Research

The State of US Health, 1990-2016
Burden of Diseases, Injuries, and Risk Factors Among US States

The US Burden of Disease Collaborators

INTRODUCTION Several studies have measured health outcomes in the United States, but none have provided a comprehensive assessment of patterns of health by state.

OBJECTIVE To use the results of the Global Burden of Disease Study (GBD) to report trends in the burden of diseases, injuries, and risk factors at the state level from 1990 to 2016.

DESIGN AND SETTING A systematic analysis of published studies and available data sources estimates the burden of disease by age, sex, geography, and year.

MAIN OUTCOMES AND MEASURES Prevalence, incidence, mortality, life expectancy, healthy life expectancy (HALE), years of life lost (YLLs) due to premature mortality, years lived with disability (YLDs), and disability-adjusted life-years (DALYs) for 333 causes and 84 risk factors with 95% uncertainty intervals (UIs) were computed.

RESULTS Between 1990 and 2016, overall death rates in the United States declined from 745.2 (95% UI, 740.6 to 749.8) per 100 000 persons to 578.0 (95% UI, 569.4 to 587.1) per 100 000 persons. The probability of death among adults aged 20 to 55 years declined in 31 states and Washington, DC from 1990 to 2016. In 2016, Hawaii had the highest life expectancy at birth (81.3 years) and Mississippi had the lowest (74.7 years), a 6.6-year difference. Minnesota had the highest HALE at birth (70.3 years), and West Virginia had the lowest (63.8 years), a 6.5-year difference. The leading causes of DALYs in the United States for 1990 and 2016 were ischemic heart disease and lung cancer, while the third leading cause in 1990 was low back pain, and the third leading cause in 2016 was chronic obstructive pulmonary disease. Opioid use disorders moved from the 11th leading cause of DALYs in 1990 to the 7th leading cause in 2016, representing a 74.5% (95% UI, 42.8% to 93.9%) change. In 2016, each of the following 6 risks individually accounted for more than 5% of risk-attributable DALYs: tobacco consumption, high body mass index (BMI), poor diet, alcohol and drug use, high fasting plasma glucose, and high blood pressure. Across all US states, the top risk factors in terms of attributable DALYs were due to 1 of the 3 following causes: tobacco consumption (32 states), high BMI (10 states), or alcohol and drug use (8 states).

CONCLUSIONS AND RELEVANCE There are wide differences in the burden of disease at the state level. Specific diseases and risk factors, such as drug use disorders, high BMI, poor diet, high fasting plasma glucose level, and alcohol use disorders are increasing and warrant increased attention. These data can be used to inform national health priorities for research, clinical care, and policy.

➕ **Author Audio Interview**

➕ **Supplemental content**

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Previous studies have reported on health disparities in US states and counties.[1,2] These studies showed that health disparities have increased with time. Recent attention has focused on increased mortality in some age groups and a decline in life expectancy.[3] In addition, the performance of the US health care system does not match its level of spending on health and lags behind countries with similar financial resources.[4] For example, in 2014, US life expectancy ranked 43rd in the world, although the United States spent the most ($3.0 trillion) on health care, exceeding the median amount spent by Organisation for Economic Co-operation and Development countries by 35%.[5]

Several studies have shown large variations in risk factors by state and county, and these variations have contributed to differences in health outcomes.[6-9] In the Global Burden of Disease Study 2010 (GBD 2010) US Burden of Disease report, the following risk factors were reported as the main causes associated with US morbidity and mortality (percent contributed to total disability-adjusted life-years [DALYs] in 2010): poor diet (14%), smoking (11%), high blood pressure (8%), and obesity (11%).[10-12] None of the previous studies of US health have been as comprehensive as the GBD study.[5,13-18] The GBD systematically accounts for differences in data sources and biases and analyzes levels and trends for causes and risk factors within the same computational framework, which maximizes comparability across states, years, and different age groups by sex. GBD is now conducted on an annual cycle, with GBD 2016 providing updated estimates of mortality, morbidity, and risk factors in 195 locations, including the United States, from 1990 to 2016.

The findings of GBD 2016 indicate that while the United States overall is experiencing improvements in health outcomes, the patterns of health burden at the state level vary across geography. Routinely monitoring the trend of burden of disease at the state level is essential given the vital role of states in many aspects of health and social policy[19]—from the Medicaid program to regulation of private insurers[20] and considering that individual states also experience different economic circumstances. The current study uses GBD 2016 to report the change in burden of disease, including injuries and risk factors at the state level, from 1990 to 2016.

Methods

Overview

The GBD study is estimated annually and each round of results is internally consistent (cause-specific mortality estimates are summed to match all-cause mortality estimates) and collectively exhaustive (residual categories ["other"] are captured to enable quantifying total burden) (Sections 1-5 in Supplement 1). The numbers reported in the previous round of GBD are not identical to those of the current round (GBD 2016) for 2 main reasons. First, since the GBD 2010 Special Communication regarding US risk factors, there has been further refinement of the "garbage coding" (ie, ill-defined causes of death) redistribution methods (Supplement 1). Second, the new analysis at the state level changes some of the estimation slightly when aggregated to the national level. GBD 2016 provides a new time series.

Key Points

Question How have the levels and trends of burden of diseases, injuries, and risk factors in the United States changed from 1990 to 2016 by state?

Findings This study, involving examination of 333 causes and 84 risk factors, demonstrated that health in the United States improved from 1990 to 2016, although the drivers of mortality and morbidity have changed in some states, with specific risk factors such as drug use disorders, high body mass index (BMI), and alcohol use disorders being associated with adverse outcomes. In 5 states, the probability of death between ages 20 and 55 years has increased more than 10% between 1990 and 2016.

Meaning Differences in health outcomes and drivers of morbidity and mortality at the state level indicate the need for greater investment in preventive and medical care across the life course. The intersection of risk, mortality, and morbidity in particular geographic areas needs to be further explored at the state level.

The GBD 2016 methodology has been published previously.[5,13-18] GBD uses several metrics to report results for health loss related to specific diseases, injuries, and risk factors: deaths and death rates, years of life lost (YLLs) due to premature mortality, prevalence and prevalence rates for sequelae, years lived with disability (YLDs), and DALYs (**Box**; Sections 2, 3, and 5 in Supplement 1 and Appendix Table 2 in Supplement 2). GBD provides a comprehensive assessment of all-cause mortality and estimates for death due to 264 causes in 195 countries and territories from 1990 to 2016, as well as 333 causes of DALYs (Appendix Table 2 in Supplement 2). GBD 2016 has 4 levels of causes that are mutually exclusive (Appendix Table 3 in Supplement 2). Level 1 has 3 causes: communicable, maternal, neonatal, and nutritional disorders; noncommunicable diseases; and injuries. Level 2 has 21 causes. Levels 3 and 4 consist of more disaggregated causes. GBD 2016 documented each step of the estimation processes, as well as data sources, in accordance with the Guidelines for Accurate and Transparent Health Estimates Reporting.[21] A more detailed methodology is available in the appendix to this article (Sections 8 and 9 in Supplement 1).

Data

To estimate the US burden of disease prevalence, computation for each sequela began with a systematic analysis of published studies and available data sources providing information on prevalence, incidence, remission, and excess mortality, such as the National Health and Nutrition Examination Surveys,[22] state inpatient databases,[23] the National Ambulatory Medical Care Survey,[24] National Hospital Ambulatory Medical Care Survey,[25] Medical Expenditure Panel Survey,[26] National Comorbidity Survey,[27] National Epidemiological Survey on Alcohol and Related Conditions,[28] National Survey on Drug Use and Health,[29] US Department of Agriculture Continuing Survey of Food Intakes,[30] Marketscan,[31] National Health Interview Survey,[32] Behavioral Risk Factor Surveillance System,[33] and the Centers for Disease Control and Prevention Disease Surveillance Reports.[34]

Hospital inpatient data were extracted and used for this analysis. Moreover, outpatient encounter data were available for the United States through aggregate data derived from a

Disability-adjusted life-years: a summary metric of population health. DALYs represent a health gap and, as such, measure the state of a population's health compared to a normative goal. The goal is for individuals to live the standard life expectancy in full health. DALYs are the sum of 2 components: years of life lost (YLLs) and years lived with disability (YLDs).

Healthy life expectancy: the number of years that a person at a given age can expect to live in good health, taking into account mortality and disability.

Summary Exposure Value: the relative risk–weighted prevalence of exposure (developed for Global Burden of Diseases Study 2015).

Years lived with disability: computed as the prevalence of different disease sequelae and injury sequelae multiplied by disability weights for that sequela. Disability weights are selected on the basis of surveys of the general population about the health loss associated with the health state related to the disease sequela.

Years of life lost due to premature mortality: computed by multiplying the number of deaths at each age by a standard life expectancy at that age. The standard selected represents the normative goal for survival and has been computed based on the lowest recorded death rates across countries in 2010.

database of claims information for US private and public insurance schemes for the years 2000, 2010, and 2012. GBD methodology applied several correction factors to account for bias in health service encounter data from these claims that were available as aggregated by *International Classification of Diseases* (*ICD*) code and by primary diagnosis only. First, for chronic disorders, the study estimated the ratio between prevalence from primary diagnoses and prevalence from all diagnoses associated with a claim. Second, the claims data were used to generate the mean number of outpatient visits per disorder. Similarly, the study generated per-person discharge rates from hospital inpatient data in the United States.

All-Cause Mortality and Cause of Death

All-cause mortality was estimated by age, sex, geography, and year using 6 modeling approaches to assess cause-specific mortality; the Cause of Death Ensemble Model was used to generate estimates for the vast majority of causes. This analysis used deidentified death records from the National Center for Health Statistics (NCHS)[35] and population counts from the US Census Bureau,[36] NCHS, and the Human Mortality Database.[37] Deaths and population were tabulated by county, age group, sex, year, and (in the case of death data) cause. The cause list developed for the GBD[13] is arranged hierarchically in 4 levels. Within each level, the cause list is designed such that all deaths are assigned exactly 1 cause. As part of the GBD study, a map has been developed that allows *ICD-9* and *ICD-10* codes to be translated to GBD causes.

Previous studies have documented the existence of insufficiently specific or implausible causes of death used in death registration data that may lead to misleading geographic and temporal patterns.[38] Algorithms developed for the GBD were used to reallocate deaths assigned one of these garbage codes to plausible alternatives.[39] First, plausible target causes were assigned to each garbage code or group of garbage codes. Second, deaths were reassigned to specified target codes according to proportions derived in 1 of 4 ways: (1) published literature or expert opinion; (2) regression models; (3) according to the proportions initially observed among targets; and (4) for HIV/AIDS specifically, by comparison to years before HIV/AIDS became widespread. More detail on each of these methods is provided in Section 2 of Supplement 1.

Based on standard GBD methods, YLLs were computed by multiplying the number of deaths from each cause in each age group by the reference life expectancy at the mean of age of death among those who died in the age group. The YLLs computation is based on the precedent set by GBD and uses the same life table standard for calculating YLLs in all locations and years (essential for comparing estimates of YLLs across locations and years). The standard is meant to represent the mortality experience of a population with minimal excess mortality using the lowest observed age-specific mortality rates in 2016 among all countries with a population greater than 5 million. This standard does not vary with time because for most populations, the number of YLLs (once normalized for population size) is larger in earlier years than in later years due to improving survival rather than an artifact of the standard used.

Analysis of Incidence, Prevalence, and YLDs

In this study, incidence and prevalence of diseases by age, sex, cause, year, and geography were estimated using a wide range of updated and standardized analytical procedures. GBD used DisMod-MR, a Bayesian meta-regression tool, to determine prevalence and incidence by cause and sequelae.[40]

Data sources used for quantifying nonfatal outcomes are available online in the GBD results tool[41] and in Section 3 of Supplement 1. Prevalence of each sequela was multiplied by the disability weight for the corresponding health state to calculate YLDs for the sequela. The sum of all YLDs for relevant sequelae equated to overall YLDs for each disease. Details on disability weights for GBD 2016, including data collection and disability weight construction, are described elsewhere.[14]

Analysis of DALYs and HALE

Following GBD 2016 methods, national and state-level DALYs were computed by summing YLLs and YLDs for each cause, age, and sex in 1990, 1995, 2000, 2005, 2010, and 2016 (Section 4 in Supplement 1). DALYs were computed for 333 causes, with 95% uncertainty intervals (UIs) capturing the uncertainty for both YLL and YLD rates. HALE was calculated using the Sullivan method and generated 95% UIs that indicated uncertainty for age-specific death rates and YLDs per capita for each geography, age group, sex, and year. HALE was calculated for the United States and for each individual state using multiple-decrement life tables and estimated YLDs per capita; additional details on HALE methodology are provided in Section 4 in Supplement 1.

Risk Factors

GBD 2016 used the comparative risk assessment framework to estimate attributable deaths, DALYs, and trends in exposure by age group, sex, year, and geography for risks from 1990 to 2016. GBD has 84 behavioral, environmental and occupational, and metabolic risks or clusters of risks (Section 5 in Supplement 1). Risk-outcome pairs were included in the GBD 2016 study if they

met World Cancer Research Fund criteria for convincing or probable evidence. Relative risk (RR) estimates were extracted from published and unpublished randomized clinical trials, cohorts, and pooled cohorts. Risk exposures were estimated based on published studies, household surveys, US Census data, satellite data, and other sources. Two modeling approaches, a Bayesian meta-regression model and a spatiotemporal Gaussian process regression model, were developed for the GBD study and used to pool data from different sources, adjust for bias in the data, and incorporate potential covariates. GBD used the counterfactual scenario of theoretical minimum risk exposure level (ie, the level for a given risk exposure that could minimize risk at the population level) to attribute burden. A summary exposure value was developed for GBD 2015 as the RR-weighted prevalence of exposure (range, 0 [no excess risk exists in a population] to 1 [population is at the highest risk]).[16]

$$SEV = \frac{\sum_{i=1}^{n} Pr_i \, RR_i - 1}{RR_{max} - 1}$$

Where Pr_i is prevalence of category i exposure; RR_i is the RR of the category i; and RR_{max} is the maximum RR observed (between categories). This quantity is estimated for each age group, sex, geography, and year. In the case of dichotomous exposure, summary exposure value is equal to prevalence. For continuous risks, summary exposure value is defined as follows:

$$SEV = \frac{\int_{x=1}^{u} RR(x) \, P(x) \, dx - 1}{RR_{max} - 1}$$

Where (χ) is the density of exposure at level χ of exposure; (χ) is the RR of the level χ; and RR_{max} is the highest RR that is supported by data and reflects a level in which more than 1% of the population is exposed globally. In this study, summary exposure value is reported on a scale from 0% to 100% to emphasize that it is risk-weighted prevalence.

To calculate risk-attributable fractions of disease burden by cause, the effects of risk exposure levels were modeled, RRs associated with risk exposure and specific health outcomes were documented, and counterfactual levels of risk exposure on estimates of national and state-level deaths, YLLs, YLDs, and DALYs were computed. Detailed descriptions of the GBD 2016 methods for risk factor assessment and attribution are published elsewhere (Section 5 in Supplement 1).[5,13-18]

Decomposition of Changes in Probability of Death

The probability of death was calculated for 3 summary age intervals and the cause-specific contributions to each of these summary indicators for ages 0 to 20, 20 to 55, and 55 to 90 years. These age groups were chosen to reflect variations in trends and burden for adolescents, young adults, and older people. For each probability of death, the multiple decrement life-table method was used to compute the probability of death from each cause and the overall contribution of each cause of death to the summary probability of death. Although discrete age categories from life table calculations were used, the age categories slightly overlap

for calculations of probability of death (ages 20 years and 55 years; see Section 6 in Supplement 1). To decompose the key drivers of life loss, the probability of death was determined and examined in parallel to the cause fractions for that same age group. Additional information on the decomposition of changes in the probability of death, including the formulas used, is available in the online methods section (Supplement 1).

Sociodemographic Index

GBD 2015 created a summary indicator that combines measures of income per capita, educational attainment for age 15 years or older, and total fertility rates.[39,42-46] This indicator is updated for each GBD round. The current sociodemographic index (SDI) was used to compare observed patterns of health loss to expected patterns for countries or locations with similar SDI scores. The SDI was computed similarly to the computation of the human development index to improve interpretability. Each component of the SDI was weighted equally and rescaled (range, 0 [lowest observed value during 1980-2016] to 1 [highest observed value during 1980-2016]). In the United States in 2016, the SDI ranged from 0.874 in Mississippi to 0.978 in Washington, DC (global SDI values in 2016 ranged from 0.268 in Somalia to 0.978 in Washington, DC).

Results

US Mortality and YLLs

Table 1 lists the 25 leading causes of death and premature mortality from 1990 to 2016. Ischemic heart disease (IHD); cancer of the trachea, bronchus, and lung; chronic obstructive pulmonary disease; Alzheimer disease and other dementias; and cancer of the colon and rectum were the 5 leading causes of death. Despite a 50.7% decline in age-standardized mortality and a 50.4% decline in age-standardized YLLs, IHD remained the leading cause of death and premature mortality. There was an increase in age-standardized mortality and in age-standardized YLLs from 1990 for chronic obstructive pulmonary disease (13.8% for deaths and 4.6% for YLLs) and for Alzheimer disease and other dementias (11.6% for deaths and 5.5% for YLLs). There was a decrease in age-standardized mortality and in age-standardized YLLs for colon and rectal cancer (29.6% for deaths and 27.9% for YLLs) and for breast cancer (32.6% for deaths and 36.0% for YLLs). Deaths from endocrine, metabolic, blood, and immune disorders increased by 89.1%, and YLLs increased by 60.3% from 1990 to 2016 (an increase in rank from 37 in 2010 to 22 in 2016). Other notable findings seen in Table 1 are declines in deaths from self-harm by firearm (13.2%) and physical violence by firearm (28.5%) but an increase in self-harm by other means (16.9%).

