% UI 5·1 to 40·7] increase; ninth-highest age-standardised SEV in 2050), diet high in sodium (12·0% [3·1 to 42·7] increase; ranked 12th), high BMI in adults (11·6% [3·8 to 27·5] increase; ranked 13th), high FPG (28·3% [11·9 to 44·8] increase; ranked 19th), high systolic blood pressure (8·9% [–1·9 to 19·8] increase; ranked 22nd), and high alcohol use (13·7% [4·9 to 19·5] increase; ranked 29th; table 2). While exposure to some components of poor diet is projected to decline over the forecasted period, many will remain leading risk factors for exposure, with diet high in processed meat ranked first in 2050 (age-standardised SEV 87·4 [70·6 to 99·4] per 100 000 population). Different SEV patterns are observed by sex and age (see GBD Foresight).

Different trends in age-standardised SEVs from 2022 to 2050 emerge at the state level (appendix 1 p 339).

	Safer environment			Improved behavioural and metabolic risks			Improved childhood nutrition and vaccination			Combined		
	2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
Life expectancy, years												
USA	78·3 (78·1–78·5)	79·9 (79·6–80·2)	80·4 (79·8–81·0)	78·3 (78·1–78·5)	82·0 (81·7–82·3)	84·2 (83·7–84·7)	78·3 (78·1–78·5)	79·9 (79·6–80·2)	80·4 (79·8–81·0)	78·3 (78·1–78·5)	82·0 (81·7–82·3)	84·2 (83·7–84·7)
Alabama	74·8 (73·2–76·3)	76·3 (74·6–77·8)	76·9 (75·2–78·4)	74·8 (73·2–76·2)	78·8 (77·2–80·3)	81·4 (79·7–83·0)	74·8 (73·2–76·2)	76·2 (74·6–77·8)	76·9 (75·2–78·4)	74·8 (73·2–76·3)	78·8 (77·2–80·3)	81·4 (79·8–83·0)
Alaska	77·6 (76·3–78·9)	79·7 (78·4–81·1)	80·4 (78·9–81·9)	77·6 (76·3–78·9)	82·0 (80·7–83·5)	84·8 (83·3–86·2)	77·6 (76·3–78·9)	79·7 (78·4–81·1)	80·5 (79·0–81·9)	77·6 (76·3–78·9)	82·1 (80·7–83·5)	84·8 (83·3–86·3)
Arizona	77·6 (76·0–79·1)	79·7 (78·2–81·3)	80·2 (78·6–82·0)	77·6 (76·0–79·1)	81·8 (80·2–83·5)	84·0 (82·4–85·7)	77·6 (76·0–79·1)	79·7 (78·2–81·3)	80·2 (78·6–81·9)	77·6 (76·0–79·1)	81·8 (80·2–83·5)	84·1 (82·5–85·7)
Arkansas	74·8 (73·3–76·3)	76·4 (74·7–78·0)	77·0 (75·3–78·6)	74·8 (73·3–76·3)	79·0 (77·3–80·6)	81·7 (80·1–83·3)	74·8 (73·3–76·3)	76·3 (74·7–78·0)	76·9 (75·2–78·6)	74·8 (73·3–76·3)	79·0 (77·3–80·6)	81·7 (80·1–83·3)
California	80·6 (79·4–81·8)	82·1 (80·9–83·4)	82·5 (81·3–83·8)	80·6 (79·4–81·8)	84·1 (82·9–85·4)	86·1 (84·8–87·3)	80·6 (79·4–81·8)	82·1 (80·9–83·4)	82·5 (81·2–83·8)	80·6 (79·4–81·8)	84·1 (82·9–85·4)	86·1 (84·9–87·4)
Colorado	79·7 (78·2–81·1)	80·9 (79·3–82·4)	81·3 (79·8–82·8)	79·7 (78·2–81·1)	82·6 (81·0–84·1)	84·4 (82·9–85·9)	79·7 (78·2–81·1)	80·9 (79·3–82·4)	81·3 (79·8–82·8)	79·7 (78·2–81·1)	82·6 (81·0–84·1)	84·5 (83·0–85·9)
Connecticut	80·6 (79·1–82·2)	82·1 (80·5–83·6)	82·5 (81·0–84·0)	80·6 (79·1–82·2)	83·9 (82·4–85·5)	85·9 (84·3–87·4)	80·6 (79·1–82·2)	82·0 (80·5–83·6)	82·4 (80·9–84·0)	80·6 (79·1–82·2)	83·9 (82·4–85·5)	85·9 (84·4–87·4)
Delaware	77·6 (76·4–78·6)	79·3 (78·1–80·5)	79·8 (78·6–81·1)	77·5 (76·4–78·6)	81·4 (80·2–82·5)	83·7 (82·5–84·9)	77·5 (76·4–78·6)	79·2 (78·0–80·4)	79·8 (78·6–81·1)	77·6 (76·4–78·6)	81·4 (80·2–82·6)	83·7 (82·5–84·9)
Florida	78·5 (77·1–79·9)	80·1 (78·7–81·5)	80·6 (79·2–82·1)	78·5 (77·1–79·9)	82·2 (80·8–83·5)	84·3 (82·9–85·7)	78·5 (77·1–79·9)	80·1 (78·7–81·5)	80·6 (79·2–82·1)	78·5 (77·1–79·9)	82·2 (80·8–83·6)	84·4 (83·0–85·7)
Georgia	77·0 (75·5–78·4)	78·8 (77·3–80·4)	79·4 (77·9–81·0)	76·9 (75·5–78·4)	81·1 (79·5–82·6)	83·5 (82·0–85·0)	76·9 (75·5–78·4)	78·8 (77·2–80·3)	79·4 (77·8–81·0)	77·0 (75·5–78·4)	81·1 (79·5–82·6)	83·5 (82·0–85·0)
Hawaii	81·4 (79·9–82·8)	82·4 (80·9–83·8)	82·8 (81·3–84·3)	81·4 (79·9–82·8)	84·4 (82·9–85·8)	86·5 (85·0–87·8)	81·4 (79·9–82·8)	82·4 (80·9–83·8)	82·8 (81·3–84·3)	81·4 (79·9–82·8)	84·4 (82·9–85·8)	86·5 (85·0–87·8)
Idaho	79·3 (78·0–80·7)	80·5 (79·2–81·9)	80·9 (79·5–82·4)	79·3 (78·0–80·7)	82·4 (81·2–83·8)	84·4 (83·1–85·8)	79·3 (78·0–80·7)	80·5 (79·2–81·9)	80·9 (79·5–82·4)	79·3 (78·0–80·7)	82·4 (81·2–83·8)	84·5 (83·1–85·8)
Illinois	78·3 (76·9–79·6)	80·3 (78·8–81·7)	80·8 (79·4–82·3)	78·3 (76·9–79·6)	82·3 (80·9–83·8)	84·6 (83·2–86·0)	78·3 (76·9–79·6)	80·2 (78·8–81·7)	80·8 (79·4–82·3)	78·3 (76·9–79·6)	82·4 (80·9–83·8)	84·6 (83·2–86·1)
Indiana	76·5 (75·1–77·8)	77·8 (76·3–79·2)	78·3 (76·8–79·9)	76·5 (75·1–77·8)	80·0 (78·5–81·4)	82·3 (80·8–83·8)	76·5 (75·1–77·8)	77·8 (76·2–79·2)	78·3 (76·8–79·9)	76·5 (75·1–77·8)	80·0 (78·5–81·4)	82·4 (80·9–83·8)
Iowa	79·1 (77·6–80·6)	80·1 (78·5–81·7)	80·5 (78·9–82·1)	79·1 (77·6–80·6)	82·2 (80·6–83·7)	84·3 (82·7–85·8)	79·1 (77·6–80·6)	80·1 (78·5–81·7)	80·5 (78·9–82·1)	79·1 (77·6–80·6)	82·2 (80·6–83·7)	84·3 (82·7–85·8)
Kansas	77·8 (76·2–79·4)	78·9 (77·4–80·6)	79·4 (77·9–81·1)	77·8 (76·2–79·4)	81·2 (79·6–82·9)	83·4 (81·9–85·0)	77·8 (76·2–79·4)	78·9 (77·4–80·6)	79·4 (77·9–81·2)	77·8 (76·2–79·4)	81·2 (79·6–82·8)	83·4 (81·9–85·0)
Kentucky	74·4 (72·7–75·9)	76·0 (74·1–77·5)	76·6 (74·7–78·2)	74·4 (72·7–75·9)	78·5 (76·7–80·1)	81·1 (79·4–82·7)	74·4 (72·7–75·9)	75·9 (74·1–77·5)	76·5 (74·7–78·1)	74·4 (72·7–75·9)	78·5 (76·8–80·1)	81·1 (79·4–82·7)
Louisiana	74·9 (73·3–76·4)	76·4 (74·8–78·0)	77·1 (75·3–78·7)	74·9 (73·3–76·4)	79·0 (77·4–80·5)	81·7 (80·0–83·3)	74·9 (73·3–76·4)	76·4 (74·8–78·0)	77·1 (75·2–78·7)	74·9 (73·3–76·4)	79·0 (77·4–80·5)	81·7 (80·0–83·3)
Maine	77·7 (76·3–79·2)	79·1 (77·6–80·6)	79·5 (78·1–81·0)	77·7 (76·3–79·2)	81·0 (79·6–82·5)	83·0 (81·6–84·5)	77·7 (76·3–79·2)	79·1 (77·6–80·6)	79·5 (78·1–81·0)	77·7 (76·3–79·2)	81·0 (79·6–82·5)	83·1 (81·6–84·5)
Maryland	78·3 (76·8–79·9)	80·2 (78·8–82·0)	80·7 (79·3–82·5)	78·3 (76·8–79·9)	82·2 (80·7–83·9)	84·4 (82·9–86·1)	78·3 (76·8–79·9)	80·2 (78·7–81·9)	80·7 (79·3–82·5)	78·3 (76·8–79·9)	82·2 (80·7–83·9)	84·4 (82·9–86·2)
Massachusetts	81·2 (79·7–82·7)	82·3 (80·8–83·9)	82·7 (81·2–84·1)	81·2 (79·7–82·7)	84·0 (82·5–85·5)	85·7 (84·3–87·2)	81·2 (79·7–82·7)	82·3 (80·8–83·8)	82·6 (81·2–84·1)	81·2 (79·7–82·7)	84·0 (82·5–85·5)	85·8 (84·3–87·2)
Michigan	77·7 (76·3–79·1)	79·1 (77·6–80·6)	79·6 (78·1–81·2)	77·7 (76·3–79·1)	81·2 (79·7–82·7)	83·5 (82·0–84·9)	77·7 (76·3–79·1)	79·1 (77·5–80·6)	79·6 (78·0–81·1)	77·7 (76·3–79·1)	81·3 (79·7–82·7)	83·5 (82·0–84·9)

(Table 3 continues on next page)