US YLDs

Table 2 provides the 25 leading diseases and injuries contributing to YLDs. Low back pain and major depressive disorders remained the first and second causes of YLDs in 2016. Age-standardized rates of low back pain declined by 12.4%, while age-standardized rates of major depressive disorder did not change from 1990. Diabetes, which was the third leading cause of YLDs, had a 29.6% increase in age-standardized rates from 1990, and increased in rank from 8 in 1990 to 3 in 2016. From 1990 to 2016,

Table 1. Deaths and Years of Life Lost With Percentage Change From the 25 Leading Causes of Death in the United States, 1990 and 2016

Diseases and Injuries	YLL Rank 1990	YLL Rank 2016	YLLs, No. in Thousands (95% UI) 1990	YLLs, No. in Thousands (95% UI) 2016	Percent Change YLLs	Percent Change Age-Standardized YLL Rate	Deaths, No. in Thousands (95% UI) 1990	Deaths, No. in Thousands (95% UI) 2016	Percent Change Deaths	Percent Change Age-Standardized Death Rate
Ischemic heart disease	1	1	9445.4 (9309.4 to 9657.0)	7605.3 (7409.6 to 7802.4)	-19.5 (-21.7 to -17.3)	-50.4 (-51.8 to -49.1)	640.9 (632.7 to 653.3)	544.8 (531.7 to 557.5)	-15.0 (-17.1 to -13.0)	-50.7 (-52.0 to -49.5)
Tracheal, bronchus, and lung cancer	2	2	3155.4 (3102.5 to 3210.7)	3586.1 (3493.4 to 3681.9)	13.6 (10.3 to 17.2)	-32.8 (-34.8 to -30.6)	151.0 (148.5 to 153.6)	191.5 (186.5 to 196.8)	26.8 (22.9 to 31.0)	-24.0 (-26.3 to -21.6)
Chronic obstructive pulmonary disease	4	3	1382.5 (1326.7 to 1412.8)	2347.4 (2267.8 to 2463.5)	69.8 (63.2 to 79.7)	4.6 (0.6 to 10.6)	86.9 (83.6 to 88.8)	163.8 (158.2 to 172.1)	88.5 (80.9 to 100.0)	13.8 (9.2 to 20.7)
Alzheimer disease and other dementias	7	4	1049.8 (913.6 to 1224.1)	1875.8 (1690.2 to 2076.6)	78.7 (66.5 to 91.8)	5.5 (-1.0 to 12.7)	116.4 (100.7 to 135.1)	238.9 (214.3 to 264.8)	105.3 (90.6 to 119.9)	11.6 (4.4 to 19.1)
Colon and rectum cancer	6	5	1241.6 (1219.5 to 1264.9)	1437.0 (1393.5 to 1482.4)	15.7 (11.5 to 20.0)	-27.9 (-30.5 to -25.2)	68.4 (67.2 to 69.7)	79.3 (77.0 to 81.8)	15.9 (11.7 to 20.1)	-29.6 (-32.1 to -27.0)
Motor vehicle road injuries	3	6	1792.7 (1696.8 to 1953.0)	1349.9 (1275.6 to 1484.0)	-24.7 (-27.8 to -20.8)	-39.4 (-41.9 to -36.2)	36.1 (34.0 to 39.1)	31.3 (29.5 to 34.4)	-13.4 (-16.7 to -9.0)	-35.4 (-37.8 to -32.0)
Lower respiratory infections	8	7	1044.8 (1006.1 to 1081.6)	1334.8 (1268.2 to 1398.1)	27.8 (21.8 to 33.8)	-19.0 (-22.6 to -15.3)	63.5 (59.9 to 66.9)	96.0 (89.6 to 102.3)	51.2 (43.4 to 59.6)	-12.3 (-16.5 to -7.8)
Diabetes	12	8	921.1 (901.8 to 940.9)	1305.7 (1264.1 to 1345.5)	41.8 (36.5 to 47.0)	-10.1 (-13.4 to -6.8)	49.2 (48.1 to 50.3)	71.5 (69.2 to 73.7)	45.3 (40.0 to 50.4)	-11.4 (-14.6 to -8.2)
Intracerebral hemorrhage	13	9	901.0 (872.3 to 938.0)	1152.5 (1109.5 to 1199.2)	27.9 (22.3 to 33.1)	-19.3 (-22.7 to -16.0)	42.2 (40.5 to 44.1)	63.9 (61.1 to 67.1)	51.3 (44.8 to 58.0)	-10.3 (-13.9 to -6.4)
Ischemic stroke	11	10	1006.2 (959.6 to 1050.4)	1139.6 (1085.3 to 1194.3)	13.3 (8.7 to 17.6)	-31.2 (-34.0 to -28.6)	84.0 (79.1 to 88.4)	113.3 (106.4 to 120.4)	34.8 (28.8 to 40.7)	-23.8 (-27.0 to -20.9)
Breast cancer	10	11	1023.4 (996.5 to 1051.8)	1056.8 (1014.5 to 1104.5)	3.3 (-1.5 to 8.9)	-36.0 (-39.0 to -32.5)	43.9 (42.7 to 45.1)	49.3 (47.4 to 51.5)	12.4 (7.2 to 18.3)	-32.6 (-35.7 to -29.0)
Self-harm by other specified means	16	12	668.7 (577.4 to 883.1)	981.4 (771.2 to 1176.6)	46.9 (21.2 to 57.2)	19.1 (-2.0 to 27.6)	14.9 (12.7 to 19.5)	22.8 (17.7 to 27.6)	52.8 (27.9 to 62.4)	16.9 (-2.8 to 24.4)
Self-harm by firearm	14	13	827.2 (710.3 to 1071.4)	893.0 (700.7 to 1062.3)	7.9 (-8.3 to 16.3)	-16.9 (-29.1 to -10.7)	19.7 (16.3 to 24.6)	23.8 (18.5 to 27.9)	21.3 (3.2 to 29.5)	-13.2 (-26.1 to -7.3)
Pancreatic cancer	17	14	521.9 (511.0 to 532.4)	840.8 (816.1 to 865.1)	61.1 (55.8 to 67.0)	-2.5 (-5.7 to 1.1)	27.9 (27.4 to 28.5)	46.3 (44.9 to 47.6)	65.5 (60.3 to 71.3)	0.4 (-2.7 to 4.0)
Opioid use disorders	52	15	165.0 (149.9 to 202.4)	830.7 (393.3 to 924.6)	403.4 (145.1 to 482.9)	327.7 (109.9 to 395.1)	3.3 (3.0 to 4.1)	18.2 (8.5 to 20.3)	447.3 (165.2 to 533.9)	343.0 (112.5 to 413.2)
Chronic kidney disease due to diabetes mellitus	35	16	264.3 (240.1 to 287.6)	677.6 (620.8 to 727.7)	156.4 (146.1 to 166.5)	60.9 (54.9 to 66.7)	15.3 (13.6 to 17.0)	40.5 (36.3 to 45.0)	165.6 (153.6 to 177.2)	61.1 (55.3 to 66.6)
Hypertensive heart disease	26	17	387.3 (270.1 to 493.3)	669.9 (397.5 to 765.3)	73.0 (36.7 to 94.1)	9.3 (-15.5 to 23.5)	22.9 (15.7 to 29.2)	40.2 (25.5 to 47.8)	75.4 (51.6 to 88.9)	2.7 (-12.4 to 11.6)
Physical violence by firearm	15	18	797.4 (377.0 to 941.3)	659.8 (354.2 to 800.6)	-17.3 (-25.3 to 4.7)	-29.3 (-36.1 to -10.7)	14.4 (6.9 to 17.1)	12.4 (6.7 to 15.1)	-14.1 (-22.5 to 8.8)	-28.5 (-35.5 to -9.3)
Cirrhosis and other chronic liver diseases due to alcohol use	27	19	373.5 (351.2 to 396.9)	655.7 (606.6 to 703.5)	75.6 (67.6 to 83.3)	9.4 (4.7 to 13.9)	14.1 (13.3 to 14.9)	25.3 (23.5 to 27.0)	79.2 (71.7 to 86.5)	9.5 (5.3 to 13.7)
Other cardiovascular and circulatory diseases	18	20	518.2 (506.6 to 532.0)	636.6 (615.2 to 661.1)	22.9 (18.1 to 27.6)	-19.7 (-23.0 to -16.6)	30.7 (30.0 to 31.4)	42.2 (40.9 to 43.5)	37.6 (32.7 to 42.4)	-19.1 (-22.1 to -16.3)
Neonatal preterm birth complications	9	21	1036.0 (999.2 to 1074.2)	608.8 (572.3 to 638.0)	-41.2 (-44.9 to -37.9)	-39.9 (-43.6 to -36.5)	12.0 (11.5 to 12.4)	7.0 (6.6 to 7.4)	-41.3 (-44.9 to -37.9)	-39.9 (-43.7 to -36.5)
Endocrine, metabolic, blood, and immune disorders	37	22	248.1 (226.6 to 328.2)	587.7 (436.0 to 623.6)	136.8 (76.2 to 155.7)	60.3 (23.3 to 72.1)	8.5 (8.0 to 11.6)	26.2 (17.8 to 28.0)	208.7 (106.8 to 238.9)	89.1 (30.7 to 106.7)
Other neoplasms	24	23	411.2 (400.8 to 421.8)	570.6 (551.6 to 588.7)	38.8 (33.4 to 44.1)	-7.7 (-11.5 to -4.0)	16.6 (16.2 to 17.0)	28.6 (27.7 to 29.5)	72.6 (66.5 to 78.8)	5.3 (1.6 to 9.2)
Cirrhosis and other chronic liver diseases due to hepatitis C	30	24	304.9 (285.9 to 323.7)	513.5 (477.5 to 551.6)	68.4 (60.5 to 76.3)	7.0 (2.4 to 11.6)	10.8 (10.1 to 11.4)	18.9 (17.6 to 20.2)	75.4 (68.1 to 82.6)	8.4 (3.9 to 12.7)
Non-Hodgkin lymphoma	23	25	433.8 (371.6 to 448.0)	482.2 (459.8 to 564.9)	11.2 (4.7 to 37.3)	-30.0 (-34.3 to -11.7)	20.2 (17.9 to 20.8)	26.8 (25.7 to 29.6)	32.6 (26.5 to 50.3)	-19.5 (-23.3 to -7.3)

Abbreviations: UI, uncertainty interval; YLLs, years of life lost due to premature mortality.

Table 2. US Years Lived With Disability (YLDs) Rank, Rate, and Percentage Change for the 25 Leading Causes of Disability and Injury, 1990 and 2016

Diseases and Injuries	YLD Rank 1990	2016	No. of YLDs, in Thousands (95% Uncertainty Interval) 1990	2016	% Change (95% Uncertainty Interval) YLDs	Age-Standardized YLD Rate
Low back pain	1	1	2461.1 (1732.3 to 3228.8)	3069.1 (2211.0 to 3989.6)	24.7 (10.9 to 39.6)	−12.4 (−22.3 to −1.9)
Major depressive disorder	2	2	1726.2 (1192.3 to 2330.5)	2193.0 (1507.6 to 2990.5)	27.0 (21.6 to 32.7)	0.1 (−4.1 to 3.7)
Diabetes mellitus	8	3	1040.2 (716.1 to 1450.3)	2142.9 (1496.1 to 2932.8)	106.0 (92.9 to 119.0)	29.6 (21.2 to 37.5)
Other musculoskeletal disorders	4	4	1573.5 (1076.0 to 2193.9)	2076.5 (1423.2 to 2843.1)	32.0 (22.5 to 42.0)	−2.3 (−8.7 to 4.3)
Migraine	3	5	1580.3 (1013.0 to 2205.4)	2010.1 (1296.4 to 2814.8)	27.2 (25.3 to 29.1)	−1.4 (−2.8 to −0.1)
Neck pain	6	6	1281.8 (880.4 to 1788.4)	1982.6 (1381.1 to 2704.7)	54.7 (39.2 to 73.3)	2.9 (−7.5 to 15.0)
Anxiety disorders	5	7	1341.7 (940.7 to 1813.1)	1755.0 (1229.6 to 2383.4)	30.8 (25.7 to 36.0)	0.6 (−3.2 to 4.5)
Opioid use disorders	7	8	1256.2 (892.8 to 1588.8)	1638.9 (1144.0 to 2097.4)	30.5 (23.3 to 37.4)	10.9 (4.2 to 17.2)
Age-related and other hearing loss	9	9	886.9 (599.0 to 1269.5)	1528.0 (1035.7 to 2157.1)	72.3 (67.3 to 78.3)	9.7 (6.6 to 13.4)
Falls	11	10	722.7 (487.8 to 1010.2)	1389.1 (960.0 to 1922.6)	92.2 (83.8 to 102.6)	22.2 (17.7 to 27.8)
Chronic obstructive pulmonary disease	12	11	674.4 (585.1 to 743.9)	1184.6 (1035.1 to 1307.3)	75.7 (66.8 to 84.9)	7.4 (2.0 to 12.9)
Osteoarthritis	14	12	573.5 (377.6 to 829.6)	1005.0 (659.5 to 1448.2)	75.2 (68.5 to 82.6)	7.9 (3.7 to 12.5)
Acne vulgaris	10	13	855.9 (573.6 to 1236.1)	992.6 (668.0 to 1441.4)	16.0 (14.3 to 17.8)	−1.5 (−3.0 to 0.2)
Dermatitis	13	14	659.8 (405.3 to 1032.9)	830.2 (515.1 to 1296.5)	25.8 (24.0 to 28.0)	1.2 (0.3 to 2.2)
Ischemic stroke	18	15	464.0 (321.3 to 607.7)	716.9 (500.9 to 912.7)	54.5 (41.5 to 64.9)	−3.5 (−11.2 to 2.9)
Schizophrenia	17	16	503.3 (365.0 to 627.7)	685.2 (506.9 to 847.9)	36.1 (32.7 to 39.5)	1.7 (−0.0 to 3.5)
Edentulism and severe tooth loss	19	17	458.0 (301.1 to 649.2)	662.2 (432.6 to 936.6)	44.6 (42.9 to 46.3)	−8.6 (−9.6 to −7.4)
Alcohol use disorders	15	18	558.2 (380.7 to 771.4)	633.9 (440.3 to 852.1)	13.6 (5.0 to 23.7)	−8.6 (−15.2 to −1.1)
Alzheimer disease and other dementias	23	19	360.8 (253.3 to 476.0)	597.6 (431.4 to 774.4)	65.6 (54.5 to 78.4)	−1.1 (−7.0 to 5.7)
Rheumatoid arthritis	25	20	350.2 (245.4 to 464.0)	592.4 (412.6 to 775.9)	69.1 (63.1 to 75.5)	10.1 (6.4 to 14.1)
Asthma	16	21	522.1 (342.5 to 744.9)	591.0 (393.8 to 832.4)	13.2 (7.5 to 19.2)	−12.4 (−17.1 to −7.6)
Other mental and substance use disorders	20	22	421.2 (288.4 to 601.1)	566.1 (390.0 to 804.1)	34.4 (32.9 to 35.9)	0.5 (−0.5 to 1.6)
Dysthymia	22	23	375.1 (254.3 to 548.2)	522.0 (352.7 to 753.3)	39.2 (31.7 to 47.2)	2.5 (−2.7 to 8.1)
Bipolar disorder	21	24	376.4 (236.7 to 545.7)	489.1 (309.6 to 703.2)	29.9 (27.9 to 32.1)	−0.4 (−1.9 to 1.0)
Psoriasis	24	25	351.9 (253.0 to 459.4)	488.2 (350.9 to 635.5)	38.7 (36.9 to 40.6)	1.9 (0.6 to 3.2)

falls had an increase of 22.2% in YLDs, opioid use disorders had an increase of 10.9% in YLDs, and asthma had a decline of 12.4% in age-standardized YLD rates. Other notable findings include an increase of 9.7% in age-standardized YLD rates of hearing loss due to aging and other causes.

US DALYs

Figure 1 shows the 25 leading causes of DALYs in 1990 and 2016 with their mean percentage change during the period. IHD and lung cancer were the leading causes of DALYs in both years, but the age-standardized rate declined between 1990 and 2016 by 49.7% for IHD and by 32.5% for lung cancer. The age-standardized DALY rate for chronic obstructive pulmonary disease (the third leading cause in 2016) increased by 5.5% between 1990 and 2016, and for diabetes (the fourth leading cause in 2016), it increased by 11%. Diabetes increased from the sixth leading cause in 1990 to the fourth in 2016, while low back pain declined from the third leading cause to the fifth. Three leading causes of DALYS had declines in age-standardized rates from 1990 to 2016: motor vehicle road injuries (by 35.0%), breast cancer (by 34.3%), and colorectal cancer (by 27.4%). Four leading causes of DALYS had increases in age-standardized rates from 1990 to 2016: opioid use disorders (by 47.9%), chronic kidney disease (by 44.3%), self-harm by other means (by 20.3%), and falls (by 19.0%).