	Safer environment			Improved behavioural and metabolic risks			Improved childhood nutrition and vaccination			Combined		
	2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)												
Minnesota	80·5 (79·2–81·9)	81·6 (80·3–82·9)	82·0 (80·7–83·4)	80·5 (79·2–81·9)	83·3 (82·0–84·7)	85·2 (83·9–86·5)	80·5 (79·2–81·9)	81·6 (80·3–82·9)	82·0 (80·7–83·4)	80·5 (79·2–81·9)	83·4 (82·1–84·7)	85·2 (83·9–86·5)
Mississippi	73·4 (71·8–75·0)	75·1 (73·2–76·7)	75·9 (73·9–77·6)	73·4 (71·8–75·0)	77·8 (75·9–79·3)	80·5 (78·6–82·1)	73·4 (71·8–75·0)	75·1 (73·2–76·7)	75·8 (73·8–77·6)	73·4 (71·8–75·0)	77·8 (75·9–79·3)	80·5 (78·6–82·2)
Missouri	76·4 (74·9–78·0)	78·0 (76·3–79·7)	78·6 (77·1–80·3)	76·4 (74·9–78·0)	80·3 (78·6–81·9)	82·8 (81·3–84·4)	76·4 (74·9–78·0)	78·0 (76·3–79·7)	78·6 (77·0–80·3)	76·4 (74·9–78·0)	80·3 (78·6–81·9)	82·8 (81·3–84·4)
Montana	78·6 (76·9–80·1)	79·7 (78·1–81·3)	80·1 (78·5–81·7)	78·6 (76·9–80·1)	81·7 (80·2–83·4)	83·9 (82·4–85·4)	78·6 (76·9–80·1)	79·6 (78·1–81·3)	80·1 (78·6–81·7)	78·6 (76·9–80·1)	81·7 (80·2–83·4)	83·9 (82·4–85·5)
Nebraska	78·8 (77·6–80·2)	80·1 (78·8–81·6)	80·5 (79·2–82·0)	78·8 (77·6–80·2)	82·2 (80·9–83·6)	84·2 (83·0–85·6)	78·8 (77·6–80·2)	80·1 (78·8–81·6)	80·5 (79·2–82·0)	78·8 (77·6–80·2)	82·2 (80·9–83·6)	84·2 (83·0–85·6)
Nevada	77·6 (76·3–79·0)	80·0 (78·4–81·5)	80·9 (79·3–82·4)	77·6 (76·3–79·0)	82·4 (80·9–84·0)	85·3 (83·8–87·0)	77·6 (76·3–79·0)	80·0 (78·4–81·5)	80·8 (79·2–82·4)	77·6 (76·3–79·0)	82·4 (81·0–84·0)	85·4 (83·8–87·0)
New Hampshire	79·4 (78·0–80·9)	80·5 (79·1–82·1)	80·9 (79·5–82·4)	79·4 (78·0–80·9)	82·3 (80·9–83·8)	84·1 (82·8–85·6)	79·4 (78·0–80·9)	80·5 (79·1–82·1)	80·9 (79·5–82·4)	79·4 (78·0–80·9)	82·3 (80·9–83·8)	84·1 (82·8–85·6)
New Jersey	80·2 (78·7–81·6)	82·0 (80·4–83·5)	82·4 (80·7–83·9)	80·2 (78·7–81·6)	83·9 (82·2–85·3)	85·8 (84·1–87·2)	80·2 (78·7–81·6)	82·0 (80·4–83·4)	82·4 (80·7–83·8)	80·2 (78·7–81·6)	83·9 (82·2–85·4)	85·8 (84·2–87·2)
New Mexico	75·6 (73·9–77·2)	78·0 (76·0–79·7)	78·6 (76·6–80·4)	75·6 (73·9–77·2)	80·4 (78·5–82·2)	82·9 (80·9–84·7)	75·6 (73·9–77·2)	78·0 (76·0–79·7)	78·6 (76·6–80·4)	75·6 (73·9–77·2)	80·4 (78·5–82·2)	82·9 (81·0–84·7)
New York	80·6 (79·3–81·9)	82·6 (81·2–84·0)	83·1 (81·8–84·4)	80·6 (79·3–81·9)	84·6 (83·2–86·0)	86·7 (85·4–88·1)	80·6 (79·3–81·9)	82·6 (81·2–84·0)	83·1 (81·7–84·4)	80·6 (79·3–81·9)	84·6 (83·3–86·1)	86·8 (85·4–88·2)
North Carolina	77·0 (75·6–78·4)	78·7 (77·1–80·2)	79·3 (77·7–80·8)	77·0 (75·6–78·4)	80·8 (79·3–82·3)	83·2 (81·6–84·7)	77·0 (75·6–78·4)	78·7 (77·1–80·2)	79·2 (77·7–80·8)	77·0 (75·6–78·4)	80·9 (79·4–82·4)	83·2 (81·6–84·7)
North Dakota	80·6 (79·2–81·9)	81·3 (79·9–82·7)	81·6 (80·2–83·0)	80·6 (79·2–81·9)	83·4 (82·0–84·7)	85·3 (84·0–86·7)	80·6 (79·2–81·9)	81·3 (79·9–82·7)	81·6 (80·2–83·0)	80·6 (79·2–81·9)	83·3 (82·0–84·7)	85·3 (84·0–86·7)
Ohio	76·4 (74·9–77·7)	77·6 (76·0–79·0)	78·1 (76·5–79·6)	76·4 (74·9–77·7)	79·8 (78·2–81·2)	82·1 (80·5–83·5)	76·4 (74·9–77·7)	77·6 (76·0–79·0)	78·1 (76·5–79·5)	76·4 (74·9–77·7)	79·8 (78·2–81·2)	82·1 (80·5–83·6)
Oklahoma	74·8 (73·2–76·1)	76·3 (74·5–77·7)	76·8 (75·0–78·5)	74·8 (73·2–76·1)	78·8 (77·1–80·2)	81·5 (79·8–83·1)	74·8 (73·2–76·1)	76·3 (74·5–77·8)	76·8 (75·0–78·5)	74·8 (73·2–76·1)	78·8 (77·1–80·2)	81·5 (79·8–83·1)
Oregon	79·4 (77·7–80·8)	80·8 (79·0–82·3)	81·2 (79·5–82·9)	79·4 (77·7–80·8)	82·7 (81·0–84·3)	84·8 (83·1–86·5)	79·4 (77·7–80·8)	80·8 (79·0–82·3)	81·2 (79·5–82·9)	79·4 (77·7–80·8)	82·7 (81·0–84·3)	84·9 (83·1–86·5)
Pennsylvania	78·3 (76·8–79·8)	79·4 (78·0–80·9)	79·9 (78·4–81·5)	78·3 (76·8–79·7)	81·3 (79·8–82·8)	83·4 (81·9–84·8)	78·3 (76·8–79·7)	79·4 (77·9–80·9)	79·9 (78·4–81·4)	78·3 (76·8–79·8)	81·3 (79·9–82·8)	83·4 (81·9–84·9)
Rhode Island	80·5 (78·9–82·0)	81·5 (79·9–83·0)	81·9 (80·3–83·4)	80·5 (78·9–82·0)	83·4 (81·9–84·9)	85·4 (83·9–86·9)	80·5 (78·9–82·0)	81·5 (79·9–83·0)	81·9 (80·3–83·4)	80·5 (78·9–82·0)	83·4 (81·9–85·0)	85·4 (83·9–86·9)
South Carolina	76·0 (74·6–77·5)	77·6 (76·1–79·2)	78·2 (76·6–79·9)	76·0 (74·6–77·5)	79·8 (78·4–81·5)	82·2 (80·7–83·8)	76·0 (74·6–77·5)	77·6 (76·1–79·2)	78·1 (76·6–79·9)	76·0 (74·6–77·5)	79·8 (78·4–81·5)	82·2 (80·7–83·8)
South Dakota	78·9 (77·5–80·2)	79·8 (78·4–81·3)	80·2 (78·8–81·6)	78·9 (77·5–80·2)	81·9 (80·5–83·3)	84·0 (82·6–85·4)	78·9 (77·5–80·2)	79·8 (78·4–81·3)	80·2 (78·8–81·6)	78·9 (77·5–80·2)	81·9 (80·5–83·3)	84·0 (82·6–85·4)
Tennessee	75·0 (73·5–76·4)	76·6 (74·9–78·2)	77·1 (75·5–78·9)	75·0 (73·5–76·4)	79·0 (77·4–80·6)	81·5 (80·0–83·2)	75·0 (73·5–76·4)	76·5 (74·9–78·2)	77·1 (75·5–78·8)	75·0 (73·5–76·4)	79·0 (77·4–80·6)	81·5 (80·0–83·2)
Texas	78·3 (76·9–79·6)	79·9 (78·5–81·3)	80·4 (79·0–81·9)	78·2 (76·9–79·6)	82·0 (80·7–83·4)	84·3 (82·9–85·7)	78·2 (76·9–79·6)	79·8 (78·5–81·2)	80·4 (79·0–81·9)	78·3 (76·9–79·6)	82·1 (80·7–83·4)	84·3 (83·0–85·7)
Utah	79·7 (78·4–80·9)	80·6 (79·2–81·8)	80·9 (79·5–82·3)	79·7 (78·4–80·9)	82·3 (80·9–83·5)	84·0 (82·6–85·3)	79·7 (78·4–80·9)	80·6 (79·2–81·8)	80·9 (79·5–82·2)	79·7 (78·4–80·9)	82·3 (80·9–83·5)	84·0 (82·7–85·3)
Vermont	78·7 (77·5–79·8)	80·9 (79·6–81·9)	81·2 (80·0–82·4)	78·7 (77·5–79·8)	82·7 (81·5–83·7)	84·5 (83·3–85·7)	78·7 (77·5–79·8)	80·9 (79·6–81·9)	81·2 (79·9–82·4)	78·7 (77·5–79·8)	82·7 (81·5–83·7)	84·6 (83·3–85·7)

(Table 3 continues on next page)

	Safer environment			Improved behavioural and metabolic risks			Improved childhood nutrition and vaccination			Combined		
	2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)												
Virginia	78·6 (77·1–80·1)	80·3 (78·8–81·9)	80·9 (79·3–82·4)	78·6 (77·1–80·1)	82·4 (80·8–83·9)	84·6 (83·0–86·1)	78·6 (77·1–80·1)	80·3 (78·8–81·9)	80·9 (79·3–82·4)	78·6 (77·1–80·1)	82·4 (80·8–84·0)	84·6 (83·0–86·1)
Washington	80·2 (78·9–81·7)	81·5 (80·1–83·0)	81·9 (80·5–83·4)	80·2 (78·9–81·7)	83·3 (81·9–84·8)	85·2 (83·8–86·7)	80·2 (78·9–81·7)	81·5 (80·1–83·0)	81·9 (80·5–83·4)	80·2 (78·9–81·7)	83·3 (81·9–84·8)	85·2 (83·8–86·7)
Washington, DC	78·4 (76·9–80·0)	79·8 (78·3–81·3)	80·5 (79·1–82·0)	78·4 (76·9–80·0)	81·9 (80·4–83·4)	84·3 (82·8–85·8)	78·4 (76·9–80·0)	79·7 (78·3–81·2)	80·5 (79·0–82·0)	78·4 (76·9–80·0)	81·9 (80·4–83·4)	84·3 (82·8–85·9)
West Virginia	73·5 (71·8–75·1)	74·9 (73·0–76·9)	75·5 (73·4–77·4)	73·5 (71·8–75·0)	77·6 (75·7–79·5)	80·3 (78·4–82·2)	73·5 (71·8–75·0)	74·9 (73·0–76·8)	75·5 (73·4–77·4)	73·5 (71·8–75·1)	77·6 (75·8–79·5)	80·4 (78·4–82·3)
Wisconsin	79·0 (77·5–80·7)	80·3 (78·6–81·9)	80·7 (79·1–82·3)	79·0 (77·5–80·7)	82·1 (80·5–83·7)	84·0 (82·5–85·5)	79·0 (77·5–80·7)	80·3 (78·6–81·9)	80·7 (79·1–82·2)	79·0 (77·5–80·7)	82·1 (80·5–83·7)	84·0 (82·5–85·5)
Wyoming	78·1 (76·8–79·2)	79·2 (77·9–80·3)	79·6 (78·3–80·8)	78·1 (76·8–79·2)	81·2 (79·9–82·4)	83·4 (82·1–84·6)	78·1 (76·8–79·2)	79·2 (77·9–80·3)	79·6 (78·3–80·8)	78·1 (76·8–79·2)	81·2 (80·0–82·4)	83·4 (82·1–84·6)
Healthy life expectancy, years												
USA	65·4 (61·7–68·5)	66·7 (63·1–69·8)	67·0 (63·3–70·1)	65·4 (61·7–68·5)	68·9 (65·3–72·0)	71·1 (67·4–74·1)	65·4 (61·7–68·5)	66·7 (63·1–69·8)	67·0 (63·3–70·1)	65·4 (61·7–68·5)	69·0 (65·3–72·0)	71·1 (67·4–74·1)
Alabama	62·5 (59·3–65·7)	63·6 (60·1–66·7)	64·0 (60·4–67·1)	62·5 (59·3–65·6)	66·2 (62·8–69·3)	68·7 (65·2–71·7)	62·5 (59·3–65·6)	63·6 (60·1–66·7)	64·0 (60·4–67·1)	62·5 (59·3–65·7)	66·2 (62·8–69·3)	68·7 (65·2–71·7)
Alaska	64·8 (61·1–68·1)	66·5 (62·7–69·9)	67·0 (63·1–70·3)	64·8 (61·1–68·1)	69·0 (65·2–72·3)	71·6 (67·8–75·0)	64·8 (61·1–68·1)	66·5 (62·7–69·9)	67·0 (63·1–70·4)	64·8 (61·1–68·1)	69·0 (65·2–72·3)	71·6 (67·8–75·0)
Arizona	64·5 (60·9–68·0)	66·1 (62·4–69·6)	66·4 (62·6–70·0)	64·5 (60·9–68·0)	68·3 (64·7–71·8)	70·5 (66·8–74·0)	64·5 (60·9–68·0)	66·1 (62·4–69·6)	66·3 (62·6–70·0)	64·5 (60·9–68·0)	68·3 (64·7–71·8)	70·5 (66·9–74·1)
Arkansas	63·1 (59·7–66·1)	64·2 (60·8–67·5)	64·6 (61·0–67·9)	63·1 (59·7–66·1)	66·8 (63·4–70·0)	69·3 (65·8–72·6)	63·1 (59·7–66·1)	64·2 (60·8–67·5)	64·6 (61·0–67·9)	63·1 (59·7–66·1)	66·8 (63·4–70·0)	69·4 (65·9–72·6)
California	67·7 (64·1–71·1)	69·0 (65·4–72·3)	69·3 (65·7–72·6)	67·7 (64·1–71·1)	71·0 (67·5–74·3)	73·0 (69·5–76·3)	67·7 (64·1–71·1)	69·0 (65·4–72·3)	69·3 (65·7–72·6)	67·7 (64·1–71·1)	71·0 (67·5–74·3)	73·0 (69·5–76·3)
Colorado	66·5 (62·6–69·8)	67·6 (63·6–70·9)	67·9 (64·1–71·3)	66·5 (62·6–69·8)	69·4 (65·4–72·7)	71·2 (67·4–74·6)	66·5 (62·6–69·8)	67·6 (63·6–70·9)	67·9 (64·0–71·3)	66·5 (62·6–69·8)	69·4 (65·4–72·7)	71·2 (67·4–74·6)
Connecticut	67·3 (63·3–70·7)	68·6 (64·5–72·1)	68·9 (64·8–72·5)	67·3 (63·3–70·7)	70·7 (66·7–74·1)	72·8 (68·7–76·3)	67·3 (63·3–70·7)	68·6 (64·5–72·1)	68·9 (64·8–72·5)	67·3 (63·3–70·7)	70·7 (66·7–74·2)	72·8 (68·8–76·3)
Delaware	64·5 (60·8–67·9)	65·8 (62·1–69·3)	66·2 (62·4–69·8)	64·5 (60·8–67·8)	68·1 (64·6–71·5)	70·5 (66·8–73·9)	64·5 (60·8–67·8)	65·8 (62·1–69·3)	66·2 (62·4–69·7)	64·5 (60·8–67·9)	68·2 (64·6–71·5)	70·5 (66·9–73·9)
Florida	65·3 (61·7–68·5)	66·5 (62·8–69·8)	66·8 (63·1–70·2)	65·3 (61·7–68·5)	68·7 (65·1–71·9)	70·9 (67·3–74·0)	65·3 (61·7–68·5)	66·5 (62·8–69·8)	66·8 (63·1–70·1)	65·3 (61·7–68·5)	68·8 (65·1–71·9)	70·9 (67·3–74·1)
Georgia	64·6 (61·0–67·8)	66·0 (62·3–69·3)	66·3 (62·5–69·8)	64·5 (61·0–67·8)	68·3 (64·7–71·7)	70·7 (67·0–74·0)	64·5 (61·0–67·8)	65·9 (62·3–69·3)	66·3 (62·5–69·8)	64·6 (61·0–67·8)	68·4 (64·7–71·7)	70·7 (67·0–74·1)
Hawaii	68·5 (64·7–71·8)	69·3 (65·5–72·7)	69·5 (65·6–72·9)	68·5 (64·7–71·8)	71·5 (67·7–74·8)	73·6 (69·7–77·0)	68·5 (64·7–71·8)	69·3 (65·5–72·7)	69·5 (65·6–73·0)	68·5 (64·7–71·8)	71·5 (67·7–74·8)	73·6 (69·7–77·0)
Idaho	66·2 (62·7–69·7)	67·2 (63·7–70·6)	67·5 (63·9–71·0)	66·3 (62·7–69·7)	69·4 (65·9–72·7)	71·4 (67·9–74·7)	66·3 (62·7–69·7)	67·2 (63·7–70·6)	67·5 (63·9–71·0)	66·2 (62·7–69·7)	69·4 (65·9–72·7)	71·4 (67·9–74·7)
Illinois	65·7 (62·1–69·0)	67·4 (63·7–70·7)	67·7 (64·0–71·1)	65·7 (62·1–69·0)	69·6 (65·9–72·9)	71·8 (68·1–75·1)	65·7 (62·1–69·0)	67·3 (63·7–70·6)	67·7 (64·0–71·1)	65·7 (62·1–69·0)	69·6 (66·0–72·9)	71·8 (68·1–75·2)
Indiana	63·7 (60·3–66·9)	64·6 (61·1–68·0)	64·9 (61·2–68·4)	63·7 (60·3–66·9)	67·0 (63·5–70·3)	69·3 (65·7–72·6)	63·7 (60·3–66·9)	64·6 (61·0–67·9)	64·9 (61·2–68·4)	63·7 (60·3–66·9)	67·0 (63·5–70·3)	69·3 (65·7–72·6)
Iowa	66·4 (62·8–69·6)	67·2 (63·7–70·5)	67·4 (63·8–70·7)	66·4 (62·8–69·6)	69·5 (66·0–72·6)	71·6 (68·1–74·8)	66·4 (62·8–69·6)	67·2 (63·7–70·5)	67·4 (63·8–70·7)	66·4 (62·8–69·6)	69·5 (66·0–72·6)	71·6 (68·1–74·8)
Kansas	65·1 (61·5–68·3)	66·1 (62·4–69·2)	66·3 (62·7–69·6)	65·2 (61·5–68·3)	68·4 (64·8–71·5)	70·6 (66·9–73·6)	65·2 (61·5–68·3)	66·1 (62·4–69·2)	66·3 (62·7–69·6)	65·1 (61·5–68·3)	68·4 (64·8–71·5)	70·6 (66·9–73·6)

(Table 3 continues on next page)

	Safer environment			Improved behavioural and metabolic risks			Improved childhood nutrition and vaccination			Combined		
	2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)												
Kentucky	61·7 (58·2–65·0)	62·8 (59·0–66·1)	63·0 (59·2–66·5)	61·7 (58·2–65·0)	65·4 (61·7–68·8)	67·8 (64·1–71·2)	61·7 (58·2–65·0)	62·7 (59·0–66·1)	63·0 (59·2–66·5)	61·7 (58·2–65·0)	65·4 (61·7–68·8)	67·8 (64·1–71·2)
Louisiana	62·5 (59·1–65·8)	63·6 (59·9–67·1)	63·9 (60·1–67·4)	62·5 (59·1–65·8)	66·2 (62·5–69·6)	68·7 (65·0–72·2)	62·5 (59·1–65·8)	63·6 (59·9–67·1)	63·9 (60·1–67·4)	62·5 (59·1–65·8)	66·2 (62·5–69·6)	68·7 (65·0–72·3)
Maine	64·8 (61·0–68·2)	65·8 (62·1–69·4)	66·1 (62·3–69·6)	64·8 (61·0–68·2)	68·0 (64·3–71·5)	70·0 (66·3–73·4)	64·8 (61·0–68·2)	65·8 (62·1–69·4)	66·1 (62·3–69·6)	64·8 (61·0–68·2)	68·0 (64·3–71·5)	70·0 (66·4–73·4)
Maryland	65·8 (62·2–69·1)	67·3 (63·7–70·8)	67·7 (64·0–71·2)	65·8 (62·2–69·1)	69·5 (66·0–72·9)	71·7 (68·2–75·1)	65·8 (62·2–69·1)	67·3 (63·7–70·7)	67·7 (64·0–71·1)	65·8 (62·2–69·1)	69·5 (66·0–72·9)	71·7 (68·2–75·2)
Massachusetts	67·6 (63·8–71·0)	68·6 (64·6–72·0)	68·9 (64·9–72·3)	67·6 (63·8–71·0)	70·5 (66·7–73·9)	72·4 (68·6–75·8)	67·6 (63·8–71·0)	68·6 (64·6–72·0)	68·8 (64·9–72·3)	67·6 (63·8–71·0)	70·5 (66·7–73·9)	72·4 (68·6–75·8)
Michigan	64·6 (60·7–67·7)	65·7 (61·8–68·8)	65·9 (62·0–69·3)	64·6 (60·7–67·7)	67·9 (64·2–71·1)	70·1 (66·4–73·4)	64·6 (60·7–67·7)	65·6 (61·8–68·8)	65·9 (62·0–69·3)	64·6 (60·7–67·7)	67·9 (64·2–71·1)	70·1 (66·4–73·4)
Minnesota	67·7 (64·0–71·1)	68·7 (65·1–72·0)	69·0 (65·3–72·4)	67·7 (64·0–71·1)	70·7 (67·2–74·0)	72·6 (69·0–75·9)	67·7 (64·0–71·1)	68·7 (65·1–72·0)	69·0 (65·3–72·4)	67·7 (64·0–71·1)	70·7 (67·2–74·0)	72·6 (69·1–75·9)
Mississippi	62·2 (58·8–65·2)	63·4 (59·9–66·6)	63·9 (60·2–67·0)	62·1 (58·8–65·2)	66·1 (62·6–69·2)	68·7 (65·1–71·7)	62·1 (58·8–65·2)	63·4 (59·9–66·6)	63·9 (60·2–67·0)	62·2 (58·8–65·2)	66·1 (62·7–69·2)	68·7 (65·2–71·8)
Missouri	63·8 (60·3–66·9)	64·9 (61·3–68·1)	65·3 (61·5–68·6)	63·8 (60·3–66·9)	67·3 (63·8–70·5)	69·7 (66·1–73·0)	63·8 (60·3–66·9)	64·9 (61·3–68·1)	65·3 (61·5–68·6)	63·8 (60·3–66·9)	67·3 (63·8–70·5)	69·7 (66·1–73·0)
Montana	65·6 (61·5–68·8)	66·5 (62·3–69·8)	66·8 (62·7–70·1)	65·6 (61·4–68·8)	68·6 (64·4–71·9)	70·7 (66·5–74·0)	65·6 (61·4–68·8)	66·4 (62·3–69·8)	66·8 (62·7–70·1)	65·6 (61·5–68·8)	68·6 (64·4–71·9)	70·7 (66·5–74·0)
Nebraska	66·2 (62·5–69·4)	67·3 (63·5–70·6)	67·5 (63·7–71·0)	66·2 (62·5–69·4)	69·5 (65·8–72·7)	71·6 (67·9–74·9)	66·2 (62·5–69·4)	67·3 (63·5–70·6)	67·5 (63·7–71·0)	66·2 (62·5–69·4)	69·5 (65·8–72·7)	71·6 (67·9–74·9)
Nevada	64·9 (61·3–68·3)	66·8 (63·1–70·4)	67·4 (63·6–71·1)	64·9 (61·3–68·3)	69·3 (65·5–72·9)	72·0 (68·2–75·7)	64·9 (61·3–68·3)	66·8 (63·1–70·4)	67·3 (63·6–71·1)	64·9 (61·3–68·3)	69·3 (65·5–72·9)	72·0 (68·2–75·7)
New Hampshire	65·9 (61·9–69·5)	66·9 (62·9–70·6)	67·2 (63·2–70·9)	65·9 (61·9–69·5)	68·9 (65·0–72·5)	70·8 (67·0–74·4)	65·9 (61·9–69·5)	66·9 (62·9–70·6)	67·1 (63·2–70·9)	65·9 (61·9–69·5)	68·9 (65·0–72·5)	70·8 (67·0–74·4)
New Jersey	67·0 (63·3–70·3)	68·5 (64·7–71·8)	68·8 (64·9–72·1)	67·0 (63·3–70·3)	70·6 (66·7–73·8)	72·5 (68·8–75·8)	67·0 (63·3–70·3)	68·5 (64·7–71·8)	68·8 (64·9–72·1)	67·0 (63·3–70·3)	70·6 (66·8–73·9)	72·6 (68·8–75·8)
New Mexico	62·9 (59·2–66·4)	64·6 (60·7–68·2)	65·0 (60·9–68·5)	62·9 (59·2–66·4)	67·1 (63·2–70·7)	69·5 (65·5–73·0)	62·9 (59·2–66·4)	64·6 (60·7–68·2)	65·0 (60·9–68·5)	62·9 (59·2–66·4)	67·1 (63·2–70·7)	69·5 (65·5–73·1)
New York	66·9 (63·2–70·6)	68·5 (64·8–72·0)	68·8 (65·0–72·3)	66·9 (63·2–70·6)	70·7 (67·0–74·1)	72·8 (69·1–76·3)	66·9 (63·2–70·6)	68·5 (64·8–71·9)	68·8 (64·9–72·3)	66·9 (63·2–70·6)	70·7 (67·1–74·2)	72·9 (69·1–76·3)
North Carolina	64·5 (60·8–68·0)	65·8 (61·9–69·3)	66·1 (62·2–69·6)	64·5 (60·8–68·0)	68·1 (64·4–71·5)	70·4 (66·6–73·9)	64·5 (60·8–68·0)	65·8 (61·9–69·3)	66·1 (62·2–69·6)	64·5 (60·8–68·0)	68·2 (64·4–71·6)	70·4 (66·6–73·9)
North Dakota	67·1 (63·3–70·7)	67·7 (63·8–71·2)	67·8 (63·9–71·3)	67·1 (63·3–70·7)	70·0 (66·3–73·4)	71·9 (68·2–75·4)	67·1 (63·3–70·7)	67·7 (63·8–71·2)	67·8 (63·9–71·3)	67·1 (63·3–70·7)	70·0 (66·2–73·4)	72·0 (68·2–75·4)
Ohio	63·4 (59·6–66·7)	64·3 (60·5–67·7)	64·6 (60·7–68·0)	63·4 (59·6–66·7)	66·7 (62·9–69·9)	68·9 (65·1–72·2)	63·4 (59·6–66·7)	64·3 (60·5–67·6)	64·6 (60·7–68·0)	63·4 (59·6–66·7)	66·7 (62·9–69·9)	69·0 (65·1–72·2)
Oklahoma	62·3 (58·8–65·5)	63·4 (59·6–66·7)	63·7 (59·8–67·1)	62·3 (58·8–65·5)	65·9 (62·2–69·2)	68·4 (64·6–71·8)	62·3 (58·8–65·5)	63·4 (59·6–66·8)	63·7 (59·8–67·1)	62·3 (58·8–65·5)	65·9 (62·2–69·2)	68·4 (64·6–71·8)
Oregon	66·5 (63·0–69·9)	67·7 (64·0–71·1)	68·0 (64·4–71·5)	66·5 (63·0–69·9)	69·8 (66·1–73·1)	71·9 (68·4–75·3)	66·5 (63·0–69·9)	67·7 (64·0–71·1)	68·1 (64·5–71·5)	66·5 (63·0–69·9)	69·8 (66·2–73·1)	71·9 (68·4–75·3)
Pennsylvania	64·8 (61·0–68·0)	65·8 (62·0–69·0)	66·1 (62·2–69·3)	64·8 (61·0–68·0)	67·9 (64·1–71·0)	69·9 (66·2–73·0)	64·8 (61·0–68·0)	65·8 (61·9–68·9)	66·0 (62·2–69·3)	64·8 (61·0–68·0)	67·9 (64·1–71·0)	69·9 (66·2–73·1)

(Table 3 continues on next page)