US Risk Factor Estimates

Figure 2 shows the number of deaths and the percentage of DALYs from 17 risk factors in 2016. Diet, tobacco use, and high systolic blood pressure were the leading causes of deaths while tobacco use, high body mass index, and diet were the leading risk factors

for DALYs. For example, dietary risks accounted for 529 299 deaths in 2016, with 83.9% of these deaths due to cardiovascular diseases, and the remainder due to a combination of neoplasms and diabetes, and to urogenital, blood, and endocrine diseases. Alcohol and drug use were the eighth leading cause of death and the fourth leading cause of DALYs. In 2016, each of the 6 following risks accounted for more than 5% of DALYs: tobacco consumption, high body mass index, diet, alcohol and drug use, high fasting plasma glucose levels, and high blood pressure.

Attribution of DALYs to Risk Factors

In 2016, 44.9% of total DALYs in the United States were attributable to risk factors. Behavioral risk factors accounted for the largest percentage of the attributable fraction of DALYs due to all causes (43.5%), followed by metabolic (22.7%), and environmental and occupational risks (3.7%) (Supplement 2).

Individual State Data

GBD 2016 showed substantial variations in the burden of diseases, injuries, and risk factors by state. There was also a variation in trends by age, sex, and state (key findings and results of burden by state in Supplement 3).

Life Expectancy and HALE

Life expectancy and HALE at birth for both sexes combined for the United States, all 50 states, and for Washington, DC are shown in **Table 3**. Hawaii had the highest life expectancy at birth in 2016 (81.3 years [95% UI, 80.6 to 81.9]), while Mississippi had the lowest (74.7 years [95% UI, 73.5 to 76.1]; a 6.6-year difference). Other states with high life expectancy were California (80.9 years

Figure 1. Top 25 Causes of Disability-Adjusted Life-Years (DALYs) and % Change in Number of DALYs, All-Age DALYs, and Age-Standardized DALYs, 1990-2016

| | | Mean % Change (95% Uncertainty Interval), 1990-2016 | | |
Leading causes of DALYs, 1990	Leading causes of DALYs, 2016	No. of DALYs	All-Age DALY Rate	Age-Standardized DALY Rate
1 Ischemic heart disease	1 Ischemic heart disease	-18.3 (-20.5 to -16.1)	-36.7 (-38.4 to -35.0)	-49.7 (-51.1 to -48.3)
2 Lung cancer[a]	2 Lung cancer[a]	14.1 (10.7 to 17.7)	-11.6 (-14.2 to -8.8)	-32.5 (-34.5 to -30.4)
3 Low back pain	3 COPD	71.7 (66.2 to 78.7)	33.1 (28.8 to 38.5)	5.5 (2.2 to 9.7)
4 COPD	4 Diabetes	75.6 (67.1 to 83.9)	36.1 (29.5 to 42.5)	11.0 (5.7 to 16.2)
5 Motor vehicle road injury	5 Low back pain	25.1 (10.9 to 39.6)	-3.1 (-14.1 to 8.2)	-12.1 (-22.3 to -1.9)
6 Diabetes	6 Alzheimer disease	75.7 (63.4 to 88.2)	36.1 (26.6 to 45.8)	4.0 (-2.5 to 10.8)
7 Major depression	7 Opioid use disorders	74.5 (42.8 to 93.8)	35.2 (10.6 to 50.1)	47.9 (21.8 to 64.1)
8 Other musculoskeletal	8 Other musculoskeletal	32.2 (23.2 to 41.5)	2.4 (-4.6 to 9.6)	-2.6 (-9.0 to 3.6)
9 Migraine	9 Major depression	27.1 (21.6 to 32.7)	-1.5 (-5.8 to 2.8)	0.1 (-4.1 to 3.7)
10 Ischemic stroke	10 Migraine	27.2 (25.3 to 29.1)	-1.4 (-3.0 to 0.0)	-1.4 (-2.8 to -0.1)
11 Opioid use disorders	11 Neck pain	55.3 (39.2 to 73.3)	20.3 (7.8 to 34.2)	3.3 (-7.5 to 15.0)
12 Alzheimer disease	12 Ischemic stroke	26.3 (21.3 to 31.1)	-2.2 (-6.0 to 1.6)	-22.4 (-25.5 to -19.4)
13 HIV/AIDS other[b]	13 Falls	87.5 (68.4 to 97.5)	45.3 (30.5 to 53.0)	19.0 (8.5 to 24.5)
14 Anxiety disorders	14 Anxiety disorders	30.8 (25.7 to 36.0)	1.4 (-2.6 to 5.4)	0.6 (-3.2 to 4.5)
15 Neonatal preterm birth	15 Motor vehicle road injury	-16.5 (-20.3 to -12.2)	-35.3 (-38.3 to -31.9)	-35.0 (-37.7 to -31.8)
16 Colorectal cancer	16 Age-related hearing loss	72.5 (67.3 to 78.3)	33.6 (29.6 to 38.1)	9.8 (6.6 to 13.4)
17 Neck pain	17 Colorectal cancer	16.6 (12.4 to 20.9)	-9.7 (-12.9 to -6.3)	-27.4 (-29.9 to -24.7)
18 Breast cancer	18 Lower respiratory infection	27.7 (21.8 to 33.7)	-1.0 (-5.6 to 3.5)	-18.8 (-22.3 to -15.2)
19 Lower respiratory infection	19 Intracerebral hemorrhage	31.6 (26.1 to 36.4)	2.0 (-2.3 to 5.6)	-17.0 (-20.4 to -14.1)
20 Intracerebral hemorrhage	20 Breast cancer	6.1 (1.3 to 11.4)	-17.8 (-21.5 to -13.7)	-34.3 (-37.3 to -31.1)
21 Falls	21 Diabetes CKD[c]	127.6 (118.7 to 136.8)	76.3 (69.5 to 83.5)	44.3 (39.5 to 49.5)
22 Age-related hearing loss	22 Self-harm by other means	49.2 (23.3 to 58.9)	15.6 (-4.5 to 23.1)	20.3 (-0.5 to 28.0)
23 Acne vulgaris	23 Alcohol use disorders	30.8 (22.3 to 39.5)	1.3 (-5.2 to 8.1)	-0.2 (-5.8 to 5.7)
24 Self-harm by firearm	24 Osteoarthritis	75.3 (68.5 to 82.6)	35.8 (30.5 to 41.5)	8.0 (3.7 to 12.5)
25 Violence by firearm	25 Acne vulgaris	16.0 (14.3 to 17.8)	-10.1 (-11.4 to -8.7)	-1.5 (-3.0 to 0.2)
26 Alcohol use disorders	26 Neonatal preterm birth			
28 Self-harm by other means	28 Self-harm by firearm			
31 Osteoarthritis	37 Violence by firearm			
38 Diabetes CKD[c]	51 HIV/AIDS other[b]			

Communicable, maternal, neonatal, and nutritional diseases
Noncommunicable diseases
Injuries

Dotted lines: a leading cause has decreased in rank between 1990 and 2016; solid lines, a cause has maintained or ascended to a higher ranking. Causes in white boxes were not among the top 25 in either 1990 or in 2016. COPD, indicates chronic obstructive pulmonary disease.

[a] Includes tracheal, bronchus, and lung cancer.

[b] Indicates HIV/AIDS resulting in other diseases.

[c] Indicates chronic kidney disease (CKD) due to diabetes.

[95% UI, 79.9 to 81.9]), Connecticut (80.8 years [95% UI, 79.7 to 81.8]), Minnesota (80.8 years [95% UI, 80.0 to 81.6]), New York (80.5 years [95% UI, 79.4 to 81.6]), Massachusetts (80.4 years [95% UI, 79.6 to 81.1]), Colorado (80.2 years [95% UI, 79.4 to 80.9]), New Jersey (80.2 years [95% UI, 79.3 to 80.9]), and Washington (80.2 years [95% UI, 79.5 to 80.8]). Other states with low life expectancy were West Virigina (75.3 years [95% UI, 74.4 to 76.0]), Alabama (75.4 years [95% UI, 74.1 to 76.7]), Louisiana (75.6 years [95% UI, 74.9 to 76.4]), Oklahoma (75.7 years [95% UI, 75.0 to 76.4]), Arkansas (75.8 years [95% UI, 74.9 to 76.8]), and Kentucky (75.8 years [95% UI, 74.9 to 76.6]). In 2016, Minnesota had the highest HALE at birth with 70.3 years, while West Virginia had the lowest at 63.8 years, a 6.5-year difference. Only 2 states, Minnesota and Hawaii, had HALE values greater than 70.0 years at birth in 2016. In terms of life expectancy in 2016, only 9 states had life expectancy values greater than 80.0 years.

Male life expectancy and HALE at birth for the United States overall, for all states, and for Washington, DC, are shown in **Table 4**. Minnesota had the highest life expectancy in 2016 (78.7 years [95% UI, 77.5 to 79.8]) and HALE (69.1 years [95% UI, 66.3 to 71.9]), followed by California (life expectancy, 78.6 years [95% UI, 77.2 to 80.1]; and HALE, 68.6 years [95% UI, 65.5 to 71.6]). Mississippi had the lowest life expectancy for males in 2016 (71.8 years [95% UI, 70.1 to 73.8]) and ranked 49th for HALE (63.0 years [95% UI, 60.3 to 65.6]), while West Virginia had the low-

est HALE (62.2 years [95% UI, 54.9 to 65.0]) and ranked 49th for life expectancy (72.7 years [95% UI, 71.5 to 73.9]).

Female life expectancy and HALE at birth for the United States, for all states, and for Washington, DC, are shown in **Table 5**. Hawaii had the highest life expectancy in 2016 (84.1 years [95% UI, 83.2 to 85.0]) and HALE (71.9 years [95% UI, 68.3 to 75.1], followed by life expectancy for California (83.1 years [95% UI, 81.8 to 84.3]) and life expectancy for Connecticut (83.1 years [95% UI, 81.7 to 84.4]); the second highest HALE was for Minnesota (71.4 years [95% UI, 68.3 to 74.5]). Mississippi had the lowest life expectancy for females (77.7 years [95% UI, 76.1 to 79.6]), while West Virginia had the lowest HALE (65.5 years [95% UI, 61.9 to 68.5]).

Table 6 presents the age-standardized death rates, age-standardized YLL rates, and age-standardized YLD rates in 1990 and 2016 and their ranks by state. The 3 measurements varied widely between the states in 2016, ranging from 767.6 deaths per 100 000 in Mississippi to 465.8 deaths per 100 000 in Hawaii, from 17 775.9 YLLs per 100 000 in Mississippi to 9901.8 YLLs per 100 000 in Minnesota, and from 13 090.6 YLDs per 100 000 in West Virginia to 10 582.8 YLDs per 100 000 in Minnesota. A notable improvement was observed in Washington, DC (decreases from 1042.7 deaths per 100 000 to 603.3 deaths per 100 000, from 29 536.9 YLLS per 100 000 to 13 635.9 YLLs per 100 000, and from 12 230.8 YLDs per 100 000 to 11 421.1 YLDs per 100 000) and in California (decreases from 719.1 deaths per 100 000 to 491.7

Figure 2. Number of Deaths and Percentage of Disability-Adjusted Life-Years Related to the 17 Leading Risk Factors in the United States, 2016

A Risk factors and related deaths

B Risk factors as a percentage of disability-adjusted life-years
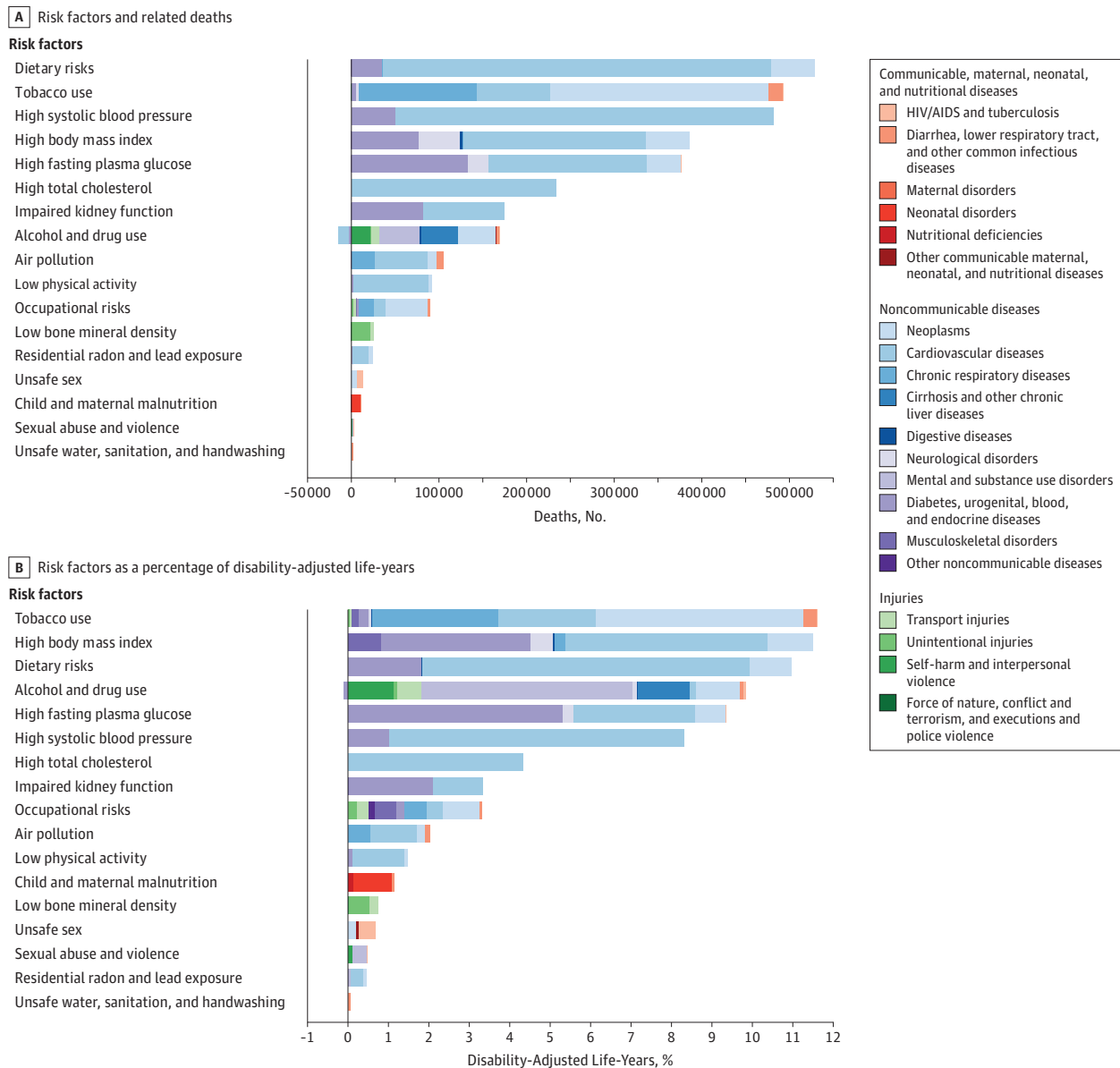
Negative values (where bars extend left of zero) indicate a protective effect.

deaths per 100 000, from 15 903.4 YLLS per 100 000 to 9987.0 YLLs per 100 000, and from 11 170.5 YLDs per 100 000 to 10 990.4 YLDs per 100 000). Decreases in mortality and increases in morbidity were more apparent in Ohio (from 761.5 deaths per 100 000 to 644.1 deaths per 100 000, from 16 349.6 YLLs per 100 000 to 13 853.3 YLLs per 100 000, and from 12 009.0 YLDs per 100 000 to 12 334.7 YLDs per 100 000) and in Oklahoma (from 773.8 deaths per 100 000 to 725.3 deaths per 100 000, from 17 062.7 YLLs per 100 000 to 16 379.3 YLLs per 100 000, and from 12 036.5 YLDs per 100 000 to 12 549.7 YLDs per 100 000). The age-standardized death rates and age-standardized YLL rates declined in all states, but the level of decline for deaths ranged from 6.3% in Oklahoma to 42.1% in Washington, DC and the level of decline for YLLs

ranged from 4.0% for Oklahoma to 53.8% for Washington, DC. Age-standardized YLD rates increased by 4.4% for West Virginia and declined by 6.6% for Washington, DC.