	Safer environment			Improved behavioural and metabolic risks			Improved childhood nutrition and vaccination			Combined		
	2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)												
Rhode Island	67·0 (63·1–70·4)	67·9 (64·1–71·4)	68·2 (64·4–71·7)	67·0 (63·1–70·4)	70·0 (66·3–73·4)	72·1 (68·3–75·4)	67·0 (63·1–70·4)	67·9 (64·1–71·4)	68·2 (64·4–71·7)	67·0 (63·1–70·4)	70·0 (66·3–73·4)	72·1 (68·4–75·5)
South Carolina	63·4 (59·9–66·6)	64·6 (60·9–68·0)	64·9 (61·2–68·4)	63·4 (59·9–66·6)	67·0 (63·4–70·4)	69·3 (65·7–72·7)	63·4 (59·9–66·6)	64·6 (60·9–68·0)	64·9 (61·1–68·4)	63·4 (59·9–66·6)	67·0 (63·4–70·4)	69·3 (65·7–72·7)
South Dakota	66·1 (62·4–69·4)	66·8 (63·0–70·2)	67·0 (63·1–70·4)	66·1 (62·4–69·4)	69·0 (65·2–72·3)	71·1 (67·3–74·4)	66·1 (62·4–69·4)	66·8 (63·0–70·2)	67·0 (63·1–70·4)	66·1 (62·4–69·4)	69·0 (65·2–72·3)	71·1 (67·3–74·4)
Tennessee	62·6 (59·1–65·8)	63·7 (60·1–67·1)	64·0 (60·4–67·4)	62·6 (59·1–65·8)	66·2 (62·7–69·5)	68·6 (65·0–72·0)	62·6 (59·1–65·8)	63·7 (60·1–67·0)	64·0 (60·4–67·4)	62·6 (59·1–65·8)	66·2 (62·7–69·5)	68·6 (65·0–72·0)
Texas	65·8 (62·2–69·0)	67·0 (63·4–70·3)	67·4 (63·6–70·9)	65·7 (62·2–69·0)	69·3 (65·8–72·6)	71·6 (68·0–74·9)	65·7 (62·2–69·0)	67·0 (63·4–70·3)	67·4 (63·6–70·8)	65·8 (62·2–69·0)	69·4 (65·8–72·6)	71·6 (68·0–74·9)
Utah	66·5 (62·7–69·8)	67·3 (63·3–70·6)	67·4 (63·4–70·8)	66·5 (62·7–69·8)	69·2 (65·4–72·5)	70·9 (67·1–74·3)	66·5 (62·7–69·8)	67·2 (63·3–70·6)	67·4 (63·4–70·8)	66·5 (62·7–69·8)	69·2 (65·4–72·5)	71·0 (67·1–74·3)
Vermont	66·2 (62·6–69·3)	67·9 (64·4–71·0)	68·1 (64·5–71·3)	66·2 (62·6–69·3)	69·9 (66·4–73·0)	71·8 (68·2–74·8)	66·2 (62·6–69·3)	67·9 (64·3–71·0)	68·1 (64·5–71·3)	66·2 (62·6–69·3)	69·9 (66·4–73·0)	71·8 (68·3–74·8)
Virginia	65·8 (62·3–69·3)	67·2 (63·5–70·8)	67·6 (63·8–71·2)	65·8 (62·3–69·3)	69·5 (65·9–73·1)	71·7 (68·2–75·3)	65·8 (62·3–69·3)	67·2 (63·5–70·8)	67·6 (63·8–71·2)	65·8 (62·3–69·3)	69·5 (65·9–73·1)	71·7 (68·2–75·3)
Washington	67·0 (63·1–70·5)	68·1 (64·3–71·6)	68·4 (64·6–71·9)	67·0 (63·1–70·5)	70·1 (66·3–73·6)	72·0 (68·3–75·4)	67·0 (63·1–70·5)	68·1 (64·3–71·6)	68·4 (64·6–71·9)	67·0 (63·1–70·5)	70·1 (66·4–73·6)	72·0 (68·3–75·4)
Washington, DC	65·9 (62·3–69·0)	67·2 (63·7–70·3)	67·7 (64·2–70·8)	65·9 (62·3–69·0)	69·3 (65·8–72·3)	71·6 (68·1–74·7)	65·9 (62·3–69·0)	67·2 (63·7–70·2)	67·7 (64·2–70·8)	65·9 (62·3–69·0)	69·3 (65·9–72·3)	71·6 (68·1–74·7)
West Virginia	60·8 (57·0–64·0)	61·7 (57·8–65·2)	62·0 (58·0–65·5)	60·8 (56·9–64·0)	64·5 (60·6–67·9)	67·1 (63·2–70·5)	60·8 (56·9–64·0)	61·7 (57·7–65·2)	62·0 (58·0–65·4)	60·8 (57·0–64·0)	64·5 (60·6–68·0)	67·1 (63·2–70·5)
Wisconsin	66·0 (62·3–69·4)	67·1 (63·3–70·7)	67·4 (63·5–71·1)	66·0 (62·3–69·4)	69·1 (65·4–72·6)	71·1 (67·4–74·6)	66·0 (62·3–69·4)	67·1 (63·3–70·7)	67·4 (63·5–71·1)	66·0 (62·3–69·4)	69·1 (65·4–72·7)	71·1 (67·4–74·7)
Wyoming	65·2 (61·7–68·5)	66·2 (62·7–69·4)	66·5 (62·9–69·8)	65·2 (61·7–68·5)	68·2 (64·8–71·5)	70·4 (66·8–73·7)	65·2 (61·7–68·5)	66·2 (62·7–69·4)	66·5 (62·8–69·8)	65·2 (61·7–68·5)	68·2 (64·8–71·5)	70·4 (66·8–73·7)

Estimates are mean (95% uncertainty interval).

***Table 3*: Life expectancy and healthy life expectancy for the USA and for US states and Washington, DC, under risk elimination scenarios, 2022, 2035, and 2050**

For example, projected decreases in age-standardised SEVs for smoking vary from a 37·0% (95% UI 31·8 to 40·1) decrease in Nevada to a 14·1% (12·1 to 15·3) reduction in Arkansas. For high systolic blood pressure, increases vary from 6·3% (–3·2 to 16·0) in California to 24·6% (–11·0 to 52·7) in West Virginia. Our findings, therefore, show the high contribution of behavioural and metabolic factors to poor health across the USA.

Risk elimination scenarios

Our combined risk elimination scenario shows that the USA could gain an additional 3·8 years (95% UI 3·6–4·0) of life expectancy and 4·1 years (3·9–4·3) of HALE in 2050 above and beyond the reference scenario forecasts, to 84·2 years (83·7–84·7) of life and 71·1 healthy years (67·4–74·1) of life, if exposure to a range of key risk factors (ie, all those in the combined scenario) were eliminated by 2050 (table 3). If these risk factors are eliminated only in the USA (ie, comparing the USA combined scenario with the reference scenario across all 203 other countries and territories), the USA will have a higher global ranking in terms of life expectancy by 2050, but will remain far from first place, at 29th in the world (figure 2A; GBD Foresight). This would put the USA just ahead of Canada;[1] the USA's combined scenario life expectancy and Canada's reference scenario life expectancy are both projected to be 84·2 years in 2050. However, if life expectancy in all countries and territories follows the future trajectory of the combined scenario, the USA's ranking will decrease further (to 100th in 2050; figure 2B).

Age-standardised mortality rates are forecasted to be 28·9% lower in the USA in 2050 in the combined scenario (338·2 deaths [95% UI 325·0–352·9] per 100 000 population) than in the reference scenario (475·9 deaths [453·7–501·2] per 100 000). This translates to a reduction of about 552 000 deaths in 2050 alone (appendix 1 p 492). Eliminating exposure to the risk factors in the combined scenario is projected to result in 12·4 million (11·3–13·5) fewer deaths in the USA between 2022 and 2050 compared with the reference scenario.

Under the combined scenario, the largest improvement in cause-specific age-standardised mortality rates is

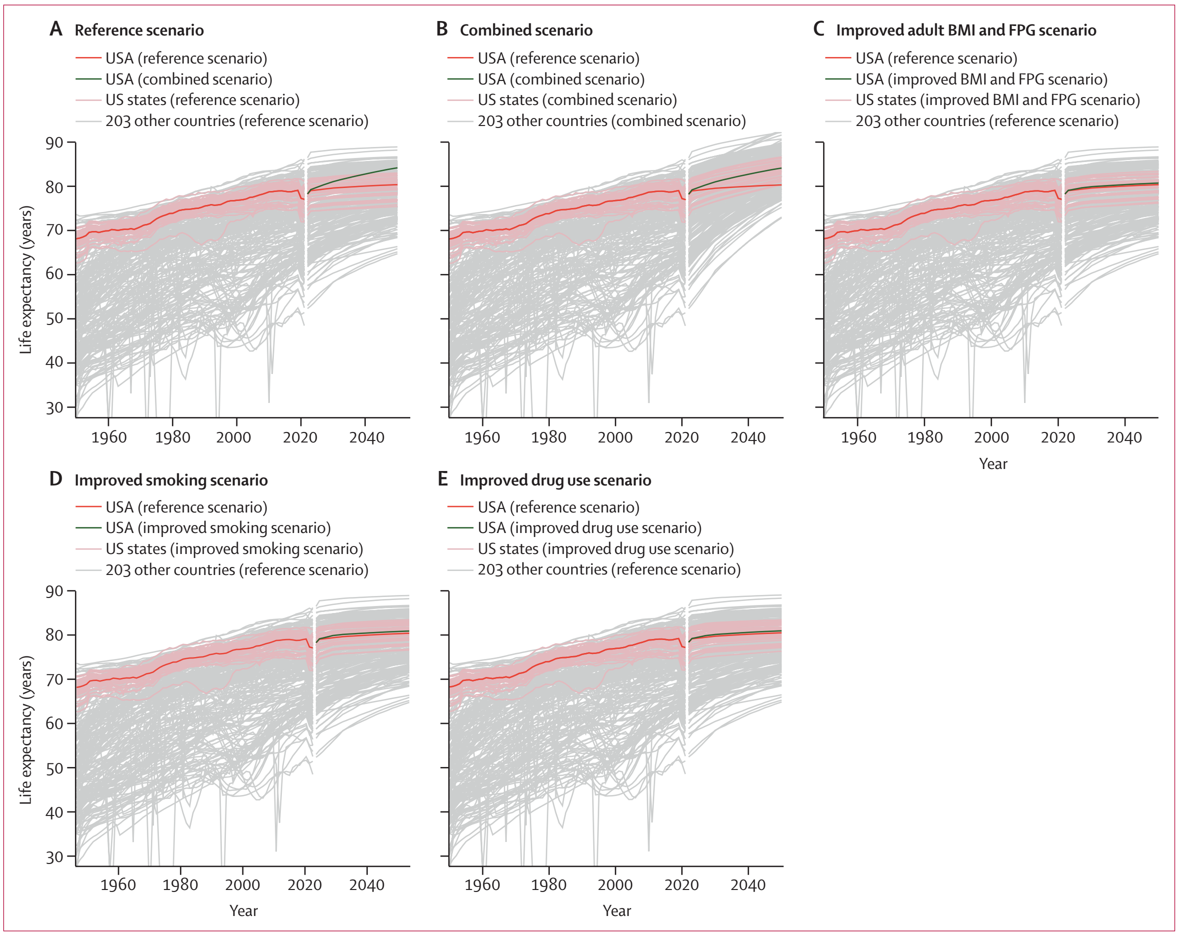

Figure 2: **Life expectancy for the USA and all other countries and territories, and for US states and Washington, DC, under various scenarios, 1950–2050**
Estimates and forecasts are for all sexes combined. (A–B) Life expectancy under the reference scenario (A) and combined scenario (B) for the USA, its states, and other countries and territories. (C–E) Life expectancy under the improved high adult BMI and FPG scenario (C), improved smoking scenario (D), and improved drug use scenario (E) for the USA and its states, versus the reference scenario for all other countries and territories. FPG=fasting plasma glucose.

expected to occur for type 2 diabetes: from 7·7 deaths (95% UI 6·2 to 9·3) per 100 000 in the reference scenario in 2050, a 34·5% (23·1 to 45·1) decline from 2022, to 0·03 deaths (0·02 to 0·04) per 100 000 in the combined scenario in 2050, a 99·7% (99·6 to 99·7) decline from 2022 (GBD Foresight). This equates to a rate that is 99·6% lower in 2050 under the combined scenario than the reference scenario. We also project substantially lower age-standardised death rates for ischaemic heart disease and chronic kidney disease in the combined scenario, with ischaemic heart disease death rates (4·7 deaths [3·8 to 5·9] per 100 000 population) projected to be 88·0% lower in 2050 than the reference scenario (39·4 deaths [31·3 to 49·1] per 100 000) and chronic kidney disease death rates (5·0 [4·1 to 6·0] per 100 000) 84·4% lower (compared with 31·9 deaths [25·9 to 38·6] per 100 000 in the reference scenario; appendix 1 p 492). Similar patterns are observed for DALYs, with the largest improvement in the combined scenario compared with the reference due to declines in type 2 diabetes: from 928·1 age-standardised DALYs (704·7 to 1193·9) per 100 000 in the reference scenario in 2050, a 4·2% (–0·9 to 8·9) increase from 2022, to 83·1 (58·6 to 112·2) in the combined scenario, a 90·6% (89·8 to 90·7) decline from 2022 (GBD Foresight). This equates to a rate that is 91·0% lower in 2050 under the combined scenario than the reference scenario.

We likewise project additional gains in life expectancy and HALE across US states under the combined scenario (table 3). The largest improvements in 2050 compared with the reference scenario are forecasted in West Virginia (4·9 additional years and 5·1 additional healthy years). Reductions in age-standardised mortality and DALY rates are expected in all states under the combined scenario, although the magnitude of improvement will vary by state (appendix 1 pp 527–735). The largest relative improvement in age-standardised DALY rates in 2050 between the reference scenario and combined scenario is projected to occur in Mississippi, while the smallest improvement would be in Colorado. Across all states, most improvement under the combined scenario is forecasted to be due to improvements in behavioural and metabolic factors, since exposure to environmental and childhood disease-related risks is already very low in the USA.

USA-specific scenarios

We also produced forecasts for three USA-specific scenarios, wherein exposure to (or deaths due to, in the case of drug use) high adult BMI and FPG combined, smoking, and drug use in all US states is set to match that of the three best-performing US states. Imposing these best-performing trends on all locations did not substantially improve health outcomes beyond the reference scenario, however. For example, we forecasted that the USA could gain an additional 0·4 years (95% UI 0·3–0·6) of life expectancy and 0·6 years (0·5–0·8) of HALE in 2050 under the improved drug use scenario above and beyond the reference scenario forecasts (table 4). Life expectancy and HALE are likewise projected to be 0·4–0·5 years higher in 2050 under the improved adult BMI and FPG and improved smoking scenarios than the reference scenario. Following the trajectory of these scenarios would likewise lead to minimal improvement in global life expectancy ranking for the USA (compared with all other countries and territories under the reference scenario), from 66th under the reference scenario in 2050 to 64th with improved drug use or improved BMI and FPG, and 63rd with improved smoking (figure 2C–E).

Age-standardised mortality rates are forecasted to decline to 461·8 deaths (95% UI 441·0–485·8) per 100 000 in 2050 for the improved drug use scenario, 3·0% lower than that of the reference scenario; 459·8 deaths (439·7–484·2) per 100 000 for improved adult BMI and FPG (3·4% lower than reference); and 454·5 (434·0–479·3) per 100 000 for improved smoking (4·5% lower than reference; appendix 1 p 510). These small declines equate to 1·2 million (0·9–1·5) fewer deaths over the entire 2022–50 period in the improved drug use scenario compared with the reference scenario, 1·4 million (0·7–2·2) fewer deaths in the improved adult BMI and FPG scenario, and 2·1 million (1·3–2·9) fewer deaths in the improved smoking scenario. These all-cause mortality decreases reflect a 55·0% lower age-standardised rate of drug use disorder deaths in the improved drug use scenario in 2050 (12·4 deaths [11·1–14·0] per 100 000) compared with that of the reference scenario (26·7 deaths [21·2–33·4] per 100 000), an 7·7% lower rate of ischaemic heart disease deaths (36·4 deaths [28·7–45·2] per 100 000 versus 39·4 [31·3–49·1]) and 18·1% lower rate of diabetes deaths (6·6 deaths [5·3–7·8] per 100 000 versus 8·1 [6·5–9·7]) in the improved adult BMI and FPG scenario, and a 17·6% lower rate of lung cancer (21·0 deaths [18·1–24·2] per 100 000 versus 25·5 [21·8–29·4]) and 12·2% lower rate of COPD (26·1 deaths [20·8–30·8] per 100 000 versus 29·7 deaths [24·5–35·3]) in the improved smoking scenario (appendix 1 p 510). Similar patterns are observed for DALYs under the three USA-specific alternative scenarios (appendix 1 p 516).