Decomposition of the Probability of Death by Age and State
The decomposition of change in the probability of death from birth to age 20 years, ages 20 to 55 years, and ages 55 to 90 years are shown in **Figure 3**, **Figure 4**, and **Figure 5**. For the United States and each state, these figures show the change in the probability of death from 1990 to 2016. In addition, these figures show changes in the probability of death over the interval due to changes in causes of death (GBD cause hierarchy level 2). The change in the probability of death from birth to age 20 years

Table 3. Life Expectancy and Healthy Life Expectancy at Birth for the United States, the 50 States, and Washington, DC, 1990 and 2016, Both Sexes

Location	Life Expectancy at Birth, y				Healthy Life Expectancy at Birth, y			
	1990		2016		1990		2016	
	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank
United States	75.5 (75.4-75.5)		78.9 (78.7-79.0)		65.3 (62.4-67.9)		67.7 (64.5-70.5)	.
Alabama	73.7 (73.3-74.2)	47	75.4 (74.1-76.7)	49	63.7 (61.0-66.3)	48	64.6 (61.5-67.6)	48
Alaska	75.0 (74.5-75.6)	34	78.1 (76.9-79.4)	34	65.0 (62.2-67.6)	32	67.3 (64.2-70.3)	33
Arizona	76.1 (75.7-76.6)	22	79.5 (78.6-80.4)	19	65.4 (62.4-68.1)	24	67.7 (64.3-70.8)	27
Arkansas	74.4 (74.0-74.8)	43	75.8 (74.9-76.8)	45	64.5 (61.7-67.1)	40	65.5 (62.6-68.2)	44
California	75.9 (75.5-76.4)	24	80.9 (79.9-81.9)	2	66.1 (63.3-68.6)	19	69.9 (66.6-72.8)	3
Colorado	77.1 (76.7-77.4)	6	80.2 (79.4-80.9)	7	66.7 (63.7-69.4)	10	68.9 (65.7-71.8)	9
Connecticut	77.0 (76.6-77.5)	7	80.8 (79.7-81.8)	3	66.5 (63.5-69.1)	12	69.0 (65.7-72.1)	6
Delaware	74.9 (74.5-75.3)	37	78.6 (77.9-79.4)	28	64.6 (61.7-67.2)	39	67.2 (64.0-70.1)	34
Florida	76.0 (75.6-76.4)	23	79.6 (78.6-80.5)	15	65.5 (62.6-68.2)	23	67.9 (64.5-71.0)	24
Georgia	73.8 (73.2-74.3)	46	77.4 (76.2-78.4)	41	63.9 (61.0-66.5)	44	66.6 (63.5-69.5)	38
Hawaii	78.5 (78.2-78.9)	1	81.3 (80.6-81.9)	1	68.2 (65.2-70.9)	1	70.1 (66.9-73.0)	2
Idaho	77.0 (76.6-77.5)	8	79.1 (78.1-80.3)	23	66.4 (63.5-69.0)	13	67.9 (64.5-70.9)	25
Illinois	75.0 (74.7-75.4)	35	79.1 (78.4-79.8)	24	65.2 (62.5-67.7)	29	68.3 (65.3-71.0)	18
Indiana	75.4 (75.0-75.9)	27	77.2 (76.0-78.5)	42	65.1 (62.2-67.7)	31	66.0 (62.9-69.0)	42
Iowa	77.3 (77.0-77.7)	5	79.5 (78.6-80.4)	17	67.4 (64.6-70.0)	4	68.9 (65.8-71.7)	7
Kansas	76.8 (76.4-77.3)	12	78.5 (77.3-79.7)	30	66.8 (64.0-69.3)	8	67.8 (64.8-70.7)	26
Kentucky	74.4 (74.1-74.8)	42	75.8 (74.9-76.6)	46	63.7 (60.8-66.5)	45	64.3 (61.2-67.3)	50
Louisiana	73.3 (73.0-73.7)	49	75.6 (74.9-76.4)	48	63.2 (60.4-65.8)	50	65.0 (62.0-67.7)	46
Maine	76.3 (75.9-76.7)	21	79.0 (78.3-79.7)	26	66.1 (63.3-68.6)	17	68.0 (65.0-70.9)	21
Maryland	74.8 (74.5-75.2)	38	79.2 (78.5-79.9)	21	64.7 (61.8-67.3)	37	68.0 (65.0-70.7)	22
Massachusetts	76.7 (76.3-77.1)	15	80.4 (79.6-81.1)	6	66.1 (63.2-68.7)	18	68.9 (65.6-71.8)	8
Michigan	75.2 (74.9-75.5)	33	78.0 (77.3-78.7)	35	64.9 (62.0-67.6)	35	67.0 (63.9-69.9)	35
Minnesota	77.8 (77.4-78.2)	3	80.8 (80.0-81.6)	4	67.9 (65.1-70.4)	2	70.3 (67.4-73.0)	1
Mississippi	73.1 (72.6-73.6)	50	74.7 (73.5-76.1)	51	63.7 (61.0-66.1)	46	64.9 (62.1-67.6)	47
Missouri	75.3 (75.0-75.7)	31	77.4 (76.8-78.2)	40	65.3 (62.4-67.9)	28	66.5 (63.4-69.2)	39
Montana	76.4 (75.9-76.9)	18	78.9 (77.7-80.1)	27	66.0 (63.1-68.6)	20	67.7 (64.5-70.9)	28
Nebraska	76.9 (76.5-77.3)	10	79.4 (78.8-80.1)	20	67.0 (64.2-69.5)	7	68.8 (65.7-71.5)	12
Nevada	74.5 (74.1-74.9)	41	78.1 (77.3-79.0)	33	64.3 (61.5-67.0)	41	66.9 (63.9-69.7)	36
New Hampshire	76.7 (76.4-77.1)	14	79.9 (79.2-80.6)	11	66.2 (63.3-68.8)	16	68.5 (65.3-71.4)	14
New Jersey	75.4 (75.1-75.8)	26	80.2 (79.3-80.9)	8	65.3 (62.5-67.9)	25	68.8 (65.7-71.8)	10
New Mexico	75.9 (75.4-76.4)	25	77.8 (76.5-79.1)	38	65.3 (62.4-68.0)	26	66.3 (63.0-69.4)	40
New York	74.7 (74.3-75.2)	39	80.5 (79.4-81.6)	5	64.3 (61.4-67.0)	42	68.5 (65.1-71.6)	15
North Carolina	74.7 (74.4-75.1)	40	77.9 (77.3-78.6)	37	64.9 (62.2-67.5)	34	67.4 (64.4-70.1)	32
North Dakota	77.7 (77.2-78.2)	4	79.8 (78.8-80.9)	12	67.6 (64.7-70.1)	3	68.8 (65.6-71.8)	11
Ohio	75.4 (75.0-75.7)	29	77.5 (76.8-78.2)	39	64.9 (62.0-67.6)	33	66.1 (62.9-69.0)	41
Oklahoma	75.0 (74.6-75.4)	36	75.7 (75.0-76.4)	47	64.6 (61.7-67.2)	38	64.5 (61.4-67.4)	49
Oregon	76.3 (76.0-76.7)	19	79.5 (78.9-80.2)	16	66.0 (63.1-68.5)	21	68.4 (65.3-71.2)	17
Pennsylvania	75.4 (75.1-75.7)	28	78.5 (77.9-79.2)	29	64.7 (61.8-67.5)	36	66.8 (63.7-69.8)	37
Rhode Island	76.6 (76.1-77.0)	17	79.6 (78.6-80.7)	13	65.8 (62.8-68.5)	22	68.1 (64.9-71.2)	20
South Carolina	73.7 (73.2-74.2)	48	76.8 (75.7-77.8)	43	63.6 (60.8-66.2)	49	65.8 (62.7-68.7)	43
South Dakota	76.9 (76.4-77.4)	11	79.1 (78.1-80.1)	25	67.1 (64.3-69.6)	6	68.4 (65.3-71.4)	16
Tennessee	74.3 (74.0-74.7)	44	76.1 (75.5-77.0)	44	64.2 (61.4-66.8)	43	65.4 (62.3-68.2)	45
Texas	75.3 (74.8-75.6)	32	78.5 (77.8-79.3)	31	65.3 (62.5-67.9)	27	67.4 (64.4-70.3)	29
Utah	77.9 (77.6-78.3)	2	79.6 (79.0-80.3)	14	67.1 (64.1-69.8)	5	68.2 (64.9-71.1)	19
Vermont	76.6 (76.2-77.0)	16	79.9 (79.2-80.7)	10	66.4 (63.5-69.0)	14	69.0 (65.9-71.8)	5
Virginia	75.3 (75.0-75.7)	30	79.2 (78.5-79.9)	22	65.2 (62.3-67.8)	30	68.0 (64.9-70.8)	23
Washington	76.8 (76.5-77.2)	13	80.2 (79.5-80.8)	9	66.5 (63.7-69.1)	11	69.1 (65.8-71.9)	4
West Virginia	74.3 (74.0-74.7)	45	75.3 (74.4-76.0)	50	63.7 (60.7-66.3)	47	63.8 (60.7-66.7)	51
Wisconsin	76.9 (76.6-77.3)	9	79.5 (78.8-80.1)	18	66.8 (63.9-69.3)	9	68.6 (65.4-71.5)	13
Wyoming	76.3 (75.8-76.8)	20	78.4 (77.2-79.5)	32	66.2 (63.3-68.8)	15	67.4 (64.1-70.4)	30
Washington, DC	68.4 (67.7-69.0)	51	78.0 (76.8-79.1)	36	59.1 (56.6-61.6)	51	67.4 (64.4-70.3)	31

Abbreviation: UI, uncertainty interval.

Table 4. Life Expectancy and Healthy Life Expectancy at Birth for the United States, the 50 States, and Washington, DC, 1990 and 2016, Males

| | Life Expectancy at Birth, y | | | | Healthy Life Expectancy at Birth, y | | | |
| | 1990 | | 2016 | | 1990 | | 2016 | |
Location	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank
United States	71.9 (71.8-72.1)		76.5 (76.2-76.7)		63.0 (60.5-65.2)		66.3 (63.5-68.8)	
Alabama	69.7 (69.1-70.4)	48	72.6 (70.8-74.5)	50	61.1 (58.6-63.4)	47	63.0 (60.1-65.8)	48
Alaska	71.9 (71.0-72.6)	31	75.9 (74.2-77.7)	33	63.0 (60.5-65.4)	29	66.2 (63.3-69.2)	31
Arizona	72.7 (72.1-73.3)	22	77.1 (75.9-78.5)	20	63.2 (60.6-65.6)	23	66.5 (63.3-69.4)	27
Arkansas	70.6 (70.0-71.2)	44	73.3 (71.8-74.7)	45	62.0 (59.6-64.4)	41	64.1 (61.5-66.5)	44
California	72.6 (72.0-73.3)	23	78.6 (77.2-80.1)	2	63.9 (61.5-66.2)	20	68.6 (65.5-71.6)	2
Colorado	73.9 (73.4-74.5)	6	78.1 (77.0-79.1)	6	64.9 (62.3-67.3)	6	67.8 (65.0-70.6)	5
Connecticut	73.7 (73.1-74.4)	10	78.4 (76.7-79.9)	4	64.3 (61.6-66.7)	15	67.6 (64.5-70.6)	8
Delaware	71.7 (71.2-72.3)	33	76.2 (75.1-77.4)	29	62.6 (60.0-64.9)	35	65.8 (63.0-68.5)	33
Florida	72.3 (71.7-72.9)	25	77.0 (75.4-78.3)	22	63.1 (60.6-65.4)	27	66.4 (63.3-69.4)	28
Georgia	69.8 (69.1-70.6)	46	74.8 (73.1-76.3)	42	61.3 (58.8-63.5)	45	65.2 (62.2-68.0)	38
Hawaii	75.5 (75.0-76.1)	1	78.4 (77.4-79.4)	3	66.3 (63.7-68.8)	1	68.3 (65.3-71.1)	3
Idaho	74.0 (73.3-74.7)	5	77.2 (75.6-78.8)	16	64.6 (62.0-67.0)	12	67.0 (63.8-70.0)	19
Illinois	71.5 (70.9-72.0)	37	76.6 (75.5-77.6)	26	62.9 (60.5-65.1)	31	66.8 (64.0-69.4)	21
Indiana	72.0 (71.4-72.7)	28	74.8 (73.1-76.5)	41	63.1 (60.5-65.4)	28	64.8 (61.9-67.7)	40
Iowa	73.9 (73.3-74.5)	7	77.2 (76.0-78.3)	18	65.2 (62.7-67.5)	5	67.6 (64.8-70.1)	7
Kansas	73.5 (72.8-74.1)	13	76.1 (74.4-77.9)	31	64.7 (62.3-67.0)	10	66.5 (63.7-69.5)	25
Kentucky	70.8 (70.3-71.3)	42	73.2 (72.0-74.4)	47	61.3 (58.7-63.8)	44	62.8 (59.9-65.7)	50
Louisiana	69.4 (68.8-69.9)	49	72.9 (71.8-74.0)	48	60.7 (58.3-62.9)	50	63.3 (60.7-65.8)	47
Maine	72.9 (72.4-73.5)	21	76.5 (75.4-77.5)	27	64.0 (61.5-66.2)	18	66.5 (63.6-69.2)	26
Maryland	71.4 (70.9-71.9)	38	76.8 (75.8-77.7)	24	62.5 (60.1-64.8)	37	66.7 (63.9-69.4)	22
Massachusetts	73.3 (72.8-73.9)	14	77.9 (76.9-78.9)	9	63.9 (61.3-66.4)	21	67.4 (64.3-70.1)	12
Michigan	71.9 (71.4-72.3)	32	75.6 (74.7-76.7)	35	62.8 (60.3-65.1)	34	65.6 (62.8-68.4)	35
Minnesota	74.5 (74.0-75.0)	3	78.7 (77.5-79.8)	1	65.9 (63.5-68.1)	2	69.1 (66.3-71.9)	1
Mississippi	69.0 (68.3-69.7)	50	71.8 (70.1-73.8)	51	60.9 (58.6-63.0)	49	63.0 (60.3-65.6)	49
Missouri	71.6 (71.0-72.1)	34	74.9 (73.9-76.0)	40	62.9 (60.5-65.2)	30	65.1 (62.2-67.6)	39
Montana	73.2 (72.5-73.9)	18	76.8 (75.1-78.7)	23	64.1 (61.4-66.3)	17	66.6 (63.5-69.8)	23
Nebraska	73.6 (73.0-74.0)	12	77.2 (76.1-78.1)	19	64.9 (62.5-67.1)	7	67.5 (64.7-70.1)	9
Nevada	71.3 (70.7-71.8)	39	75.9 (74.6-77.1)	34	62.3 (59.8-64.6)	40	65.7 (62.9-68.4)	34
New Hampshire	73.6 (73.1-74.2)	11	77.7 (76.6-78.7)	11	64.2 (61.6-66.5)	16	67.1 (64.3-70.0)	17
New Jersey	72.2 (71.6-72.7)	26	77.8 (76.6-78.9)	10	63.1 (60.6-65.5)	24	67.3 (64.4-70.1)	14
New Mexico	72.4 (71.7-73.2)	24	75.0 (73.1-76.9)	39	63.1 (60.5-65.6)	25	64.7 (61.4-67.9)	42
New York	70.9 (70.3-71.6)	40	78.1 (76.6-79.7)	5	61.7 (59.2-64.1)	42	67.1 (64.0-70.1)	16
North Carolina	70.9 (70.4-71.3)	41	75.4 (74.4-76.4)	36	62.3 (59.9-64.5)	39	65.9 (63.2-68.4)	32
North Dakota	74.2 (73.6-74.9)	4	77.2 (75.7-78.8)	15	65.5 (63.0-67.7)	3	67.4 (64.3-70.2)	13
Ohio	72.1 (71.7-72.6)	27	75.1 (74.0-76.1)	37	62.9 (60.3-65.1)	33	64.8 (61.8-67.4)	41
Oklahoma	71.6 (71.0-72.1)	35	73.2 (72.1-74.4)	46	62.5 (60.0-64.8)	36	63.3 (60.5-66.1)	46
Oregon	73.2 (72.7-73.7)	17	77.4 (76.5-78.3)	13	63.9 (61.3-66.3)	19	67.2 (64.5-69.9)	15
Pennsylvania	71.9 (71.5-72.4)	29	76.0 (74.9-77.0)	32	62.4 (59.8-64.8)	38	65.3 (62.5-68.0)	37
Rhode Island	73.1 (72.5-73.7)	19	77.2 (75.6-78.5)	17	63.6 (61.0-66.1)	22	66.6 (63.7-69.6)	24
South Carolina	69.8 (69.0-70.5)	47	74.2 (72.5-75.9)	43	61.0 (58.5-63.3)	48	64.3 (61.4-67.1)	43
South Dakota	73.2 (72.6-73.9)	16	76.7 (75.1-78.2)	25	64.7 (62.2-66.9)	11	67.1 (64.2-70.0)	18
Tennessee	70.5 (70.0-71.0)	45	73.5 (72.5-74.7)	44	61.6 (59.2-63.9)	43	63.8 (61.0-66.4)	45
Texas	71.5 (70.9-72.1)	36	76.1 (75.0-77.3)	30	62.9 (60.4-65.2)	32	66.2 (63.5-69.0)	30
Utah	75.0 (74.5-75.5)	2	77.9 (77.0-78.9)	8	65.5 (62.8-67.9)	4	67.5 (64.7-70.2)	10
Vermont	73.3 (72.8-73.9)	15	77.6 (76.4-78.7)	12	64.3 (61.7-66.6)	14	67.7 (64.8-70.3)	6
Virginia	71.9 (71.4-72.3)	30	77.0 (76.0-78.0)	21	63.1 (60.6-65.4)	26	67.0 (64.1-69.6)	20
Washington	73.8 (73.3-74.3)	8	78.1 (77.1-79.1)	7	64.8 (62.2-67.0)	9	68.1 (65.1-70.8)	4
West Virginia	70.6 (70.1-71.2)	43	72.7 (71.5-73.9)	49	61.2 (58.6-63.5)	46	62.2 (59.4-65.0)	51
Wisconsin	73.7 (73.2-74.2)	9	77.3 (76.2-78.2)	14	64.8 (62.3-67.1)	8	67.4 (64.6-70.1)	11
Wyoming	73.1 (72.4-73.8)	20	76.2 (74.6-77.8)	28	64.3 (61.7-66.7)	13	66.3 (63.2-69.3)	29
Washington, DC	62.3 (61.4-63.3)	51	75.1 (73.4-76.6)	38	54.5 (52.3-56.8)	51	65.5 (62.6-68.3)	36

Abbreviation: UI, uncertainty interval.