Under our USA-specific scenarios, we likewise project small gains in life expectancy and HALE across US states compared with the reference scenario (table 4; appendix 1 p 338). Across the three USA-specific scenarios and all US states, the largest improvements in life expectancy and HALE in 2050 compared with the reference scenario are forecasted under the improved drug use scenario in West Virgina (1·6 additional years and 2·3 additional healthy years). Reductions in age-standardised mortality and DALY rates under each of the three scenarios are forecasted across the USA but would vary by state (appendix 1 pp 736–1415). For the improved adult BMI and FPG scenario, West Virginia is

	Improved adult BMI and fasting plasma glucose			Improved smoking			Improved drug use		
	2022	2035	2050	2022	2035	2050	2022	2035	2050
Life expectancy, years									
USA	78·3 (78·1–78·5)	80·2 (79·9–80·5)	80·8 (80·2–81·3)	78·3 (78·1–78·5)	80·4 (80·0–80·7)	80·9 (80·3–81·4)	78·3 (78·1–78·5)	80·3 (80·0–80·6)	80·9 (80·3–81·3)
Alabama	74·8 (73·2–76·2)	76·7 (75·1–78·2)	77·4 (75·7–78·9)	74·8 (73·2–76·2)	77·0 (75·5–78·6)	77·7 (76·0–79·2)	74·8 (73·2–76·2)	76·7 (75·1–78·2)	77·4 (75·8–78·9)
Alaska	77·6 (76·3–78·9)	80·0 (78·6–81·5)	80·8 (79·3–82·3)	77·6 (76·3–78·9)	80·3 (78·9–81·8)	81·1 (79·6–82·6)	77·6 (76·3–78·9)	80·2 (78·8–81·6)	81·0 (79·5–82·4)
Arizona	77·6 (76·0–79·1)	80·0 (78·3–81·6)	80·5 (78·9–82·1)	77·6 (76·0–79·1)	80·2 (78·6–81·9)	80·7 (79·1–82·4)	77·6 (76·1–79·1)	80·2 (78·6–81·8)	80·7 (79·1–82·4)
Arkansas	74·8 (73·3–76·3)	76·8 (75·2–78·5)	77·5 (75·8–79·2)	74·8 (73·3–76·3)	77·4 (75·8–79·0)	78·1 (76·4–79·8)	74·8 (73·3–76·3)	76·6 (75·0–78·2)	77·2 (75·6–78·9)
California	80·6 (79·4–81·8)	82·3 (81·0–83·5)	82·7 (81·4–84·0)	80·6 (79·4–81·8)	82·3 (81·0–83·5)	82·7 (81·4–84·0)	80·6 (79·4–81·8)	82·2 (81·0–83·5)	82·6 (81·4–83·9)
Colorado	79·7 (78·3–81·1)	81·0 (79·5–82·4)	81·4 (79·9–82·8)	79·7 (78·3–81·1)	81·3 (79·7–82·7)	81·7 (80·1–83·1)	79·7 (78·2–81·2)	81·2 (79·7–82·6)	81·7 (80·1–83·0)
Connecticut	80·6 (79·2–82·2)	82·3 (80·8–83·9)	82·8 (81·2–84·4)	80·6 (79·2–82·2)	82·4 (80·8–84·0)	82·8 (81·2–84·5)	80·6 (79·1–82·2)	82·5 (81·1–84·1)	82·9 (81·5–84·4)
Delaware	77·5 (76·4–78·6)	79·6 (78·5–80·8)	80·2 (79·0–81·5)	77·5 (76·4–78·6)	79·8 (78·7–81·0)	80·4 (79·2–81·7)	77·5 (76·4–78·6)	79·9 (78·9–81·1)	80·6 (79·6–81·8)
Florida	78·5 (77·1–79·9)	80·4 (79·0–81·8)	81·0 (79·5–82·4)	78·5 (77·1–79·9)	80·6 (79·3–82·1)	81·2 (79·7–82·6)	78·5 (77·1–79·9)	80·6 (79·3–81·9)	81·2 (79·9–82·6)
Georgia	76·9 (75·5–78·4)	79·2 (77·6–80·7)	79·8 (78·3–81·4)	76·9 (75·5–78·4)	79·3 (77·7–80·8)	80·0 (78·4–81·6)	76·9 (75·5–78·4)	79·0 (77·5–80·5)	79·7 (78·2–81·2)
Hawaii	81·4 (80·0–82·8)	82·5 (81·1–84·0)	83·0 (81·6–84·5)	81·4 (80·0–82·8)	82·7 (81·2–84·2)	83·2 (81·7–84·6)	81·4 (79·9–82·8)	82·5 (81·0–83·9)	83·0 (81·5–84·4)
Idaho	79·3 (78·0–80·6)	80·7 (79·4–82·2)	81·3 (79·8–82·7)	79·3 (78·0–80·6)	80·9 (79·6–82·3)	81·4 (79·9–82·8)	79·3 (78·0–80·7)	80·7 (79·4–82·1)	81·1 (79·7–82·6)
Illinois	78·3 (76·9–79·7)	80·5 (79·1–82·1)	81·1 (79·6–82·6)	78·3 (76·9–79·7)	80·7 (79·2–82·2)	81·2 (79·7–82·7)	78·3 (76·9–79·6)	80·5 (79·1–81·9)	81·1 (79·8–82·5)
Indiana	76·5 (75·1–77·8)	78·2 (76·7–79·6)	78·8 (77·3–80·4)	76·5 (75·1–77·8)	78·5 (77·0–79·9)	79·0 (77·5–80·6)	76·5 (75·1–77·8)	78·4 (77·0–79·8)	79·1 (77·6–80·6)
Iowa	79·2 (77·7–80·6)	80·4 (78·9–82·0)	80·9 (79·3–82·5)	79·2 (77·7–80·6)	80·6 (79·1–82·2)	81·1 (79·5–82·7)	79·1 (77·6–80·6)	80·2 (78·7–81·8)	80·7 (79·0–82·2)
Kansas	77·8 (76·2–79·4)	79·3 (77·8–81·1)	79·8 (78·2–81·5)	77·8 (76·2–79·4)	79·5 (77·9–81·2)	80·0 (78·4–81·7)	77·8 (76·2–79·4)	79·1 (77·6–80·8)	79·6 (78·1–81·3)
Kentucky	74·4 (72·7–75·9)	76·5 (74·7–78·0)	77·1 (75·3–78·7)	74·4 (72·7–75·9)	77·0 (75·3–78·5)	77·6 (75·8–79·1)	74·4 (72·7–75·8)	76·9 (75·2–78·4)	77·6 (75·9–79·1)
Louisiana	74·9 (73·3–76·4)	76·9 (75·3–78·5)	77·6 (75·7–79·2)	74·9 (73·3–76·4)	77·3 (75·7–78·9)	78·0 (76·0–79·6)	74·9 (73·3–76·4)	77·0 (75·3–78·5)	77·8 (76·1–79·3)
Maine	77·7 (76·3–79·2)	79·3 (77·8–80·8)	79·8 (78·2–81·4)	77·7 (76·3–79·2)	79·7 (78·2–81·2)	80·1 (78·6–81·7)	77·7 (76·3–79·2)	79·7 (78·3–81·1)	80·2 (78·7–81·7)
Maryland	78·3 (76·8–80·0)	80·5 (79·0–82·3)	81·1 (79·6–82·9)	78·3 (76·8–80·0)	80·5 (79·0–82·3)	81·1 (79·6–82·9)	78·3 (76·8–79·9)	80·4 (78·9–82·1)	81·0 (79·5–82·7)
Massachusetts	81·2 (79·7–82·7)	82·4 (80·9–83·9)	82·8 (81·3–84·2)	81·2 (79·7–82·7)	82·6 (81·1–84·1)	83·0 (81·5–84·4)	81·2 (79·7–82·6)	82·9 (81·6–84·3)	83·3 (82·0–84·6)
Michigan	77·7 (76·2–79·1)	79·5 (78·0–81·1)	80·1 (78·6–81·7)	77·7 (76·2–79·1)	79·8 (78·3–81·3)	80·3 (78·8–81·9)	77·7 (76·3–79·1)	79·7 (78·2–81·2)	80·3 (78·7–81·7)
Minnesota	80·5 (79·2–81·9)	81·8 (80·4–83·1)	82·2 (80·9–83·5)	80·5 (79·2–81·9)	82·0 (80·7–83·4)	82·4 (81·1–83·7)	80·5 (79·2–81·9)	81·7 (80·4–83·0)	82·1 (80·8–83·4)
Mississippi	73·4 (71·8–75·0)	75·7 (73·9–77·2)	76·5 (74·5–78·1)	73·4 (71·8–75·0)	76·0 (74·2–77·5)	76·8 (74·9–78·5)	73·4 (71·8–75·0)	75·4 (73·7–77·0)	76·2 (74·4–77·9)
Missouri	76·4 (74·9–78·1)	78·4 (76·7–80·1)	79·0 (77·3–80·8)	76·4 (74·9–78·1)	78·8 (77·2–80·5)	79·4 (77·7–81·2)	76·4 (74·9–78·0)	78·5 (76·9–80·2)	79·2 (77·7–80·9)
Montana	78·6 (76·9–80·1)	79·8 (78·2–81·4)	80·4 (78·8–81·9)	78·6 (76·9–80·1)	80·3 (78·7–81·9)	80·8 (79·2–82·4)	78·6 (76·9–80·1)	79·9 (78·4–81·5)	80·5 (78·9–82·0)
Nebraska	78·8 (77·6–80·2)	80·4 (79·2–81·9)	80·9 (79·6–82·4)	78·8 (77·6–80·2)	80·6 (79·3–82·0)	81·0 (79·7–82·5)	78·8 (77·6–80·2)	80·1 (78·8–81·6)	80·6 (79·3–82·0)

(Table 4 continues on next page)