Table 5. Life Expectancy and Healthy Life Expectancy at Birth for the United States, the 50 States, and Washington, DC, 1990 and 2016, Females

Location	Life Expectancy at Birth, y				Healthy Life Expectancy at Birth, y			
	1990		2016		1990		2016	
	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank	Estimate (95% UI)	Rank
United States	78.9 (78.8-79.0)		81.2 (81.0-81.5)		67.5 (64.2-70.4)		69.0 (65.5-72.1)	
Alabama	77.6 (77.0-78.3)	46	78.1 (76.6-79.7)	49	66.2 (63.0-69.1)	46	66.2 (62.7-69.5)	48
Alaska	78.8 (78.0-79.5)	28	80.5 (78.9-82.1)	36	67.4 (64.2-70.3)	31	68.5 (65.0-72.0)	34
Arizona	79.7 (79.1-80.2)	19	81.9 (80.7-83.0)	15	67.7 (64.4-70.8)	25	69.0 (65.2-72.4)	25
Arkansas	78.2 (77.6-78.8)	39	78.5 (77.3-79.8)	45	66.9 (63.8-69.8)	34	67.1 (63.7-70.1)	44
California	79.2 (78.7-79.9)	25	83.1 (81.8-84.3)	2	68.2 (65.1-71.0)	16	71.1 (67.7-74.3)	3
Colorado	80.0 (79.6-80.5)	11	82.3 (81.3-83.2)	9	68.4 (65.1-71.5)	11	69.9 (66.3-73.1)	13
Connecticut	80.1 (79.5-80.7)	9	83.1 (81.7-84.4)	3	68.4 (65.2-71.4)	12	70.4 (66.8-73.9)	4
Delaware	77.9 (77.4-78.4)	45	81.0 (80.0-82.0)	29	66.4 (63.2-69.4)	44	68.6 (65.2-71.8)	32
Florida	79.7 (79.2-80.2)	16	82.2 (81.1-83.4)	11	67.9 (64.6-71.0)	22	69.4 (65.8-72.8)	21
Georgia	77.5 (77.0-78.2)	47	79.8 (78.2-81.4)	41	66.4 (63.2-69.3)	45	68.1 (64.6-71.1)	38
Hawaii	81.8 (81.3-82.3)	1	84.1 (83.2-85.0)	1	70.2 (67.0-73.1)	1	71.9 (68.3-75.1)	1
Idaho	80.1 (79.5-80.8)	8	81.2 (79.8-82.5)	26	68.3 (65.0-71.4)	13	68.8 (65.2-72.1)	28
Illinois	78.4 (77.9-78.8)	36	81.5 (80.6-82.3)	23	67.5 (64.4-70.3)	28	69.8 (66.4-72.7)	16
Indiana	78.7 (78.1-79.3)	31	79.6 (77.9-81.2)	42	67.1 (63.8-70.1)	33	67.3 (63.8-70.6)	43
Iowa	80.6 (80.1-81.1)	6	81.9 (80.8-83.1)	16	69.5 (66.4-72.4)	5	70.2 (66.8-73.4)	9
Kansas	80.1 (79.5-80.7)	10	80.9 (79.1-82.5)	30	68.7 (65.5-71.7)	7	69.1 (65.7-72.4)	23
Kentucky	78.1 (77.5-78.6)	42	78.4 (77.3-79.4)	46	66.1 (62.8-69.1)	48	65.8 (62.2-69.1)	50
Louisiana	77.1 (76.6-77.7)	50	78.4 (77.4-79.4)	47	65.7 (62.5-68.7)	50	66.6 (63.2-69.8)	47
Maine	79.5 (79.0-80.0)	22	81.5 (80.7-82.4)	22	68.2 (65.0-71.1)	15	69.6 (66.3-72.8)	18
Maryland	78.1 (77.7-78.6)	40	81.5 (80.6-82.4)	21	66.7 (63.5-69.7)	38	69.2 (65.8-72.4)	22
Massachusetts	79.8 (79.2-80.2)	15	82.7 (81.8-83.6)	6	68.0 (64.8-71.0)	19	70.3 (66.8-73.7)	5
Michigan	78.4 (78.0-78.8)	34	80.4 (79.5-81.4)	37	66.9 (63.7-69.9)	35	68.3 (64.9-71.4)	36
Minnesota	80.9 (80.5-81.4)	3	82.9 (81.8-83.9)	4	69.9 (66.7-72.7)	2	71.4 (68.3-74.5)	2
Mississippi	77.2 (76.6-77.8)	49	77.7 (76.1-79.6)	51	66.5 (63.5-69.2)	43	66.8 (63.7-70.0)	46
Missouri	79.0 (78.5-79.4)	27	79.9 (79.0-80.9)	39	67.6 (64.3-70.5)	26	67.9 (64.5-71.0)	40
Montana	79.7 (79.0-80.4)	17	81.0 (79.4-82.5)	28	68.1 (64.9-71.1)	18	68.8 (65.2-72.2)	29
Nebraska	80.1 (79.6-80.6)	7	81.8 (80.8-82.7)	17	68.9 (65.7-71.9)	6	70.0 (66.6-73.0)	11
Nevada	78.0 (77.5-78.5)	43	80.5 (79.5-81.7)	35	66.6 (63.4-69.5)	41	68.2 (64.7-71.4)	37
New Hampshire	79.7 (79.2-80.1)	18	82.2 (81.4-83.0)	13	68.0 (64.7-71.0)	20	69.9 (66.2-73.0)	12
New Jersey	78.5 (78.1-79.0)	32	82.4 (81.4-83.5)	8	67.4 (64.2-70.3)	30	70.2 (66.8-73.4)	8
New Mexico	79.4 (78.8-80.1)	24	80.7 (79.1-82.3)	33	67.5 (64.2-70.6)	27	67.9 (64.3-71.5)	39
New York	78.3 (77.8-78.9)	38	82.7 (81.3-84.2)	5	66.7 (63.4-69.8)	39	69.7 (65.9-73.3)	17
North Carolina	78.4 (77.9-78.8)	35	80.3 (79.5-81.2)	38	67.4 (64.3-70.2)	29	68.8 (65.4-71.7)	30
North Dakota	81.3 (80.6-82.0)	2	82.6 (81.3-83.9)	7	69.8 (66.5-72.7)	3	70.3 (66.8-73.6)	7
Ohio	78.5 (78.1-79.0)	33	79.9 (79.1-80.7)	40	66.8 (63.5-69.9)	37	67.4 (63.9-70.5)	41
Oklahoma	78.3 (77.9-78.8)	37	78.2 (77.2-79.2)	48	66.6 (63.3-69.6)	42	65.8 (62.3-68.9)	49
Oregon	79.4 (79.0-79.9)	23	81.7 (80.8-82.6)	19	68.0 (64.8-70.9)	21	69.5 (66.3-72.7)	19
Pennsylvania	78.7 (78.3-79.1)	29	81.0 (80.2-81.9)	27	66.9 (63.6-70.0)	36	68.4 (64.7-71.6)	35
Rhode Island	79.7 (79.1-80.3)	20	82.0 (80.7-83.3)	14	67.8 (64.5-70.8)	23	69.4 (65.8-72.9)	20
South Carolina	77.4 (76.8-78.1)	48	79.4 (77.7-80.9)	43	66.1 (62.9-69.0)	49	67.3 (63.7-70.6)	42
South Dakota	80.6 (80.0-81.2)	5	81.6 (80.1-83.0)	20	69.5 (66.3-72.4)	4	69.8 (66.4-72.9)	15
Tennessee	78.1 (77.7-78.6)	41	78.8 (77.8-79.7)	44	66.7 (63.6-69.6)	40	66.9 (63.4-70.1)	45
Texas	79.0 (78.5-79.5)	26	80.9 (79.8-81.9)	31	67.7 (64.5-70.6)	24	68.6 (65.2-71.9)	31
Utah	80.8 (80.3-81.2)	4	81.4 (80.5-82.2)	24	68.7 (65.2-71.7)	8	68.8 (65.3-71.9)	27
Vermont	79.8 (79.3-80.3)	13	82.2 (81.2-83.3)	12	68.5 (65.3-71.4)	10	70.3 (67.0-73.5)	6
Virginia	78.7 (78.3-79.2)	30	81.3 (80.4-82.1)	25	67.2 (64.0-70.2)	32	69.0 (65.6-72.1)	26
Washington	79.8 (79.3-80.3)	14	82.3 (81.4-83.2)	10	68.3 (65.0-71.2)	14	70.0 (66.4-73.2)	10
West Virginia	78.0 (77.5-78.5)	44	77.9 (76.8-78.9)	50	66.2 (62.9-69.1)	47	65.5 (61.9-68.5)	51
Wisconsin	80.0 (79.6-80.5)	12	81.7 (80.8-82.5)	18	68.6 (65.4-71.5)	9	69.8 (66.3-73.0)	14
Wyoming	79.6 (78.8-80.3)	21	80.8 (79.3-82.2)	32	68.1 (64.8-71.1)	17	68.6 (64.9-71.9)	33
Washington, DC	74.6 (73.9-75.3)	51	80.6 (79.1-82.2)	34	63.9 (60.8-66.6)	51	69.1 (65.6-72.6)	24

Abbreviation: UI, uncertainty interval.

Table 6. Age-Standardized Rates of Death, Years of Life Lost Due to Premature Mortality, and Years Lived With Disability for the United States, the 50 States, and Washington, DC, 1990 and 2016, Both Sexes

Location	Age-Standardized Death Rate, per 100 000			Age-Standardized YLL Rate, per 100 000				Age-Standardized YLD Rate, per 100 000			
	1990 Rate (95% UI)	2016 Rate (95% UI)	Rank	1990 Rate (95% UI)	Rank	2016 Rate (95% UI)	Rank	1990 Rate (95% UI)	Rank	2016 Rate (95% UI)	Rank
United States	745.2 (740.6-749.8)	578.0 (569.4-587.1)	.	16518.3 (16410.3-16632.5)	.	12257.5 (12064.5-12452.7)	.	11644.0 (8660.1-14968.1)	.	11717.7 (8722.3-15059.7)	.
Alabama	831.2 (801.9-859.4)	740.2 (667.5-814.5)	4	19179.9 (18491.3-19854.3)	3	16851.4 (15167.5-18586.1)	5	11872.3 (8849.6-15244.8)	16	12249.1 (9128.0-15787.0)	8
Alaska	765.6 (733.3-800.7)	610.4 (546.2-670.7)	18	17185.2 (16461.9-17961.4)	17	13423.3 (11995.1-14839.1)	15	11485.6 (8574.6-14812.8)	32	11517.8 (8588.1-14848.5)	34
Arizona	699.6 (677.5-721.6)	539.3 (498.6-578.3)	35	15824.6 (15295.3-16355.4)	38	12045.3 (11125.9-12950.2)	30	12141.3 (9021.7-15624.5)	7	12242.7 (9112.6-15658.6)	9
Arkansas	793.7 (767.6-819.7)	715.0 (666.7-764.7)	11	18151.2 (17514.5-18753.1)	7	16176.9 (15046.7-17365.8)	7	11579.7 (8597.3-14853.0)	31	11604.9 (8631.1-14935.5)	33
California	719.1 (695.1-743.6)	491.7 (449.2-535.5)	28	15903.4 (15362.8-16464.3)	50	9987.0 (9086.3-10951.1)	29	11170.5 (8300.7-14399.6)	44	10990.4 (8165.7-14201.2)	50
Colorado	668.6 (649.8-688.9)	522.5 (491.0-558.1)	44	14269.3 (13850.9-14687.4)	45	10784.5 (10092.7-11584.1)	44	11414.0 (8489.6-14634.4)	37	11495.6 (8556.5-14785.0)	35
Connecticut	669.4 (643.8-694.7)	496.8 (453.0-546.0)	43	14278.3 (13719.3-14847.9)	49	10012.6 (9102.2-11076.8)	43	11755.8 (8752.1-15078.4)	23	11932.9 (8912.6-15337.7)	18
Delaware	787.6 (763.2-813.1)	582.9 (548.1-618.9)	12	17107.6 (16506.0-17672.8)	24	12784.4 (11939.3-13641.8)	17	12024.5 (8970.5-15407.6)	10	12107.8 (9049.6-15513.8)	13
Florida	694.0 (672.2-715.4)	532.0 (493.7-575.3)	38	16414.6 (15886.2-16933.9)	41	11938.8 (11058.2-12931.1)	23	11738.6 (8743.2-15142.9)	24	11960.0 (8900.6-15356.1)	17
Georgia	829.2 (800.1-861.5)	652.7 (599.1-716.1)	6	19071.7 (18365.8-19834.3)	11	13945.8 (12753.4-15335.5)	6	11633.4 (8641.4-15016.0)	27	11652.8 (8615.6-15024.4)	29
Hawaii	586.4 (569.0-604.2)	465.8 (439.8-494.3)	51	12739.0 (12341.0-13138.5)	51	10138.2 (9539.8-10788.7)	51	11028.6 (8216.7-14261.0)	46	11090.8 (8247.3-14405.3)	47
Idaho	668.4 (641.3-695.0)	571.4 (518.1-627.1)	45	14390.0 (13800.5-14964.0)	27	11790.6 (10629.1-13011.9)	42	11706.8 (8715.5-15042.3)	25	11730.9 (8810.9-15210.6)	24
Illinois	769.4 (748.5-788.9)	570.6 (536.2-606.5)	17	17158.5 (16639.6-17617.6)	29	11878.6 (11150.8-12673.1)	16	11242.3 (8353.2-14443.3)	43	11300.2 (8468.7-14597.7)	41
Indiana	758.6 (730.9-785.9)	657.7 (593.8-726.2)	23	16326.9 (15731.9-16937.8)	10	14178.4 (12757.5-15633.6)	27	11765.1 (8748.8-15122.3)	22	12154.0 (9119.3-15588.8)	10
Iowa	658.8 (638.2-678.7)	556.0 (516.4-602.1)	47	13773.1 (13328.3-14213.5)	32	11215.6 (10359.6-12152.9)	47	10821.7 (8041.9-13938.7)	49	11030.0 (8153.3-14290.3)	48
Kansas	678.8 (652.5-703.3)	595.5 (537.8-658.1)	41	14549.4 (13970.3-15080.3)	21	12617.6 (11369.9-13923.7)	37	11104.9 (8213.9-14332.6)	45	11307.9 (8434.3-14600.1)	40
Kentucky	813.3 (791.9-834.9)	729.2 (685.1-777.9)	8	17708.0 (17218.0-18214.3)	4	16047.8 (15015.7-17183.9)	12	12574.6 (9336.3-16086.0)	1	13044.8 (9781.6-16602.9)	2
Louisiana	853.4 (830.0-875.8)	725.3 (685.7-766.9)	3	19771.1 (19200.4-20286.8)	5	16507.6 (15563.3-17560.9)	3	12087.5 (9002.4-15500.5)	8	12110.8 (9002.1-15512.5)	12
Maine	723.1 (701.8-745.1)	580.7 (544.3-615.7)	27	14859.5 (14414.0-15343.1)	25	11980.0 (11222.5-12759.6)	34	11452.5 (8488.9-14749.9)	35	11468.3 (8522.1-14767.5)	36
Maryland	782.6 (762.4-803.3)	558.7 (527.5-592.7)	13	17261.4 (16806.5-17738.0)	30	11931.6 (11229.7-12656.4)	14	11796.6 (8772.9-15103.9)	20	11647.5 (8744.3-14997.4)	30
Massachusetts	694.9 (671.5-716.4)	519.3 (488.6-556.2)	46	14452.9 (13954.6-14918.3)	46	10316.3 (9656.5-11084.0)	40	11931.8 (8856.0-15314.6)	14	11720.4 (8695.3-15038.6)	25
Michigan	761.8 (741.1-782.4)	618.1 (585.1-653.0)	19	16839.8 (16397.3-17288.8)	15	13266.5 (12512.2-14079.3)	19	11797.4 (8764.9-15181.8)	19	11800.8 (8835.1-15095.9)	21
Minnesota	639.5 (619.0-660.4)	499.8 (462.1-536.5)	48	13167.4 (12740.2-13617.9)	48	9901.8 (9123.5-10668.9)	49	10673.6 (7960.0-13781.8)	51	10582.8 (7913.2-13640.3)	51
Mississippi	856.9 (824.8-889.2)	767.6 (695.6-838.6)	2	20205.8 (19404.7-20980.9)	1	17775.9 (16050.5-19528.3)	2	11265.3 (8375.4-14543.6)	41	11256.4 (8444.8-14484.4)	44
Missouri	751.4 (730.8-772.6)	642.6 (607.0-678.5)	26	16661.6 (16188.1-17157.3)	13	13999.7 (13137.5-14844.2)	21	11481.7 (8537.8-14818.3)	33	11814.3 (8845.4-15220.7)	20
Montana	694.6 (666.4-723.2)	571.2 (517.1-628.5)	37	15261.1 (14641.3-15880.3)	28	12459.2 (11201.1-13768.0)	32	11583.2 (8605.5-14871.2)	30	11655.8 (8712.6-15,013.9)	28
Nebraska	676.7 (656.6-696.9)	557.9 (525.3-591.3)	42	14395.9 (13955.8-14862.7)	31	11400.3 (10658.6-12162.4)	41	10949.8 (8148.9-14134.8)	47	11020.1 (8203.9-14215.1)	49
Nevada	805.1 (779.9-828.2)	613.3 (569.4-656.4)	10	17800.5 (17209.9-18358.0)	16	12987.3 (12032.1-14000.4)	20	11867.6 (8782.2-15278.2)	17	12002.9 (8964.4-15428.2)	16
New Hampshire	701.7 (682.8-723.6)	537.8 (505.5-573.0)	33	14213.2 (13787.3-14665.6)	40	10855.5 (10153.7-11633.6)	46	11828.2 (8772.6-15147.7)	18	11742.3 (8757.5-15080.9)	22
New Jersey	755.3 (733.9-777.1)	526.2 (490.1-567.1)	24	16378.6 (15892.3-16881.0)	43	10605.8 (9827.2-11477.5)	24	11588.6 (8620.3-14901.0)	29	11643.9 (8632.8-15014.8)	31
New Mexico	705.1 (679.7-734.8)	608.6 (549.2-669.2)	31	16272.8 (15656.8-16969.0)	18	14218.1 (12673.0-15771.9)	28	11991.5 (8920.9-15393.5)	13	12401.4 (9248.5-15907.9)	5
New York	773.1 (746.1-798.3)	508.6 (460.7-560.7)	16	17741.2 (17099.9-18338.1)	47	10279.3 (9279.1-11391.9)	11	12168.8 (9045.5-15688.9)	5	12254.7 (9140.2-15737.0)	7
North Carolina	779.3 (757.7-800.6)	622.3 (589.0-656.4)	14	17628.0 (17133.8-18121.3)	14	13366.2 (12620.1-14165.6)	13	11288.9 (8412.6-14533.0)	39	11291.6 (8386.1-14568.8)	42
North Dakota	637.8 (610.9-663.9)	525.7 (479.7-574.5)	49	13499.1 (12938.2-14041.9)	44	11431.6 (10389.4-12556.6)	48	10892.6 (8091.1-14040.5)	34	11259.2 (8397.6-14507.9)	43
Ohio	761.5 (741.1-781.2)	644.1 (608.7-679.9)	20	16349.6 (15901.8-16791.9)	12	13853.3 (13037.7-14672.9)	26	12009.0 (8918.1-15405.3)	12	12334.7 (9199.1-15781.7)	6
Oklahoma	773.8 (752.5-796.3)	725.3 (686.4-763.9)	15	17062.7 (16588.6-17559.8)	6	16379.3 (15465.9-17299.4)	18	12036.5 (8968.0-15488.4)	9	12549.7 (9358.4-16161.4)	3
Oregon	708.9 (690.0-728.4)	552.8 (521.3-582.0)	29	15122.3 (14700.2-15557.7)	36	11300.8 (10622.8-11944.4)	33	11692.7 (8722.5-14973.6)	26	11658.6 (8651.6-14977.2)	26