	Improved adult BMI and fasting plasma glucose			Improved smoking			Improved drug use		
	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)									
Nevada	77·6 (76·2–79·1)	80·2 (78·7–81·8)	81·2 (79·6–82·7)	77·6 (76·2–79·1)	80·7 (79·2–82·2)	81·5 (80·0–83·0)	77·6 (76·3–79·1)	80·4 (78·9–81·9)	81·3 (79·8–82·8)
New Hampshire	79·4 (78·0–80·9)	80·8 (79·2–82·3)	81·2 (79·8–82·7)	79·4 (78·0–80·9)	81·0 (79·5–82·5)	81·4 (80·0–82·9)	79·4 (78·0–80·9)	81·3 (79·9–82·7)	81·7 (80·4–83·1)
New Jersey	80·2 (78·7–81·6)	82·3 (80·6–83·6)	82·7 (81·1–84·1)	80·2 (78·7–81·6)	82·3 (80·7–83·7)	82·7 (81·1–84·1)	80·2 (78·7–81·6)	82·4 (80·9–83·8)	82·8 (81·3–84·2)
New Mexico	75·6 (73·9–77·2)	78·3 (76·4–80·0)	79·0 (77·0–81·0)	75·6 (73·9–77·2)	78·6 (76·7–80·3)	79·2 (77·2–81·2)	75·6 (73·9–77·2)	78·8 (76·9–80·4)	79·5 (77·6–81·2)
New York	80·6 (79·3–82·0)	82·9 (81·5–84·3)	83·4 (82·1–84·7)	80·6 (79·3–82·0)	83·0 (81·6–84·3)	83·5 (82·1–84·7)	80·6 (79·3–81·9)	82·8 (81·4–84·3)	83·3 (82·0–84·7)
North Carolina	77·0 (75·6–78·4)	79·0 (77·5–80·6)	79·7 (78·1–81·2)	77·0 (75·6–78·4)	79·2 (77·7–80·7)	79·8 (78·2–81·4)	77·0 (75·6–78·4)	79·2 (77·7–80·7)	79·8 (78·3–81·3)
North Dakota	80·6 (79·3–81·9)	81·6 (80·2–83·0)	82·0 (80·5–83·4)	80·6 (79·3–81·9)	81·8 (80·4–83·2)	82·2 (80·7–83·5)	80·6 (79·2–81·9)	81·4 (80·0–82·7)	81·7 (80·3–83·1)
Ohio	76·4 (74·9–77·7)	78·1 (76·5–79·4)	78·6 (77·1–80·1)	76·4 (74·9–77·7)	78·3 (76·8–79·7)	78·8 (77·3–80·3)	76·4 (74·9–77·7)	78·6 (77·2–79·9)	79·2 (77·8–80·5)
Oklahoma	74·8 (73·2–76·1)	76·8 (74·9–78·4)	77·4 (75·6–79·0)	74·8 (73·2–76·1)	77·2 (75·3–78·7)	77·7 (75·9–79·3)	74·8 (73·2–76·1)	76·8 (75·1–78·2)	77·4 (75·6–79·0)
Oregon	79·4 (77·7–80·8)	81·0 (79·2–82·5)	81·5 (79·7–83·1)	79·4 (77·7–80·8)	81·3 (79·5–82·8)	81·8 (80·0–83·4)	79·4 (77·7–80·8)	81·0 (79·3–82·5)	81·5 (79·8–83·1)
Pennsylvania	78·2 (76·8–79·7)	79·7 (78·1–81·2)	80·2 (78·7–81·7)	78·2 (76·8–79·7)	79·9 (78·4–81·4)	80·4 (78·9–81·9)	78·3 (76·8–79·7)	80·3 (79·0–81·7)	80·9 (79·5–82·2)
Rhode Island	80·5 (78·9–82·0)	81·7 (80·1–83·2)	82·2 (80·7–83·7)	80·5 (78·9–82·0)	82·0 (80·4–83·5)	82·3 (80·8–83·9)	80·5 (78·9–82·0)	82·0 (80·5–83·5)	82·5 (81·0–83·9)
South Carolina	76·0 (74·6–77·5)	78·0 (76·5–79·6)	78·6 (77·1–80·3)	76·0 (74·6–77·5)	78·2 (76·7–79·8)	78·8 (77·3–80·5)	76·0 (74·6–77·5)	78·0 (76·5–79·6)	78·7 (77·2–80·3)
South Dakota	78·9 (77·5–80·2)	80·1 (78·7–81·5)	80·6 (79·1–82·0)	78·9 (77·5–80·2)	80·4 (79·0–81·8)	80·9 (79·4–82·3)	78·9 (77·5–80·2)	79·9 (78·4–81·3)	80·3 (78·8–81·7)
Tennessee	75·0 (73·5–76·4)	77·0 (75·3–78·6)	77·6 (75·9–79·4)	75·0 (73·5–76·4)	77·4 (75·7–79·0)	78·0 (76·3–79·8)	75·0 (73·5–76·4)	77·3 (75·7–78·8)	78·0 (76·4–79·5)
Texas	78·2 (76·9–79·6)	80·2 (78·9–81·6)	80·8 (79·4–82·3)	78·2 (76·9–79·6)	80·2 (78·9–81·6)	80·8 (79·3–82·2)	78·2 (76·9–79·6)	80·0 (78·6–81·4)	80·6 (79·1–82·0)
Utah	79·7 (78·4–80·9)	80·8 (79·5–82·1)	81·2 (79·8–82·5)	79·7 (78·4–80·9)	80·6 (79·3–81·9)	81·0 (79·6–82·4)	79·7 (78·4–80·9)	81·0 (79·7–82·2)	81·3 (80·0–82·6)
Vermont	78·7 (77·5–79·8)	81·0 (79·8–82·1)	81·4 (80·1–82·6)	78·7 (77·5–79·8)	81·3 (80·1–82·4)	81·7 (80·4–82·9)	78·7 (77·5–79·8)	81·2 (80·0–82·3)	81·6 (80·4–82·7)
Virginia	78·6 (77·1–80·1)	80·6 (79·0–82·3)	81·2 (79·6–82·7)	78·6 (77·1–80·1)	80·8 (79·2–82·4)	81·3 (79·7–82·8)	78·6 (77·1–80·1)	80·6 (79·0–82·1)	81·1 (79·5–82·6)
Washington	80·2 (78·9–81·7)	81·6 (80·3–83·2)	82·1 (80·8–83·7)	80·2 (78·9–81·7)	81·8 (80·5–83·3)	82·2 (80·9–83·8)	80·2 (78·9–81·7)	81·8 (80·4–83·3)	82·2 (80·8–83·7)
Washington, DC	78·4 (76·9–80·0)	79·9 (78·5–81·4)	80·7 (79·2–82·2)	78·4 (76·9–80·0)	80·3 (78·9–81·8)	81·1 (79·6–82·6)	78·4 (76·9–80·0)	80·1 (78·7–81·6)	80·9 (79·5–82·4)
West Virginia	73·5 (71·9–75·1)	75·6 (73·7–77·5)	76·2 (74·2–78·2)	73·5 (71·9–75·1)	76·0 (74·1–77·9)	76·6 (74·6–78·6)	73·5 (71·8–75·0)	76·3 (74·5–78·1)	77·1 (75·2–78·8)
Wisconsin	79·0 (77·5–80·8)	80·5 (78·8–82·1)	81·0 (79·3–82·5)	79·0 (77·5–80·8)	80·7 (79·1–82·3)	81·1 (79·5–82·7)	79·0 (77·5–80·7)	80·6 (79·0–82·2)	81·1 (79·5–82·6)
Wyoming	78·1 (76·8–79·2)	79·3 (78·0–80·5)	79·8 (78·5–81·2)	78·1 (76·8–79·2)	79·8 (78·5–81·1)	80·3 (79·0–81·6)	78·1 (76·9–79·2)	79·5 (78·3–80·6)	80·0 (78·7–81·2)
Healthy life expectancy, years									
USA	65·4 (61·7–68·5)	67·1 (63·5–70·2)	67·5 (63·9–70·6)	65·4 (61·7–68·5)	67·1 (63·4–70·3)	67·4 (63·7–70·6)	65·4 (61·7–68·5)	67·3 (63·7–70·4)	67·7 (64·1–70·7)
Alabama	62·5 (59·3–65·7)	64·2 (60·9–67·3)	64·7 (61·2–67·8)	62·5 (59·3–65·7)	64·3 (60·9–67·5)	64·6 (61·0–67·8)	62·5 (59·2–65·6)	64·4 (60·9–67·5)	64·8 (61·3–67·9)
Alaska	64·8 (61·1–68·1)	66·9 (63·1–70·2)	67·5 (63·7–70·9)	64·8 (61·1–68·1)	67·1 (63·2–70·4)	67·6 (63·7–71·0)	64·8 (61·1–68·1)	67·2 (63·4–70·5)	67·8 (63·9–71·0)

(Table 4 continues on next page)

	Improved adult BMI and fasting plasma glucose			Improved smoking			Improved drug use		
	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)									
Arizona	64·5 (60·8–68·0)	66·4 (62·6–69·8)	66·7 (63·0–70·4)	64·5 (60·8–68·0)	66·5 (62·7–70·0)	66·8 (63·0–70·5)	64·5 (60·9–68·0)	66·9 (63·2–70·3)	67·1 (63·5–70·6)
Arkansas	63·1 (59·7–66·1)	64·8 (61·4–68·0)	65·3 (61·8–68·6)	63·1 (59·7–66·1)	65·1 (61·6–68·4)	65·5 (61·9–68·9)	63·1 (59·7–66·1)	64·7 (61·2–67·8)	65·0 (61·4–68·3)
California	67·7 (64·1–71·1)	69·2 (65·6–72·5)	69·5 (65·9–72·8)	67·7 (64·1–71·1)	69·1 (65·5–72·5)	69·4 (65·8–72·8)	67·7 (64·1–71·1)	69·2 (65·6–72·5)	69·4 (65·8–72·7)
Colorado	66·5 (62·6–69·9)	67·6 (63·7–71·0)	68·0 (64·1–71·5)	66·5 (62·6–69·9)	67·9 (63·9–71·2)	68·2 (64·3–71·7)	66·5 (62·6–69·8)	68·1 (64·1–71·4)	68·4 (64·5–71·8)
Connecticut	67·3 (63·3–70·7)	68·9 (65·0–72·5)	69·3 (65·3–72·8)	67·3 (63·3–70·7)	68·9 (64·9–72·4)	69·2 (65·2–72·8)	67·3 (63·3–70·7)	69·3 (65·4–72·7)	69·6 (65·6–73·1)
Delaware	64·5 (60·8–67·9)	66·3 (62·7–69·7)	66·8 (63·1–70·1)	64·5 (60·8–67·9)	66·3 (62·6–69·7)	66·7 (62·9–70·0)	64·5 (60·8–67·8)	66·8 (63·0–70·1)	67·2 (63·4–70·6)
Florida	65·3 (61·7–68·5)	66·9 (63·3–70·2)	67·2 (63·6–70·6)	65·3 (61·7–68·5)	67·0 (63·3–70·3)	67·3 (63·6–70·7)	65·3 (61·7–68·5)	67·3 (63·6–70·5)	67·6 (63·9–70·9)
Georgia	64·5 (61·0–67·8)	66·4 (62·8–69·8)	66·9 (63·2–70·3)	64·5 (61·0–67·8)	66·4 (62·7–69·8)	66·8 (63·0–70·3)	64·5 (61·0–67·8)	66·3 (62·8–69·7)	66·7 (63·0–70·2)
Hawaii	68·5 (64·7–71·9)	69·4 (65·7–72·9)	69·7 (65·9–73·2)	68·5 (64·7–71·9)	69·5 (65·8–73·0)	69·8 (66·0–73·3)	68·5 (64·7–71·8)	69·4 (65·6–72·7)	69·6 (65·8–73·0)
Idaho	66·3 (62·7–69·7)	67·6 (64·1–71·0)	67·9 (64·3–71·4)	66·3 (62·7–69·7)	67·6 (64·0–71·1)	67·9 (64·2–71·4)	66·3 (62·7–69·7)	67·7 (64·1–71·1)	67·9 (64·3–71·4)
Illinois	65·7 (62·1–69·0)	67·8 (64·2–71·1)	68·2 (64·5–71·6)	65·7 (62·1–69·0)	67·7 (64·1–71·1)	68·1 (64·4–71·5)	65·7 (62·2–69·0)	67·8 (64·0–71·0)	68·2 (64·5–71·5)
Indiana	63·7 (60·3–66·9)	65·2 (61·7–68·5)	65·6 (61·9–69·0)	63·7 (60·3–66·9)	65·2 (61·6–68·6)	65·5 (61·6–68·9)	63·7 (60·2–66·9)	65·6 (62·0–68·8)	65·9 (62·2–69·3)
Iowa	66·5 (62·8–69·6)	67·7 (64·3–71·0)	68·1 (64·7–71·3)	66·5 (62·8–69·6)	67·7 (64·2–71·0)	67·9 (64·4–71·2)	66·4 (62·8–69·6)	67·3 (63·8–70·6)	67·6 (64·0–70·9)
Kansas	65·2 (61·5–68·4)	66·6 (62·9–69·7)	66·9 (63·2–70·2)	65·2 (61·5–68·4)	66·5 (62·8–69·7)	66·8 (63·1–70·2)	65·2 (61·5–68·3)	66·4 (62·8–69·6)	66·7 (63·1–69·9)
Kentucky	61·7 (58·1–65·0)	63·4 (59·8–66·8)	63·8 (60·1–67·3)	61·7 (58·1–65·0)	63·6 (59·9–67·1)	63·8 (59·9–67·4)	61·7 (58·1–65·0)	64·3 (60·5–67·6)	64·7 (60·7–67·9)
Louisiana	62·5 (59·1–65·8)	64·2 (60·6–67·8)	64·6 (61·0–68·1)	62·5 (59·1–65·8)	64·3 (60·6–67·8)	64·6 (60·9–68·2)	62·5 (59·1–65·8)	64·5 (60·8–67·9)	64·9 (61·2–68·5)
Maine	64·8 (60·9–68·2)	66·2 (62·6–69·7)	66·5 (62·8–70·0)	64·8 (60·9–68·2)	66·3 (62·6–69·9)	66·6 (62·8–70·2)	64·8 (61·0–68·2)	66·7 (63·0–70·2)	67·1 (63·4–70·5)
Maryland	65·8 (62·2–69·1)	67·7 (64·2–71·2)	68·2 (64·6–71·7)	65·8 (62·2–69·1)	67·6 (64·0–71·1)	68·0 (64·4–71·6)	65·8 (62·2–69·1)	67·5 (64·0–71·0)	67·9 (64·3–71·5)
Massachusetts	67·6 (63·8–71·0)	68·8 (65·0–72·3)	69·1 (65·3–72·5)	67·6 (63·8–71·0)	68·9 (65·0–72·3)	69·1 (65·2–72·6)	67·6 (63·8–71·0)	69·5 (65·6–72·9)	69·8 (66·0–73·2)
Michigan	64·6 (60·7–67·8)	66·2 (62·5–69·5)	66·6 (62·7–70·0)	64·6 (60·7–67·8)	66·2 (62·4–69·5)	66·5 (62·5–69·9)	64·6 (60·8–67·7)	66·5 (62·7–69·7)	66·8 (63·0–70·2)
Minnesota	67·7 (64·0–71·1)	69·0 (65·5–72·3)	69·4 (65·8–72·8)	67·7 (64·0–71·1)	69·0 (65·4–72·4)	69·3 (65·6–72·8)	67·7 (64·0–71·1)	68·8 (65·2–72·2)	69·1 (65·4–72·5)
Mississippi	62·1 (58·8–65·2)	64·1 (60·7–67·2)	64·7 (61·2–67·8)	62·1 (58·8–65·2)	64·2 (60·6–67·3)	64·7 (61·1–67·9)	62·1 (58·8–65·2)	64·0 (60·6–67·1)	64·5 (60·9–67·6)
Missouri	63·8 (60·3–66·9)	65·4 (61·9–68·8)	65·9 (62·2–69·3)	63·8 (60·3–66·9)	65·6 (61·9–68·9)	65·9 (62·1–69·4)	63·8 (60·3–66·9)	65·7 (62·1–68·9)	66·2 (62·5–69·4)
Montana	65·6 (61·5–68·8)	66·7 (62·6–70·0)	67·1 (63·0–70·5)	65·6 (61·5–68·8)	67·0 (62·8–70·3)	67·4 (63·2–70·8)	65·6 (61·4–68·8)	67·0 (62·9–70·2)	67·3 (63·2–70·6)
Nebraska	66·2 (62·6–69·4)	67·8 (64·2–71·0)	68·2 (64·5–71·4)	66·2 (62·6–69·4)	67·7 (64·0–70·9)	68·0 (64·3–71·3)	66·2 (62·5–69·4)	67·3 (63·5–70·6)	67·6 (63·8–71·0)
Nevada	64·9 (61·3–68·3)	67·0 (63·3–70·6)	67·7 (63·9–71·3)	64·9 (61·3–68·3)	67·4 (63·6–71·0)	67·9 (64·1–71·6)	64·9 (61·3–68·3)	67·5 (63·8–71·0)	68·1 (64·5–71·7)
New Hampshire	65·9 (61·9–69·5)	67·2 (63·2–71·0)	67·6 (63·6–71·3)	65·9 (61·9–69·5)	67·3 (63·2–71·1)	67·6 (63·6–71·4)	65·9 (61·9–69·5)	68·1 (64·1–71·6)	68·4 (64·5–72·0)
New Jersey	67·0 (63·3–70·4)	68·9 (65·0–72·2)	69·2 (65·3–72·5)	67·0 (63·3–70·4)	68·8 (64·9–72·2)	69·1 (65·2–72·4)	67·0 (63·3–70·3)	69·1 (65·3–72·4)	69·4 (65·5–72·7)

(Table 4 continues on next page)

	Improved adult BMI and fasting plasma glucose			Improved smoking			Improved drug use		
	2022	2035	2050	2022	2035	2050	2022	2035	2050
(Continued from previous page)									
New Mexico	62·9 (59·2–66·4)	64·9 (61·0–68·5)	65·4 (61·3–69·1)	62·9 (59·2–66·4)	65·1 (61·1–68·7)	65·5 (61·4–69·2)	62·9 (59·2–66·4)	65·7 (61·8–69·3)	66·2 (62·2–69·7)
New York	66·9 (63·2–70·5)	68·9 (65·2–72·4)	69·2 (65·5–72·7)	66·9 (63·2–70·5)	68·8 (65·1–72·4)	69·1 (65·4–72·6)	66·9 (63·2–70·5)	68·8 (65·2–72·3)	69·1 (65·4–72·6)
North Carolina	64·5 (60·8–68·0)	66·3 (62·5–69·8)	66·7 (63·0–70·3)	64·5 (60·8–68·0)	66·3 (62·4–69·8)	66·6 (62·7–70·2)	64·5 (60·8–68·0)	66·5 (62·8–70·0)	66·9 (63·1–70·4)
North Dakota	67·2 (63·3–70·7)	68·2 (64·5–71·7)	68·5 (64·6–71·9)	67·2 (63·3–70·7)	68·2 (64·3–71·7)	68·3 (64·4–71·9)	67·1 (63·3–70·7)	67·8 (63·9–71·3)	67·9 (64·0–71·4)
Ohio	63·4 (59·6–66·7)	64·9 (61·2–68·3)	65·3 (61·5–68·7)	63·4 (59·6–66·7)	64·9 (61·1–68·4)	65·2 (61·3–68·6)	63·4 (59·6–66·7)	65·7 (62·0–69·0)	66·1 (62·3–69·3)
Oklahoma	62·3 (58·7–65·5)	64·0 (60·3–67·3)	64·4 (60·7–67·8)	62·3 (58·7–65·5)	64·1 (60·4–67·5)	64·4 (60·6–67·8)	62·3 (58·8–65·5)	64·4 (60·8–67·6)	64·8 (61·0–68·1)
Oregon	66·6 (63·0–69·9)	68·0 (64·4–71·3)	68·4 (64·8–71·9)	66·6 (63·0–69·9)	68·2 (64·5–71·5)	68·5 (64·9–72·1)	66·5 (63·0–69·9)	68·2 (64·6–71·6)	68·6 (64·9–72·0)
Pennsylvania	64·8 (60·9–68·0)	66·2 (62·4–69·4)	66·6 (62·8–69·9)	64·8 (60·9–68·0)	66·2 (62·3–69·4)	66·5 (62·6–69·8)	64·8 (61·0–68·0)	67·0 (63·2–70·1)	67·4 (63·6–70·6)
Rhode Island	67·0 (63·1–70·5)	68·2 (64·5–71·6)	68·6 (64·8–72·1)	67·0 (63·1–70·5)	68·3 (64·5–71·8)	68·6 (64·7–72·1)	67·0 (63·1–70·4)	68·7 (65·1–72·1)	69·1 (65·4–72·5)
South Carolina	63·4 (59·9–66·6)	65·2 (61·5–68·6)	65·6 (61·9–69·1)	63·4 (59·9–66·6)	65·1 (61·4–68·6)	65·5 (61·7–69·1)	63·4 (59·9–66·6)	65·4 (61·8–68·7)	65·7 (62·0–69·2)
South Dakota	66·1 (62·4–69·4)	67·2 (63·5–70·6)	67·6 (63·7–70·9)	66·1 (62·4–69·4)	67·3 (63·5–70·7)	67·5 (63·7–71·0)	66·1 (62·4–69·4)	66·9 (63·0–70·2)	67·1 (63·2–70·5)
Tennessee	62·6 (59·1–65·8)	64·2 (60·7–67·5)	64·7 (61·2–68·1)	62·6 (59·1–65·8)	64·4 (60·8–67·7)	64·7 (61·1–68·1)	62·6 (59·1–65·8)	64·9 (61·4–68·1)	65·3 (61·8–68·6)
Texas	65·7 (62·2–69·0)	67·5 (63·8–70·8)	67·9 (64·1–71·3)	65·7 (62·2–69·0)	67·3 (63·5–70·6)	67·7 (63·8–71·1)	65·7 (62·2–69·0)	67·2 (63·7–70·5)	67·6 (63·9–71·1)
Utah	66·6 (62·7–69·8)	67·6 (63·7–71·0)	67·8 (63·9–71·2)	66·6 (62·7–69·8)	67·3 (63·4–70·7)	67·6 (63·6–71·0)	66·5 (62·7–69·8)	67·9 (64·0–71·2)	68·1 (64·1–71·4)
Vermont	66·2 (62·6–69·3)	68·2 (64·6–71·3)	68·5 (64·8–71·5)	66·2 (62·6–69·3)	68·3 (64·7–71·5)	68·5 (64·9–71·7)	66·2 (62·6–69·3)	68·4 (64·9–71·5)	68·7 (65·1–71·8)
Virginia	65·8 (62·3–69·3)	67·7 (64·0–71·2)	68·1 (64·4–71·6)	65·8 (62·3–69·3)	67·6 (63·9–71·2)	68·0 (64·2–71·5)	65·8 (62·3–69·3)	67·6 (64·0–71·1)	68·0 (64·4–71·5)
Washington	67·0 (63·2–70·5)	68·3 (64·6–71·9)	68·7 (65·0–72·3)	67·0 (63·2–70·5)	68·4 (64·5–71·9)	68·6 (64·9–72·2)	67·0 (63·2–70·5)	68·6 (64·9–72·1)	68·9 (65·2–72·4)
Washington, DC	65·9 (62·3–69·0)	67·4 (63·9–70·4)	68·0 (64·5–71·0)	65·9 (62·3–69·0)	67·7 (64·2–70·7)	68·2 (64·7–71·3)	65·9 (62·3–68·9)	67·6 (64·2–70·6)	68·2 (64·7–71·2)
West Virginia	60·8 (56·9–64·0)	62·6 (58·7–65·9)	63·0 (59·0–66·6)	60·8 (56·9–64·0)	62·6 (58·7–66·0)	62·9 (58·8–66·6)	60·8 (56·9–64·0)	63·9 (60·2–67·1)	64·3 (60·5–67·8)
Wisconsin	66·0 (62·3–69·4)	67·5 (63·7–71·0)	67·8 (64·0–71·3)	66·0 (62·3–69·4)	67·4 (63·6–71·0)	67·7 (63·8–71·3)	66·0 (62·3–69·4)	67·7 (63·9–71·2)	68·0 (64·2–71·6)
Wyoming	65·2 (61·7–68·5)	66·4 (62·9–69·6)	66·8 (63·3–70·1)	65·2 (61·7–68·5)	66·7 (63·1–70·0)	67·1 (63·5–70·4)	65·2 (61·7–68·5)	66·7 (63·3–70·0)	67·1 (63·5–70·4)

Estimates are mean (95% uncertainty interval).

***Table 4:* Life expectancy and healthy life expectancy for the USA and for US states and Washington, DC, under USA-specific scenarios, 2022, 2035, and 2050**

forecasted to see the largest relative declines in age-standardised DALY rates in 2050 compared with the reference scenario, whereas Colorado will have the smallest decline. For improved drug use, the greatest improvements are projected to be in West Virginia, and the least in Nebraska. For improved smoking, the largest decreases in burden will be in Arkansas, while the smallest will be in California. Since smoking was already declining and at a low level in many states, additional improvements in health outcomes under the improved smoking scenario compared with the reference scenario are expected to be smaller than those of the improved drug use and improved adult BMI and FPG scenarios.

Model performance

Based on a skill metric that evaluated the performance of our forecasting model against a simple baseline model, we found that skill values for the USA were positive for out-of-sample predictions for all causes combined for both deaths and DALYs, at 0·53 for males and 0·50 for females for deaths, and 0·37 for males and 0·52 for females for DALYs. A positive skill value indicates better model performance than the baseline model. Skill values were also positive for all Level 1 causes except injuries in males for deaths (–0·13) and both males and females for DALYs (–0·14 and –0·19). The highest Level 1 skill value for deaths was for NCDs in males (0·54), and for DALYs was for NCDs in females (0·60). Skill values by Level 2 cause are presented in the appendix 1 (pp 70–72).

Discussion

Main findings

This study presents forecasts of the burden of disease for the USA and all 50 US states and Washington, DC, from 2022 to 2050. Our findings show a concerning trajectory for the future of US health, in which the USA will fail to keep up with health progress around the world unless concerted efforts are made to reduce exposure to key modifiable risk factors. We found that the USA's global ranking for life expectancy and HALE will continue to decline in the years to come compared with all other countries, with particularly poor outcomes forecasted for females in the USA relative to females in other countries. Several states, such as Kentucky and West Virginia, are projected to have worse health outcomes in 2050 than in 1990, with female HALE declining between 1990 and 2050 in 20 US states. Worse trends in HALE than life expectancy in these and other states indicate that, while life expectancy will increase in most of the country over the next several decades, for many, those additional years of life will be spent in poorer health. While overall age-standardised rates of disease and injury burden (both mortality and DALYs) will decline over the forecasted period for most states—albeit at slower rates than in the 1990–2010 period—rates are projected to increase dramatically for certain causes, including for drug use disorders and chronic kidney disease. Exposure (measured by SEVs) to several key risk factors is also forecasted to increase substantially in the coming decades, including for high BMI, high FPG, and high sodium, contributing to slower declines in the health outcomes associated with these risks.

The USA is facing substantial and, in some instances, increasing health challenges, with rising rates of obesity, high and increasing prevalence of drug use, and suboptimal control of blood pressure and blood sugar levels, among others. These factors contribute to a high burden of chronic diseases such as heart disease, diabetes, kidney diseases, and cancer, as well as drug use disorders. Through our analyses, we aimed to show the potential health improvements that could occur if lagging states could achieve the risk levels and associated health outcomes of the best-performing states. Unfortunately, even when setting our forecasts to match the achievements of the best-performing states, the overall improvements are forecasted to be modest, with increases in life expectancy and HALE of just 0·4–0·6 years compared with the reference scenario, and the USA continues to fall further behind other countries. We also produced alternative scenarios wherein exposure to a range of key environmental, behavioural, and metabolic risk factors was set to be eliminated by 2050. Under a scenario that combines the effects of eliminating all of these risks, we do forecast substantial potential improvements in health outcomes; however, compared with other countries under the same combined scenario, many US states still perform poorly. In fact, if the USA managed to eliminate exposure to all these key risks by 2050, the country's life expectancy would still only be on par with that of Canada if Canada made no improvements to its current (reference) trajectory. These findings call for a multifaceted approach, with interventions and policies that address a range of risk factors and health outcomes from different prevention and treatment angles.

Addressing key modifiable risk factors

Our combined scenario indicates that eliminating exposure to the risk factors in that scenario—namely high BMI, high FPG, high systolic blood pressure, high sodium, and smoking—will have the largest impact on rates of type 2 diabetes, ischaemic heart disease, and chronic kidney disease, with approximately 85–100% lower age-standardised rates of death due to these three diseases in 2050 compared with the reference scenario. Eliminating exposure to these risks by 2050 would likewise avert an estimated 12·4 million deaths in the USA between 2022 and 2050. These findings offer policy makers and health professionals alike important insights into the risks and health outcomes that most need to be addressed in the USA over the next several decades—namely drug use, high BMI, high FPG and diabetes, and high blood pressure and its associated health outcomes, non-optimal diet, and smoking. The NCD Countdown 2030 collaborators identified 21 evidence-based, high-priority policy interventions to reduce mortality from NCDs to Sustainable Development Goal (SDG) target 3.4 levels by 2030,[22] many of which target the key risk factors and associated health outcomes from our combined scenario findings. Many of these interventions would also be made more accessible by universal health coverage, which we discuss further below. For high FPG, and the associated diabetes and chronic kidney disease, effective interventions included in universal health coverage include diabetes screening and treatment.[22] Additional interventions for managing blood sugar levels include increasing access to diabetes education, promoting self-management skills, and ensuring that individuals have the necessary resources to maintain a healthy lifestyle.

For ischaemic heart disease, interventions include primary and secondary prevention for cardiovascular disease, acute and chronic treatment for health failure, and percutaneous coronary intervention and medical management of acute coronary syndrome.[22] For high systolic blood pressure, it is necessary to treat and control blood pressure levels in addition to encouraging regular blood pressure monitoring and lifestyle modifications, such as a healthy diet and regular physical activity.[23] Other studies have found that progress on obesity could be made through the expanded use of new medications[24,25] alongside a combination of public health initiatives, such as promoting and improving affordable access to healthier food options, encouraging physical activity, and implementing policies that support healthy environments.[5,26] In addition to clinical-level interventions, the NCD Countdown 2030 collaborators also found substantial reductions from six intersectoral policies that address the same key risks and associated health outcomes: alcohol excise taxes; alcohol regulations; tobacco excise taxes; smoking regulations and information, education, and communication; sodium reduction measures; and bans on trans fats.[22]

Our forecasts, combined with recent findings that the 15 dietary risks included in GBD 2021 contributed to 10·2% of total deaths in the USA in 2021,[5] likewise show that many of the USA's biggest health concerns are associated with diet. Increasingly unhealthy diets across US states are fostering slow progress on or even increases in chronic health conditions like obesity, diabetes, and heart disease.[5,27] While the recent development and demonstration in randomised trials of glucagon-like peptide 1 (GLP-1) agonists provides a new and effective strategy for reducing weight,[24,25] there is still considerable research and time needed to understand the feasibility and long-term effectiveness of widespread use of GLP-1s, and it is difficult to imagine a future in which the prevalence of overweight and obesity in the USA declines considerably without population-level changes to diet quality. GBD 2021 provides strong indications of which components of diet can most reduce health risks,[5] but policy interventions to encourage reduced consumption of unhealthy components of diet requires action on multiple fronts.