(continued)

Table 6. Age-Standardized Rates of Death, Years of Life Lost Due to Premature Mortality, and Years Lived With Disability for the United States, the 50 States, and Washington, DC, 1990 and 2016, Both Sexes (continued)

Location	Age-Standardized Death Rate, per 100 000			Age-Standardized YLL Rate, per 100 000				Age-Standardized YLD Rate, per 100 000			
	1990	2016		1990		2016		1990		2016	
	Rate (95% UI)	Rate (95% UI)	Rank	Rate (95% UI)	Rank	Rate (95% UI)	Rank	Rate (95% UI)	Rank	Rate (95% UI)	Rank
Pennsylvania	759.6 (739.9-778.7)	595.0 (561.4-629.4)	22	16362.8 (15935.8-16789.4)	25	12619.1 (11865.9-13353.8)	22	12223.0 (9041.3-15663.8)	4	12506.3 (9378.1-15987.4)	4
Rhode Island	701.0 (675.1-726.0)	548.5 (500.7-599.7)	34	14693.5 (14149.1-15250.3)	36	11190.8 (10192.0-12316.8)	40	12149.4 (9011.5-15564.7)	6	12124.4 (9041.0-15542.0)	11
South Carolina	829.3 (799.1-859.1)	676.8 (625.2-739.6)	5	19287.6 (18569.1-19989.3)	4	14846.7 (13657.2-16269.8)	9	12015.1 (8923.8-15458.1)	11	12085.6 (8987.0-15537.6)	14
South Dakota	663.2 (636.1-688.3)	555.4 (510.0-602.8)	46	14810.8 (14208.8-15379.4)	35	12432.3 (11400.0-13504.4)	26	10786.0 (8017.8-13942.2)	50	11106.1 (8289.1-14338.2)	46
Tennessee	807.9 (786.6-830.0)	709.4 (664.7-747.1)	9	18039.2 (17547.9-18571.2)	8	15635.0 (14629.3-16495.9)	8	11910.5 (8870.9-15244.3)	15	12064.7 (8975.6-15485.5)	15
Texas	753.5 (731.3-776.8)	599.4 (561.2-636.5)	25	16787.5 (16275.7-17342.1)	20	12553.2 (11703.8-13359.6)	24	11385.2 (8500.3-14726.4)	38	11633.7 (8651.6-14997.3)	32
Utah	632.8 (615.4-651.7)	555.1 (522.5-587.6)	50	13049.2 (12687.1-13428.1)	50	11192.0 (10486.6-11895.6)	39	11783.7 (8714.8-15138.7)	21	11909.5 (8867.1-15402.9)	19
Vermont	704.8 (681.6-728.4)	539.2 (505.5-577.5)	32	14457.3 (13950.0-14957.0)	39	10792.5 (10081.0-11626.2)	42	11434.0 (8503.5-14647.4)	36	11243.2 (8344.9-14511.7)	45
Virginia	760.3 (742.2-780.7)	572.2 (538.3-607.0)	21	16447.1 (16036.4-16911.3)	22	11683.4 (10979.4-12452.2)	33	11589.6 (8609.5-15005.0)	28	11657.5 (8674.1-15008.9)	27
Washington	682.2 (662.4-701.4)	526.9 (497.1-559.2)	40	14501.1 (14069.7-14941.5)	38	10587.5 (9942.6-11291.9)	45	11462.0 (8489.0-14725.3)	34	11419.6 (8471.8-14708.2)	38
West Virginia	820.0 (795.0-844.6)	750.6 (709.1-799.7)	7	17864.8 (17332.1-18407.8)	9	16969.4 (15984.9-18167.6)	2	12540.2 (9410.5-16014.5)	2	13090.6 (9811.0-16681.6)	1
Wisconsin	683.0 (663.3-703.5)	554.9 (525.5-589.2)	39	14247.1 (13842.1-14679.3)	45	11389.6 (10740.6-12101.9)	36	11261.6 (8330.2-14507.8)	42	11310.4 (8374.7-14641.7)	39
Wyoming	705.4 (677.6-734.0)	589.8 (539.2-645.8)	30	15278.9 (14678.7-15918.9)	31	13089.2 (11911.6-14432.0)	19	11268.4 (8384.2-14546.1)	40	11740.6 (8719.4-15186.0)	23
Washington, DC	1042.7 (1002.8-1079.5)	603.3 (549.7-660.8)	1	29536.9 (28403.2-30634.1)	1	13635.9 (12369.7-15028.7)	15	12230.8 (9121.5-15731.3)	15	11421.1 (8482.8-14709.1)	37

Abbreviations: UI, uncertainty interval; YLD, years lived with disability; YLL, years of life lost due to premature mortality.

declined in all states. The most pronounced declines were in South Carolina, Georgia, Alaska, and New York, at higher than a 0.85-point decrease in probability (Figure 3). In contrast, Maine had the lowest decline of 0.32-point probability. In the United States as a whole, there was a decline of 0.70, which was associated with neonatal disorders, other noncommunicable diseases (including congenital), and a large contribution from injuries, with slight increases from mental and substance use disorders (Figure 3).

The largest reductions in probability of death for ages 20 to 55 years were observed in New York (3.5) and California (2.5) and the highest increases were observed in West Virginia (2.6) and Oklahoma (2.0) (Figure 4). In 21 states, the probability of death has actually increased from 1990 to 2016, but of these, only 5 showed an increase of greater than 10% (Kentucky, Oklahoma, New Mexico, West Virginia, and Wyoming). Conversely, 31 states and Washington, DC have seen decreases in the probability of death among adults aged 20 to 55 years over the same period, but only in 15 states was that decrease more than 10% (New York, California, Illinois, New Jersey, Georgia, Maryland, Florida, Nevada, Texas, Virginia, Connecticut, North Carolina, Massachusetts, Washington, South Carolina). Decreases in the probability of death in US states were influenced by declines in HIV/AIDS across all state groups, as well as declines in road injuries and neoplasms, while increases in probability of death were influenced by increased burden of drug use disorders, alcohol use disorders, and chronic kidney disease, among others (Figure 4).

All states experienced a considerable reduction in probabilities of death for ages 55 to 90 years, largely associated with reductions in the probability of dying from cardiovascular diseases (Figure 5). The highest point decline was observed in California at 12.6 points, compared with lowest decline of 3.5 points for Mississippi. These declines were somewhat offset by increases in the death rates associated with cirrhosis and other liver disease, neurological disorders, and mental and substance use disorders in all states. Hawaii was the only state in which the probability of death was less than 65% for ages 55 to 90 years. Other notable findings include the variation in the decline of probability of death between the 3 age groups, with an 8.3-point decline of probability of death for ages 55 to 90 years, a 1-point decline for ages 20 to 55 years, and a 0.7-point decline for ages 0 to 20 years.

## YLLs Overall, by State, and for Washington, DC

The age-standardized YLL rates for the United States, all states, and Washington, DC in 2016 for the top 20 causes are grouped by 3 levels of significance (Figure 6) indicating significantly below the mean, indistinguishable from the mean, and significantly higher than the mean. The heat map shows a clear pattern of performance ranging from Minnesota to Mississippi, with some clear patterns of exception for some causes. For example, Colorado had a YLL rate from self-harm significantly above the mean (760), while Washington, DC had a YLL rate significantly lower than the mean (306). Mississippi, West Virginia, Alabama, Oklahoma, Kentucky, Tennessee, South Carolina, Indiana, Missouri, and Ohio had YLLs significantly higher than the mean with a few exceptions of causes that were indistinguishable from the mean. Other notable findings were that Louisiana had YLLs for

Figure 3. Change in the Probability of Death Between Birth and Age 20 Years, 1990-2016, Reported Showing Major Causes of Death for the United States Overall and the 50 States
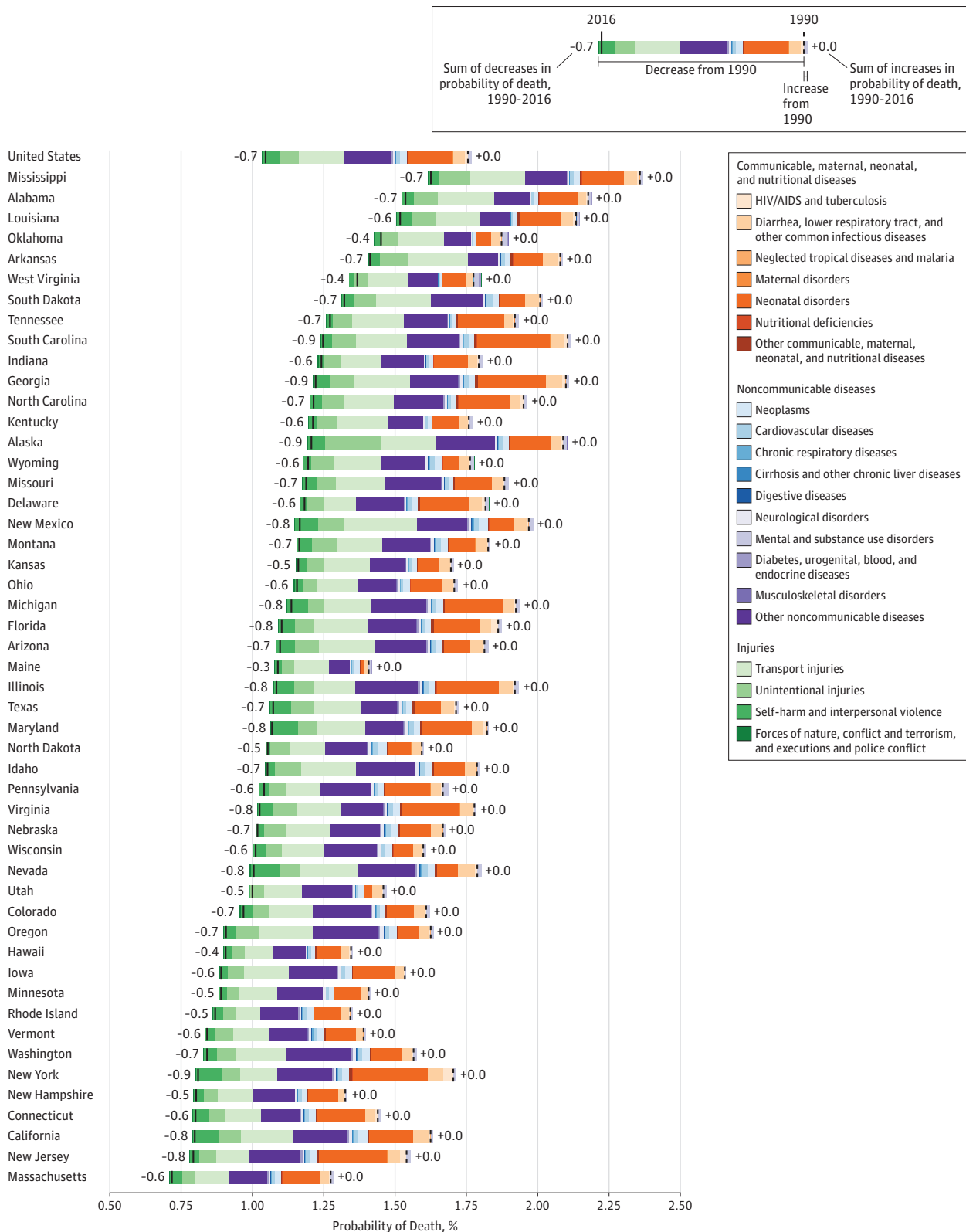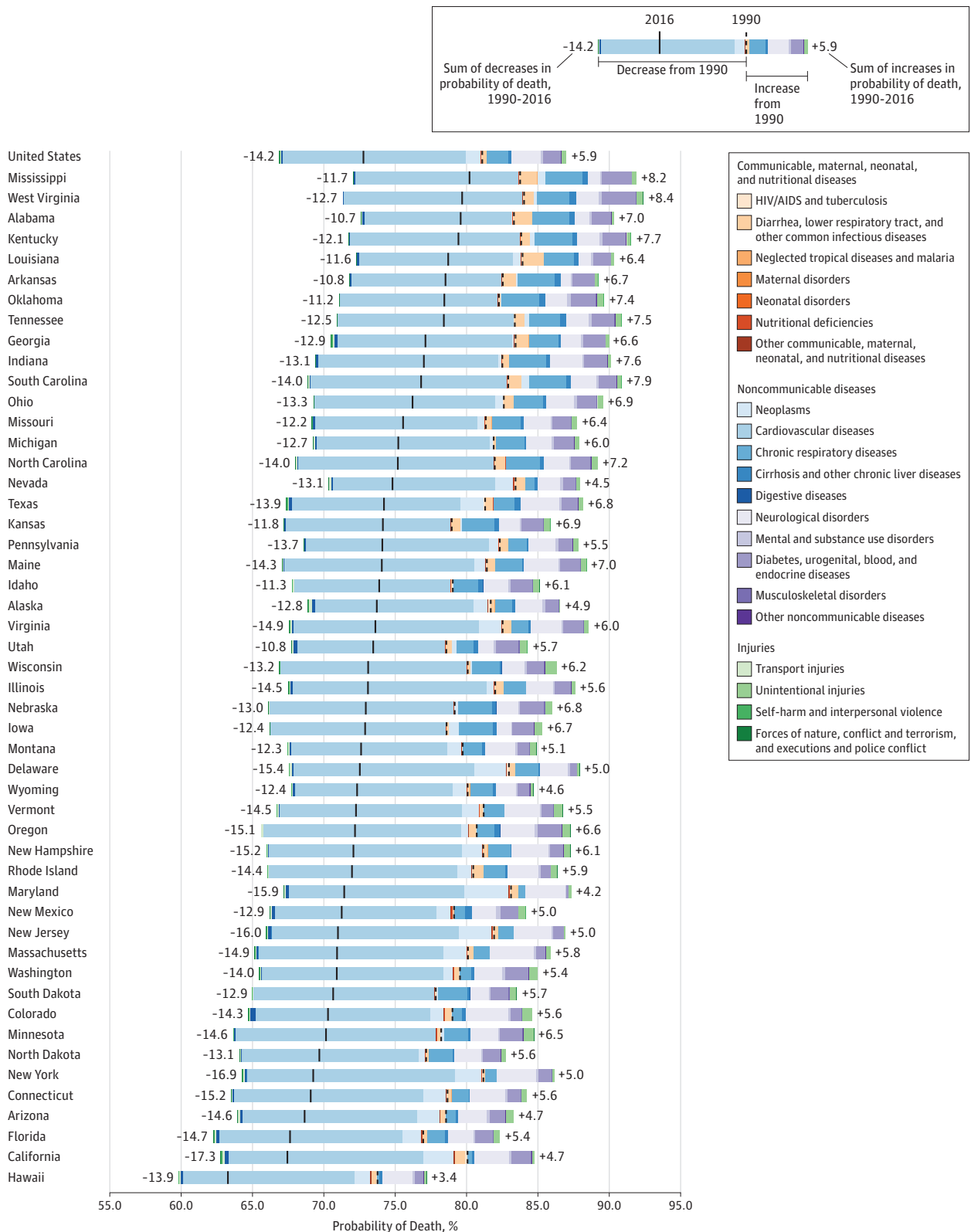

States are listed in descending order according to probability of death in 2016. Data for Washington, DC, were not included in this analysis.