The USA is also facing a monumental challenge in addressing drug abuse, particularly with the ongoing opioid epidemic. In fact, age-standardised mortality rates due to drug use disorders are forecasted to be more than twice as high in the USA in 2050 as in the next-highest country, Canada.[1] To address and prevent this issue, the country needs to invest in effective prevention strategies, such as comprehensive public health campaigns and evidence-based drug education programmes.[28,29] Additionally, we must expand access to treatment and recovery support services, including medication-assisted treatment and behavioural health interventions. We must also increase availability of naloxone, which quickly reverses the effects of opioid overdose, particularly now that it is available in the USA without a prescription.[30]

As we envision a healthier future for the USA by 2050, it is imperative to recognise that the journey towards improved public health is a shared responsibility. While preventing exposure to and treating the effects of these and other risk factors will require a range of interventions supported by a comprehensive health system and a set of policies and structures that better address the social determinants of health, the role of personal responsibility and behaviour must also be considered. If structural changes for a healthier future for all Americans are put in place, there will remain an onus on individuals to take more responsibility for their own health by making informed, health-conscious decisions.

Investing in and expanding access to disease and injury prevention, detection, and treatment

The importance of investing in disease and injury prevention cannot be overstated, particularly in the context of the increasing burden of certain diseases in the USA. While it is essential to allocate resources for medical care and treatment of existing health issues, this should not come at the cost of preventive measures and long-term planning.[31] Preventive efforts, such as promoting healthy lifestyles, early screenings, vaccinations, and reducing risk exposure, can substantially reduce the incidence and severity of chronic diseases and, in turn, ease the strain on health-care systems.[5,32] Likewise, legislation can play a crucial role in prevention efforts; previous successes include enacting seat belt laws, smoking bans and age restrictions, enacting regulations that reduce particulate matter air pollution, and fluoridation of community water supplies.[33]

Increasing access to preventive medical care, including regular screenings and physical exams, is crucial for the early detection and management of diseases and injuries. Evidence has consistently shown that early intervention can lead to better health outcomes, reduced complications, and lower health-care costs in the long run.[34–36] To make preventive medical care more accessible, it is essential to design and implement programmes that target specific segments of the population, particularly those at higher risk or with limited access to health-care services. These programmes could include public awareness campaigns, mobile screening clinics, and partnerships with community organisations to reach underserved areas. Additionally, in the continued absence of universal health coverage, it is crucial to address barriers to care, such as cost, lack of insurance coverage, and transportation challenges, through policies that promote affordable and accessible health-care services.

Increasing access to affordable medicine is a crucial aspect of improving health outcomes, particularly for individuals with chronic conditions such as hypertension and diabetes. Many effective medications for managing these conditions are available at low cost, and ensuring their widespread accessibility can lead to better disease management and quality of life for millions of Americans.[37,38] For example, generic antihypertensive drugs and metformin, a widely used medication for type 2 diabetes, are relatively inexpensive and can substantially improve patients' health when used appropriately. At the same time, it is essential to invest in the development of new medications and ensure that these advances reach those who might not be able to afford them. One such example is the emergence of novel obesity medications, which have the potential to reduce the incidence of diabetes and its associated complications.[24,25]

Addressing mental health

Mental disorders are forecasted to be the second-leading cause of age-standardised YLDs in 2050, with essentially unchanged rates from 2022. For females aged 10–24 years in the USA, more than 30% of all YLDs in 2050 will be attributable to mental disorders, with especially high rates of depressive disorders (see GBD Foresight). This aligns with previous findings that the incidence of mental health disorders has risen considerably in the USA over the past 30 years, particularly in younger females.[1,2] To address this serious issue, increased investment in mental health services and research is necessary. This includes improved access to mental health care, early intervention programmes, and the destigmatisation of mental health issues.[39,40] Additionally, integrating mental health care into primary care settings and using digital tools such as telemedicine can help to reach more people in need of support. Investing in mental health prevention is equally important as treatment in maintaining the overall wellbeing of individuals and communities.

The need for universal health coverage in the USA

Alongside other individual and societal actions to reduce risk factor exposure and improve health outcomes, our findings from this and other recent studies suggest the urgent need for universal health coverage in the USA.[41] Universal health coverage should ensure that people have access to the full range of quality preventive and curative health services that they need, when and where they need them, without financial hardship. It should cover the full continuum of essential health services from health promotion to prevention, treatment, rehabilitation, and palliative health care across the life course. The lack of universal health coverage in the USA is an important barrier to improving health outcomes, since affordable health-care access improves prevention and treatment for many of the most prominent health outcomes and risks in our study. Our alternative scenarios showed the improvements in US health trends that could be achieved if marked reductions in exposure to risk factors associated with NCDs, drug use, and more occur, and universal health coverage could be an important contributor to this effort. For example, when physicians recommend lifestyle changes, such as smoking cessation or behaviours that affect weight loss, patients are more likely to attempt these behavioural modifications.[42,43] Likewise, patients with drug use and mental health disorders are more likely to seek treatment if finances and health insurance are not a barrier.[44] Further, while health outcomes such as diabetes also have behavioural and social structure components, effective treatment includes medical care and often medication, for which cost can be a substantial barrier to access.[45,46]

That said, while universal health coverage is an important component of US health system reform, it is not a panacea for the USA's poor health performance. In our analyses, when we evaluated life expectancy at age 70 years in the USA compared with all 203 other countries around the world, in order to account for availability of free health care, we did not see much difference in the ranking of the USA or substantial changes in trends to 2050. Indeed, our previous work has found that health-care access contributes approximately 27% of disparities in health outcomes, less than risk factor exposure and socioeconomic factors.[41] But universal health coverage will nonetheless provide a safety net and will prevent citizens from facing substantial health-related financial hardship. The call for universal health coverage should also be coupled with an expansion of policies that address social determinants of health; reforms to primary health care in the USA, especially the fragmented approach to the country's health care;[47] and greater emphasis on programmes that prevent exposure to key modifiable risks.

Addressing health and social disparities

In the USA, health and social disparities continue to create substantial challenges for individuals and communities, particularly in terms of income, education, and access to health care.[48] Our study shows that even when we eliminate the many key risk factors in our combined scenario, many US states will continue to fall behind other countries in life expectancy and HALE, indicating the role of socioeconomic factors in the country's poor performance. It is crucial to implement policies and programmes that aim to narrow these gaps and promote equal opportunities for all citizens, such as through targeted investments in education, affordable housing, and community development initiatives, as well as by addressing systemic barriers that perpetuate inequality. By fostering a more equitable society, we can create a supportive environment where everyone has the opportunity to lead healthy, fulfilling lives. The strengthening of social safety nets, which can provide financial security and access to essential services such as health care and free higher education, is also important in promoting equity, and has many benefits.[49,50] The USA's weak social safety nets compared with other high-income countries contribute to substantial financial stress and wide disparities in human development and wellbeing.[51] To address this issue, policy makers must prioritise the development of comprehensive social support programmes, including expanding access to affordable health care, promoting free or affordable higher education, and improving retirement benefits.

Addressing other important factors

While the primary focus of our study has been on forecasting the burden of disease in the USA, there are important factors beyond our core analyses that merit attention, including political divisions, scientific distrust and misinformation, and insufficient investment in research. While we did not evaluate the influence of these factors on health outcomes in the USA, they nonetheless have important implications for the potential to change the trajectory of US health that we have forecasted. The divisions that shape many current conflicts in the USA also play a crucial role in the poor health outcomes and disparities forecasted in this study, as highlighted by the COVID-19 pandemic.[52] At a time when unity and coherence were paramount, the nation found itself mired in divisive rhetoric that obscured the value of scientific debates, with large segments of the population aligning their health beliefs and behaviours along political lines. This division not only hampered the country's response to the pandemic, but also underscored a broader challenge: the need for a united front in addressing population health crises. In addition, the USA has historically been at the forefront of scientific discoveries and innovation, playing a leading role in advancing global knowledge in various fields. In recent years, however, science has been attacked, the value of key preventive measures such as vaccines has been questioned, and mistrust in science and the government has been fostered by misinformation on social media.[53] Distrust and misinformation must be addressed if the full potential of health progress is to be made in the USA in the coming years. We need to promote public understanding of science by implementing public education campaigns to raise awareness about the importance of scientific research and its contributions to public health. Scientists should be encouraged to engage with the public and share their knowledge and expertise while at the same time keeping political statements out of scientific discourse.

In addition, the USA has severe limitations in the availability of some health data at the local and sometimes national levels—for example, detailed data on dietary intake, blood pressure, obesity, and more are not available at the county level and sometimes at the state level, and mortality data are often delayed. Often, delays in the release of these data prevent rapid response or a course change. Even when such data are present, often it is hard to access these data to better understand the burden of disease. Therefore, we need to invest in the development of a strong data infrastructure to support large-scale data collection, analysis, and sharing. It is crucial for policy makers to limit funding only to systems that will be publicly available and not restricted. Finally, we need strong evaluation processes for the country's programmes and policies, and to stop investing in programmes that are not working.

Limitations

This study is subject to the uncertainties and limitations of the forecasting model it uses, first published by the GBD 2021 Forecasting Collaborators.[1] First, our forecasts are limited by the quality of data and other limitations underlying the GBD estimates used as inputs to our forecasting model. These limitations vary across causes, age, and sex, as detailed in the original studies.[2,5–7] Second, while we included more than 80 drivers of health in our model, we could not incorporate all potential drivers and health threats. Possible drivers not incorporated include a range of indirect pathways through which climate change is likely to impact health; future potential pandemics; potential health threats that are difficult to quantity due to insufficient evidence on the potential magnitude of their impacts on human health at this time (including bioterrorism, nuclear escalation, and malicious artificial intelligence [AI]); potential advances in disease and injury prevention, diagnosis, treatment, and management for which there is not yet sufficient evidence for the potential population-level impacts (including new medications and new technology, such as AI-related health innovations); and completely unknown-to-date future threats. Third, while we developed alternative models to forecast several causes of death that are stochastic in nature, including exposure to forces of nature, conflict and terrorism, and executions, these models could be improved. Future stochastic events might be better predicted using extreme value theory[54] to estimate the cumulative probability of an event. Fourth, the GBD mediation matrix we used to incorporate risk factor mediation pathways—eg, how the effect of high BMI is mediated through systolic blood pressure and LDL cholesterol—only includes a subset of mediation pathways, largely due to insufficient data on the relationship between the distal and mediator risk factors. Fifth, this was the first time that non-fatal forecasts were produced within the GBD Future Health Scenarios modelling framework. For each cause, we evaluated model performance for our non-fatal forecasts and, in some instances, chose an alternative model that better fit the data than using mortality–incidence ratios or mortality–prevalence ratios to model non-fatal outcomes. In these cases, we used a modelled future incidence or prevalence directly. In future iterations, we intend to refine our non-fatal models and add additional cause-specific covariates and risk factors. Sixth, we used average disability weights from GBD to produce YLD forecasts, which assume a static association between prevalence and disability over time. This approach is thus unable to capture substantial improvements in treatment in the future. Seventh, due to the limited data on COVID-19 cases and deaths in 2022–23, there is considerable uncertainty around potential long-term trends in disease and injury burden due to the pandemic. In the absence of data to inform our COVID-19 forecasts, we assumed that COVID-19 deaths and DALYs will decline linearly to zero between 2023 and 2030. We will revisit this assumption in the future, as more and longer time-series of data become available. Eighth, the alternative scenarios presented in this paper are meant to show the potential health gains that could be achieved in the USA and across US states if substantial improvements are made to reduce exposure and disease and injury burden due to known risk factors, and how these benefits will vary by cause, age group, sex, and US state. Due to computational constraints, we were unable to produce alternative scenarios for each risk factor individually, but future studies aim to understand the individual impacts of many independent drivers on disease and injury burden. Ninth, while certain diseases and injuries had higher skill values—indicating higher forecasting accuracy of the model for those diseases and injuries—for the USA than globally (such as NCDs), skill values varied more substantially at the US level than at the global level. Identifying the best approach for applying our global forecasting models to the national and subnational levels without sacrificing model performance is an ongoing process that we will continue to iterate in future GBD rounds with potentially more country-specific model individualisation. Finally, we report metrics at the state level, and hence we are masking variation within states. Moreover, our analyses did not project the future burden by race and ethnicity or education, two factors that are associated with health disparities.

Conclusion

As the first study to provide such comprehensive forecasting insights at both the US state and national levels, our work holds immense potential for informing policy and programme decisions to address the changing burden of disease and injury in the USA in the coming decades. Our reference forecasts offer alarming insights into the future of US health, demonstrating increasingly poor health outcomes compared with other countries around the world; slow progress or, in some cases, worsening outcomes across US states and certain causes; and high and increasing rates of exposure to key risk factors. Our alternative scenarios show variable but important possible improvements that could be made by substantially reducing exposure to a range of risks. These findings call for renewed investments in public health risk prevention strategies, health-care access, education, and scientific research to ensure a healthier, more prosperous future for all Americans. By prioritising these areas and fostering collaboration between public and private sectors, the USA can transform its health-care landscape, reduce disparities, and improve its health status in the world.

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See Online for appendix 2

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Data sharing

To download GBD data used to produce the GBD estimates used as inputs for these analyses, please visit the Global Health Data Exchange GBD 2021 website (https://ghdx.healthdata.org/gbd-2021/sources).
To download the GBD 2021 estimates used as inputs for these forecasting analyses, please visit https://vizhub.healthdata.org/gbd-results/.
To download the forecasted estimates produced in these analyses, please visit https://ghdx.healthdata.org/record/ihme-data/gbd-2021-us-bod-forecasts-2022-2050; country-level results are also available via the GBD Foresight visualisation tool (https://vizhub.healthdata.org/gbd-foresight/).

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