Figure 4. Change in the Probability of Death Between Ages 20 and 55 Years, 1990-2016, Reported Showing Major Causes of Death for the United States Overall and the 50 States
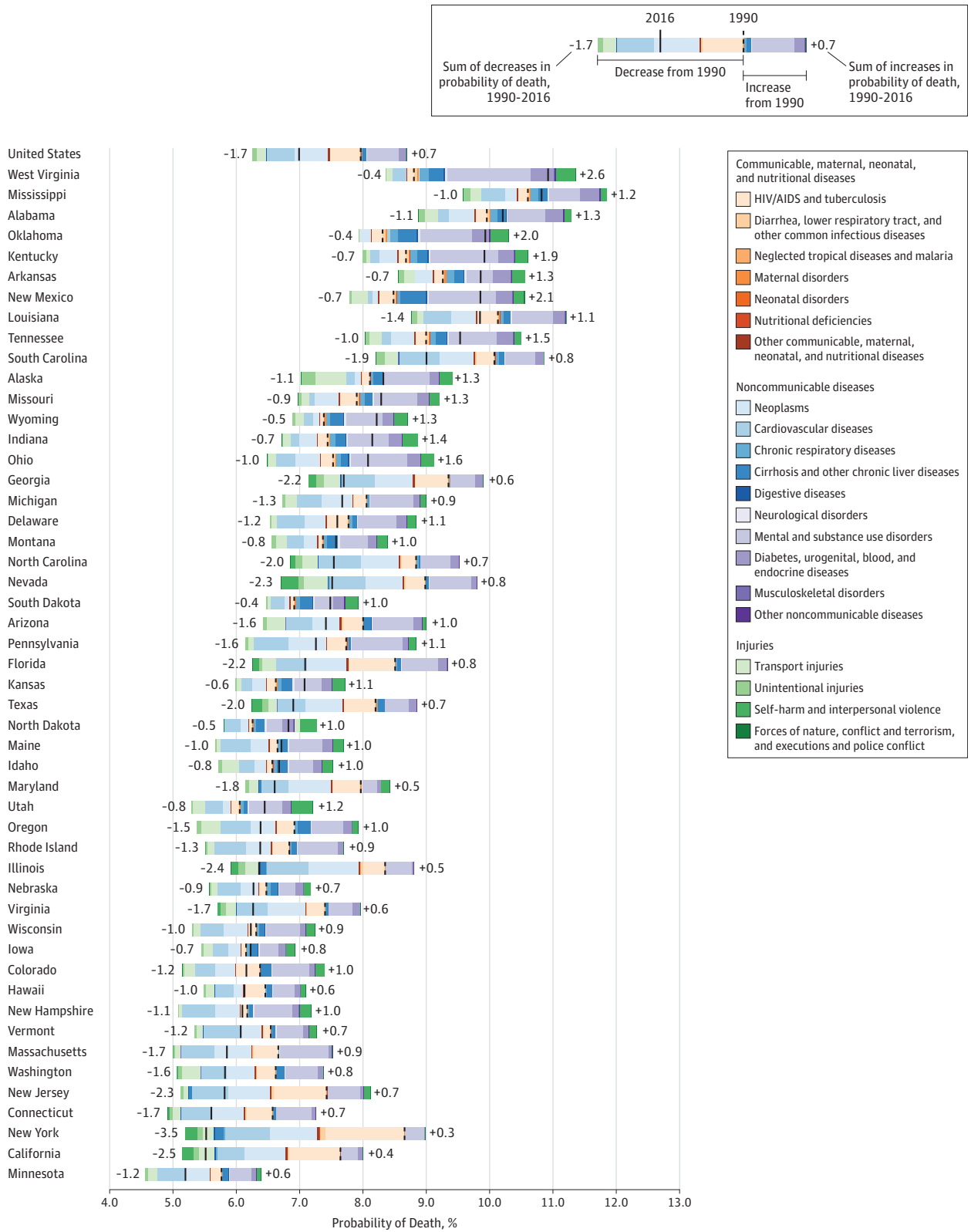
States are listed in descending order according to probability of death in 2016. Data for Washington, DC, were not included in this analysis.

Figure 5. Change in the Probability of Death Between Ages 55 and 90 Years, 1990-2016, Reported Showing Major Causes of Death for the United States Overall and the 50 States

States are listed in descending order according to probability of death in 2016. Data for Washington, DC, were not included in this analysis.

Figure 6. Age-Standardized Rates of Years of Life Lost per 100 000 Persons for the 20 Leading Causes of Years of Life Lost in 2016 for the United States Overall, the 50 States, and the District of Columbia

	Age-standardized rates of years of life lost per 100 000		
	■ Significantly lower than mean US rate	■ Indistinguishable from mean US rate	■ Significantly higher than mean US rate

	Ischemic heart disease	Tracheal, bronchus, and lung cancer	Road injuries	Self-harm	Cerebrovascular disease	Chronic obstructive pulmonary disease	Drug use disorders	Alzheimer disease and other dementias	Colon and rectum cancer	Interpersonal violence	Lower respiratory tract infections	Diabetes	Congenital birth defects	Neonatal preterm birth complications	Chronic kidney disease	Breast cancer	Pancreatic cancer	Cardiomyopathy and myocarditis	Cirrhosis and other chronic liver diseases due to alcohol use	Endocrine, metabolic, blood, and immune disorders
United States	1651	784	602	564	503	501	451	360	323	318	308	299	293	280	270	247	184	161	156	155
Minnesota	1044	693	452	534	421	413	258	349	279	163	203	234	302	198	203	214	177	113	112	124
California	1346	519	450	429	421	365	353	324	281	288	219	238	249	179	213	223	164	155	159	121
Connecticut	1231	671	422	405	349	351	480	365	284	217	255	214	202	267	196	222	183	133	131	124
Hawaii	1261	607	437	563	461	229	289	385	315	180	275	225	249	272	216	194	188	199	134	130
New York	1699	667	344	374	303	331	374	349	287	267	287	241	227	229	201	234	180	123	111	125
Massachusetts	1280	747	344	466	375	374	555	380	294	197	301	201	202	241	222	227	185	116	137	121
Washington	1196	671	422	598	448	467	455	335	274	200	202	271	250	183	172	216	175	134	152	158
New Jersey	1479	659	395	383	388	334	481	326	322	289	288	294	209	235	239	255	185	156	126	157
Colorado	1135	511	529	760	405	532	439	389	264	224	245	204	271	225	180	206	162	113	174	123
Vermont	1251	784	520	647	360	510	346	364	288	185	190	254	291	208	168	215	168	117	118	192
New Hampshire	1273	789	501	644	361	491	473	395	290	169	212	256	247	224	186	230	182	117	126	172
Rhode Island	1555	846	352	491	361	433	514	396	311	187	238	249	254	335	196	238	178	110	148	158
Utah	1225	398	489	979	512	437	410	323	267	176	312	347	316	194	221	236	166	118	138	170
Iowa	1632	825	585	564	468	555	223	306	333	155	269	246	290	170	189	227	179	127	110	152
Oregon	1159	748	485	694	504	534	413	355	294	184	199	307	252	203	187	235	186	115	179	183
Wisconsin	1443	755	561	607	465	447	410	351	292	217	251	239	297	298	236	228	191	145	121	145
Nebraska	1321	794	683	569	494	596	199	344	334	212	257	274	311	216	237	241	184	122	130	162
North Dakota	1473	731	770	638	444	422	161	368	311	183	231	303	369	271	211	216	177	118	128	186
Virginia	1516	788	504	533	521	446	330	395	314	277	352	274	278	331	294	262	185	160	134	140
Idaho	1362	666	696	772	493	591	313	366	280	183	244	291	312	219	205	231	183	117	155	166
Illinois	1654	799	462	457	487	444	437	355	327	377	333	267	285	350	288	250	188	173	124	135
Maryland	1564	718	490	694	461	358	216	398	311	429	337	289	258	403	259	262	188	192	118	167
Florida	1472	775	566	552	434	459	503	332	305	347	221	299	289	282	235	236	174	181	167	161
Maine	1346	922	614	631	436	575	420	375	312	169	258	289	349	301	229	217	185	139	138	197
Arizona	1408	626	677	735	411	502	564	324	283	345	264	307	331	236	224	233	169	138	204	159
South Dakota	1574	765	871	463	507	198	309	326	213	280	297	447	274	205	250	178	121	159	166	
Montana	1373	717	918	879	444	604	328	382	300	222	257	269	335	229	182	227	175	118	172	159
Texas	1741	713	721	529	574	505	346	413	321	321	349	318	313	253	323	239	173	156	191	149
Kansas	1628	860	719	652	532	635	328	351	326	261	322	296	348	291	272	237	189	142	148	162
Pennsylvania	1678	827	558	587	477	460	708	358	348	330	323	304	276	333	276	257	199	172	140	157
Delaware	1604	880	644	453	471	529	328	311	309	288	315	301	468	278	265	185	184	148	214	
Nevada	1721	802	561	759	526	632	599	323	354	332	398	213	275	211	292	250	190	186	212	118
Wyoming	1514	670	923	876	436	702	431	336	310	239	314	269	325	275	192	221	176	127	188	172
Michigan	1995	863	553	634	489	530	589	377	334	394	285	320	302	370	276	259	197	196	140	167
North Carolina	1695	898	732	552	647	583	447	359	323	347	388	328	321	398	334	263	187	178	156	187
Alaska	1443	875	514	915	530	530	519	361	341	328	251	301	266	197	201	224	189	158	183	156
District of Columbia	1984	797	253	306	440	283	428	399	380	625	318	332	204	432	353	320	232	214	190	186
Ohio	1882	966	566	602	561	631	691	393	359	337	338	383	348	364	305	272	199	181	159	204
Georgia	1861	884	726	541	614	588	389	360	373	392	448	335	297	372	377	271	187	191	150	161
Missouri	2072	1003	748	673	560	645	542	389	348	395	346	310	322	314	304	268	195	173	143	158
Indiana	1965	1010	684	697	581	703	502	425	357	353	340	360	355	347	335	265	197	193	151	187
New Mexico	1466	563	950	903	425	543	852	388	334	404	303	417	329	258	273	240	176	136	328	212
South Carolina	1970	965	936	593	640	452	380	363	407	397	361	297	340	367	289	201	205	192	187	
Tennessee	2324	1124	864	685	723	710	603	385	382	412	435	372	367	319	325	277	204	182	186	203
Kentucky	2323	1306	875	710	624	851	812	438	428	313	435	383	365	254	367	269	203	163	182	187
Arkansas	2492	1169	1020	788	768	758	330	338	401	434	473	408	373	268	373	285	205	173	177	172
Oklahoma	2569	1059	973	791	677	829	611	385	395	401	403	418	333	325	279	196	170	219	179	
Louisiana	2327	1055	931	636	592	551	312	438	624	488	446	375	429	489	302	230	220	185	204	
Alabama	2326	1143	1086	690	847	774	495	366	418	515	498	438	393	438	414	305	221	192	201	180
West Virginia	2317	1215	946	781	636	860	982	393	434	341	415	526	391	301	397	293	193	178	212	273
Mississippi	2664	1210	1242	638	850	736	399	344	452	552	517	452	416	418	499	323	232	216	190	181

Boxes are colored green if significantly less than the US rate (P<.05), red if significantly more than the US rate (P<.05), and yellow if not significantly different from the US rate (P≥.05).

all causes higher than that of the US mean except for Alzheimer diseases and other dementias that was significantly higher than the mean, while Georgia had only 1 cause, drug use disorder, that was significantly above the US mean.

Observed to Expected YLLs Overall, by State, and for Washington, DC

The ratio of observed YLLs to those expected, based on the SDI for the 10 leading causes of YLLs for the United States overall, each individual state, and Washington, DC, are shown in **Figure 7**. For example, in Alabama, the stroke ratio was 1, indicating that the observed rates are similar to what would be expected given the state's SDI, whereas diabetes is observed at 2.85 times more than expected. For the United States overall, the ratios of observed YLLs to those expected were 0.75 for IHD, 1.11 for lung cancer, 1.88 for chronic obstructive pulmonary disease, 0.61 for stroke, 1.19 for road injury, 1.14 for Alzheimer disease, 0.98 for self-harm, 7.17 for drugs, 0.84 for colorectal cancer, and 1.27 for lower respiratory tract infection. In general, most states performed better on IHD and stroke but worse for chronic obstructive pulmonary disease and drug use disorders. Colorado had the best performance for IHD at 0.58 observed to expected ratio of YLLs, while West Virginia had the highest observed to expected ratio of YLLs for drug use disorders at 14.38. Other notable findings are the high rates in Washington, DC for interpersonal violence, drug use disorders, HIV/AIDS, and chronic kidney disease, given that Washington, DC has the highest SDI rank in the US and in the world.

Observed to Expected YLDs by State and for Washington, DC

The ratio of the YLDs observed to those expected based on SDI for the 10 leading causes of YLDs for the United States overall, the 50 states, and Washington, DC are shown in **Figure 8**. Minnesota had lower observed YLDs from low back and neck pain (0.63 ratio) and migraine (0.79), but higher YLD rates from drug use disorders (2.32). Most states had lower than expected YLDs from low back and neck pain but higher rates for drug use disorders and other musculoskeletal disorders. A notable finding is the higher than expected rates of YLDs from depression, anxiety, and skin diseases, and lower than expected rates from falls in most states.

Observed to Expected DALYs by State and for Washington, DC

The ratio of DALYs observed to those expected based on SDI for the 10 leading causes of DALYs for the United States overall, the 50 states, and Washington, DC are shown in **Figure 9**. All states had lower than expected DALY rates from IHD except for Alabama, Arkansas, Kentucky, Mississippi, Oklahoma, Tennessee, and West Virginia. The highest observed rates of DALYs compared with expected from drug use disorders were in West Virginia at 7.77 and in Kentucky at 7.31. Other notable findings are the higher than expected rates of drug use disorders and interpersonal violence in Washington, DC, and the lower than expected rates of lung cancer in California.

Changes in Age-Standardized Summary Exposure Values

The age-standardized percent changes in summary exposure values for the top 10 risk factors from 1990 to 2016 are shown in **Table 7**. High fasting plasma glucose increased by 76% and high body mass index by 53.2%, while smoking declined by 42.8% during the same time period in the United States. There were clear patterns in these variations by states. High fasting plasma glucose increased in all states; the increase ranged from 127.2% in Mississippi to 1.7% in Pennsylvania. Drug use increased in all states except Arkansas, Maryland, and Oregon. Other notable findings include reductions in high systolic blood pressure, high total cholesterol levels, and diet low in whole grains in all states.

Leading Risk Factors for DALYs by State and for Washington, DC

The rank of risk factors by state in 2016 are shown in **Figure 10**. Tobacco smoking was the leading risk factor for DALYs in the United States and in 33 states. Alcohol and drug use were the leading risk for DALYs for 7 states and Washington, DC, while high BMI was the leading cause for 10 states (California, Connecticut, Hawaii, Illinois, Maryland, New Jersey, New York, North Dakota, Texas, and Virginia). Another notable finding is that diet was the third leading cause of DALYs in the United States overall but the second in 20 states.

Discussion

This study provides a comprehensive report on the burden of disease and its patterns in the United States and the individual 50 states from 1990 to 2016 and reveals wide disparities in burden of disease at the state level. Moreover, these findings show distinct trends in different age bands and demonstrate that improvement in some health outcomes, such as IHD, lung cancer, and neonatal preterm complications, are balanced by rising death rates from drug use disorders, chronic obstructive pulmonary disease, self-harm, chronic kidney disease, cirrhosis, and hypertensive heart disease. Summary measures, such as life expectancy, that do not differentiate the trends in different age groups mask the heterogeneous directions for US health status by age and state. Above and beyond the drivers of divergent trends, the study reveals that there has been far greater progress in reducing the burden of some major causes of YLLs, such as IHD and lung cancer, but no progress in addressing some of the leading causes of YLDs such as mental health disorders and musculoskeletal disorders. These findings should be used to examine the causes of health variations and to plan, develop, and implement programs and policies to improve health overall and eliminate disparities in the United States.

Mortality reversals in 21 states for adults ages 20 to 55 years are strongly linked to the burden of substance use disorders, cirrhosis, and self-harm, and this study shows that the trends for some of these conditions differ considerably across different states. Case and Deaton have called some of these conditions "deaths of despair" and argued that they are linked to the social and economic status of white US adults.[3] A wide range of interventions have been proposed to address substance abuse, cirrhosis, and self-harm. For substance abuse,[28,47-49] prevention programs should account for the root causes of substance use, the socioeconomic factors involved, and causes of relapses during treatment.[50,51] Physicians have a major role to play in addiction control by counseling their patients who are on medication for pain control.[52-54] For cirrhosis, intervention strategies to treat hepatitis C and decrease excessive alcohol consumption are important. For self-harm, the most promising approaches relate to decreasing the case-fatality rate from suicide attempts by restricting access to lethal means; in the United States, a large share of suicides are due to firearms.[55,56] While multiple strategies are available for dealing with these problems, they have not until very

Figure 7. Ratio of Observed Years of Life Lost (YLLs) to Expected YLLs Based on the Sodiodemographic Index (SDI) for the United States Overall, the 50 States, and the District of Columbia in 2016 for the 10 Leading Causes in Each Jurisdiction

	1	2	3	4	5	6	7	8	9	10
United States	IHD (0.75)	Lung cancer (1.11)	COPD (1.88)	Stroke (0.61)	Road injury (1.19)	Alzheimer (1.14)	Self-harm (0.98)	Drugs (7.17)	Colorectal cancer (0.84)	LRI (1.27)
Alabama	IHD (1.05)	Lung cancer (1.71)	Stroke (1.0)	COPD (2.9)	Road injury (1.97)	Self-harm (1.16)	LRI (1.98)	Diabetes (2.85)	Colorectal cancer (1.13)	Alzheimer (1.17)
Alaska	IHD (0.5)	Lung cancer (1.0)	Self-harm (1.62)	COPD (1.42)	Drugs (8.52)	Stroke (0.46)	Road injury (1.04)	Alcohol (6.59)	Colorectal cancer (0.72)	Diabetes (1.64)
Arizona	IHD (0.65)	Lung cancer (0.95)	COPD (1.9)	Self-harm (1.21)	Road injury (1.22)	Stroke (0.5)	Drugs (8.59)	Alzheimer (1.12)	Diabetes (1.95)	Colorectal cancer (0.77)
Arkansas	IHD (1.12)	Lung cancer (1.76)	COPD (2.76)	Stroke (0.9)	Road injury (1.77)	Self-harm (1.28)	LRI (1.82)	Alzheimer (1.15)	Colorectal cancer (1.1)	Diabetes (2.54)
California	IHD (0.58)	Lung cancer (0.67)	Stroke (0.47)	COPD (1.26)	Alzheimer (0.93)	Self-harm (0.77)	Road injury (0.92)	Drugs (6.0)	Colorectal cancer (0.68)	Diabetes (1.52)
Colorado	IHD (0.58)	Self-harm (1.39)	COPD (1.9)	Lung cancer (0.66)	Road injury (1.14)	Alzheimer (1.01)	Stroke (0.46)	Drugs (7.28)	Colorectal cancer (0.63)	LRI (0.97)
Connecticut	IHD (0.64)	Lung cancer (0.98)	Alzheimer (1.3)	COPD (1.57)	Stroke (0.5)	Drugs (7.54)	Colorectal cancer (0.76)	Self-harm (0.76)	Road injury (0.94)	LRI (1.29)
Delaware	IHD (0.8)	Lung cancer (1.34)	COPD (2.02)	Stroke (0.61)	Road injury (1.29)	Self-harm (1.01)	Alzheimer (1.1)	Drugs (8.12)	Colorectal cancer (0.86)	Diabetes (2.36)
District of Columbia	IHD (0.75)	Lung cancer (0.84)	Violence (8.19)	Alzheimer (0.93)	Stroke (0.46)	Drugs (7.72)	HTN HD (3.6)	Colorectal cancer (0.76)	HIV (27.64)	CKD (2.69)
Florida	IHD (0.8)	Lung cancer (1.28)	COPD (2.11)	Stroke (0.62)	Alzheimer (1.39)	Road injury (1.3)	Self-harm (0.99)	Drugs (7.69)	Colorectal cancer (0.9)	Diabetes (2.3)
Georgia	IHD (0.75)	Lung cancer (1.16)	Stroke (0.75)	COPD (1.98)	Road injury (1.4)	Self-harm (0.94)	LRI (1.61)	Colorectal cancer (0.9)	CKD (2.77)	Alzheimer (0.9)
Hawaii	IHD (0.6)	Lung cancer (0.88)	Alzheimer (1.47)	Stroke (0.6)	Self-harm (0.98)	Colorectal cancer (0.84)	Road injury (0.86)	LRI (1.21)	COPD (0.94)	CKD (1.93)
Idaho	IHD (0.59)	Lung cancer (0.97)	COPD (2.01)	Self-harm (1.23)	Stroke (0.55)	Road injury (1.19)	Alzheimer (1.14)	Diabetes (1.73)	Colorectal cancer (0.75)	LRI (0.88)
Illinois	IHD (0.75)	Lung cancer (1.09)	Stroke (0.59)	COPD (1.68)	Alzheimer (1.09)	Self-harm (0.81)	Road injury (0.95)	Colorectal cancer (0.83)	LRI (1.41)	Drugs (6.97)
Indiana	IHD (0.87)	Lung cancer (1.44)	COPD (2.5)	Stroke (0.67)	Self-harm (1.15)	Alzheimer (1.34)	Road injury (1.25)	Drugs (7.61)	Colorectal cancer (0.94)	Diabetes (2.29)
Iowa	IHD (0.79)	Lung cancer (1.21)	COPD (2.2)	Stroke (0.62)	Alzheimer (1.16)	Road injury (1.13)	Self-harm (0.94)	Colorectal cancer (0.91)	LRI (1.19)	Diabetes (1.73)
Kansas	IHD (0.73)	Lung cancer (1.18)	COPD (2.31)	Stroke (0.65)	Road injury (1.39)	Self-harm (1.1)	Alzheimer (1.18)	Colorectal cancer (0.83)	LRI (1.33)	Diabetes (1.93)
Kentucky	IHD (1.04)	Lung cancer (1.97)	COPD (3.04)	Stroke (0.72)	Road injury (1.54)	Drugs (12.44)	Self-harm (1.18)	Alzheimer (1.39)	Colorectal cancer (1.18)	LRI (1.65)
Louisiana	IHD (0.98)	Lung cancer (1.46)	Stroke (0.84)	Road injury (1.73)	COPD (2.03)	Self-harm (1.07)	CKD (3.73)	LRI (1.81)	Violence (5.13)	Colorectal cancer (1.12)
Maine	IHD (0.75)	Lung cancer (1.59)	COPD (2.75)	Stroke (0.66)	Alzheimer (1.48)	Self-harm (1.07)	Road injury (1.15)	Colorectal cancer (0.98)	Diabetes (2.39)	LRI (1.3)
Maryland	IHD (0.72)	Lung cancer (0.98)	Self-harm (1.26)	Stroke (0.57)	Alzheimer (1.16)	COPD (1.39)	Road injury (1.05)	LRI (1.46)	Colorectal cancer (0.78)	Violence (4.2)
Massachusetts	IHD (0.64)	Lung cancer (1.05)	Alzheimer (1.27)	Stroke (0.52)	COPD (1.64)	Drugs (9.07)	Self-harm (0.89)	LRI (1.53)	Colorectal cancer (0.76)	Road injury (0.82)
Michigan	IHD (0.96)	Lung cancer (1.31)	COPD (2.1)	Stroke (0.62)	Alzheimer (1.28)	Self-harm (1.06)	Drugs (8.98)	Road injury (1.06)	Colorectal cancer (0.92)	Diabetes (2.25)
Minnesota	IHD (0.49)	Lung cancer (0.97)	Stroke (0.54)	COPD (1.62)	Alzheimer (1.14)	Self-harm (0.93)	Road injury (0.93)	Colorectal cancer (0.72)	Diabetes (1.67)	CKD (1.83)
Mississippi	IHD (1.14)	Lung cancer (1.75)	Road injury (2.19)	Stroke (0.94)	COPD (2.54)	LRI (1.89)	CKD (3.79)	Self-harm (1.05)	Colorectal cancer (1.19)	Diabetes (2.75)
Missouri	IHD (0.97)	Lung cancer (1.47)	COPD (2.49)	Stroke (0.7)	Road injury (1.43)	Self-harm (1.14)	Alzheimer (1.32)	Drugs (8.28)	Colorectal cancer (0.93)	LRI (1.44)
Montana	IHD (0.69)	Lung cancer (1.14)	COPD (2.53)	Self-harm (1.46)	Road injury (1.71)	Stroke (0.6)	Alzheimer (1.38)	Colorectal cancer (0.86)	Diabetes (1.94)	LRI (1.12)
Nebraska	IHD (0.6)	Lung cancer (1.1)	COPD (2.15)	Stroke (0.6)	Road injury (1.28)	Alzheimer (1.16)	Self-harm (0.94)	Colorectal cancer (0.86)	Diabetes (1.77)	LRI (1.04)
Nevada	IHD (0.75)	Lung cancer (1.16)	COPD (2.22)	Self-harm (1.33)	Stroke (0.59)	Drugs (9.7)	Road injury (1.04)	LRI (1.49)	Colorectal cancer (0.93)	Alzheimer (0.89)
New Hampshire	IHD (0.68)	Lung cancer (1.23)	COPD (2.29)	Alzheimer (1.36)	Self-harm (1.17)	Stroke (0.52)	Road injury (1.1)	Colorectal cancer (0.82)	Drug (7.22)	Diabetes (2.15)
New Jersey	IHD (0.72)	Lung cancer (0.93)	Stroke (0.51)	Alzheimer (1.07)	COPD (1.37)	Drugs (7.52)	Colorectal cancer (0.84)	Diabetes (2.21)	LRI (1.32)	Self-harm (0.69)
New Mexico	IHD (0.68)	Road injury (1.69)	Self-harm (1.46)	Lung cancer (0.85)	Drugs (12.78)	COPD (2.03)	Alzheimer (1.3)	Stroke (0.51)	Diabetes (2.65)	Colorectal cancer (0.91)
New York	IHD (0.82)	Lung cancer (0.92)	Alzheimer (1.12)	COPD (1.34)	Stroke (0.38)	Colorectal cancer (0.73)	Drugs (6.23)	Self-harm (0.69)	LRI (1.29)	Road injury (0.76)
North Carolina	IHD (0.76)	Lung cancer (1.32)	Stroke (0.76)	COPD (2.12)	Road injury (1.35)	Self-harm (0.94)	Alzheimer (1.12)	LRI (1.52)	CKD (2.71)	Drugs (6.97)
North Dakota	IHD (0.64)	Lung cancer (0.94)	Road injury (1.55)	Self-harm (1.11)	Alzheimer (1.25)	Stroke (0.52)	COPD (1.47)	Colorectal cancer (0.75)	Diabetes (1.87)	Congenital (1.5)
Ohio	IHD (0.9)	Lung cancer (1.44)	COPD (2.47)	Stroke (0.71)	Alzheimer (1.35)	Drugs (10.5)	Self-harm (1.01)	Road injury (1.08)	Diabetes (2.66)	Colorectal cancer (0.98)
Oklahoma	IHD (1.1)	Lung cancer (1.48)	COPD (2.9)	Road injury (1.8)	Stroke (0.76)	Self-harm (1.31)	Alzheimer (1.29)	Drugs (9.48)	Diabetes (2.5)	LRI (1.5)
Oregon	IHD (0.57)	Lung cancer (1.14)	COPD (2.21)	Stroke (0.67)	Self-harm (1.23)	Alzheimer (1.2)	Road injury (0.99)	Diabetes (2.27)	Colorectal cancer (0.81)	Drugs (6.59)
Pennsylvania	IHD (0.87)	Lung cancer (1.27)	Stroke (0.67)	COPD (2.02)	Alzheimer (1.36)	Drugs (10.76)	Self-harm (1.03)	Road injury (1.13)	Colorectal cancer (0.98)	LRI (1.54)
Rhode Island	IHD (0.8)	Lung cancer (1.23)	Alzheimer (1.45)	COPD (1.87)	Stroke (0.5)	Drugs (8.34)	Self-harm (0.91)	Colorectal cancer (0.84)	Diabetes (1.93)	LRI (1.17)
South Carolina	IHD (0.9)	Lung cancer (1.48)	Stroke (0.92)	COPD (2.45)	Road injury (1.71)	Self-harm (1.0)	Alzheimer (1.2)	LRI (1.61)	CKD (3.07)	Colorectal cancer (1.01)
South Dakota	IHD (0.73)	Lung cancer (1.12)	Road injury (1.52)	COPD (1.89)	Stroke (0.57)	Self-harm (1.07)	Alzheimer (1.17)	Colorectal cancer (0.88)	Diabetes (1.88)	LRI (1.1)
Tennessee	IHD (1.04)	Lung cancer (1.66)	COPD (2.6)	Stroke (0.85)	Road injury (1.6)	Self-harm (1.16)	Drugs (9.48)	Alzheimer (1.2)	LRI (1.7)	Colorectal cancer (1.03)
Texas	IHD (0.65)	Lung cancer (0.87)	Road injury (1.34)	Stroke (0.56)	COPD (1.47)	Self-harm (0.89)	Alzheimer (1.01)	LRI (1.15)	Colorectal cancer (0.74)	CKD (2.18)
Utah	IHD (0.4)	Self-harm (1.58)	Stroke (0.43)	Road injury (0.87)	COPD (1.08)	Lung cancer (0.43)	Drugs (6.29)	Diabetes (1.62)	Alzheimer (0.71)	LRI (0.89)
Vermont	IHD (0.68)	Lung cancer (1.26)	COPD (2.4)	Alzheimer (1.32)	Self-harm (1.15)	Stroke (0.54)	Road injury (1.09)	Colorectal cancer (0.84)	Diabetes (2.09)	Drugs (5.22)
Virginia	IHD (0.68)	Lung cancer (1.07)	Stroke (0.63)	COPD (1.69)	Alzheimer (1.11)	Self-harm (0.98)	Road injury (1.08)	LRI (1.5)	Colorectal cancer (0.79)	CKD (2.52)
Washington	IHD (0.55)	Lung cancer (0.93)	COPD (1.77)	Stroke (0.55)	Self-harm (1.08)	Alzheimer (0.99)	Drugs (7.52)	Road injury (0.89)	Colorectal cancer (0.7)	Diabetes (1.91)
West Virginia	IHD (1.16)	Lung cancer (2.05)	COPD (3.53)	Stroke (0.83)	Drugs (14.38)	Road injury (1.6)	Diabetes (3.67)	Self-harm (1.26)	Alzheimer (1.49)	Colorectal cancer (1.33)
Wisconsin	IHD (0.7)	Lung cancer (1.12)	Stroke (0.61)	COPD (1.79)	Alzheimer (1.22)	Self-harm (1.03)	Road injury (1.09)	Colorectal cancer (0.8)	Drugs (6.27)	LRI (1.1)
Wyoming	IHD (0.67)	COPD (2.6)	Lung cancer (0.93)	Road injury (1.84)	Self-harm (1.5)	Stroke (0.51)	Alzheimer (0.97)	Drugs (6.69)	Colorectal cancer (0.79)	LRI (1.26)

Ratio of observed to expected YLLs

(0.0-0.66)	
(0.67-0.83)	
(0.84-0.95)	
(0.96-1.10)	
(1.11-1.22)	
(1.23-1.44)	
(1.45-1.81)	
(1.82-2.56)	
>2.56	

Ratio details: Alabama's, stroke ratio (eg, 1.0 [observed and expected rates were similar]; diabetes [2.85 × above expected]). See Appendix Table 2 in Supplement 2 for explanation of terms.

Figure 8. Ratio of Observed Years Lived With Disability (YLDs) to Expected YLDs Based on the Sociodemographic Index (SDI) for the United States Overall, the 50 States, and the District of Columbia in 2016 for the 10 Leading Causes in Each Jurisdiction

	1	2	3	4	5	6	7	8	9	10
United States	Back and neck (0.86)	Skin (1.19)	Depression (1.29)	Sense organ (0.85)	Drugs (3.49)	Diabetes (1.52)	Other MSK (2.37)	Migraine (0.85)	Anxiety (1.25)	Falls (0.85)
Alabama	Back and neck (1.09)	Skin (1.07)	Depression (1.29)	Diabetes (1.9)	Sense organ (0.88)	Drugs (3.37)	Other MSK (2.39)	Migraine (0.89)	Anxiety (1.27)	COPD (3.72)
Alaska	Back and neck (0.86)	Depression (1.36)	Skin (1.03)	Drugs (3.43)	Other MSK (2.1)	Sense organ (0.65)	Migraine (0.76)	Anxiety (1.24)	Diabetes (1.16)	Falls (0.79)
Arizona	Back and neck (0.99)	Skin (1.2)	Depression (1.44)	Drugs (4.39)	Sense organ (0.9)	Migraine (0.92)	Other MSK (2.42)	Diabetes (1.51)	Anxiety (1.25)	Falls (0.94)
Arkansas	Back and neck (0.84)	Depression (1.47)	Skin (0.99)	Sense organ (0.88)	Drugs (3.53)	Diabetes (1.6)	Migraine (0.83)	Anxiety (1.26)	Other MSK (1.97)	Falls (0.94)
California	Back and neck (0.74)	Skin (1.25)	Depression (1.23)	Sense organ (0.78)	Migraine (0.85)	Drugs (2.97)	Other MSK (2.19)	Diabetes (1.24)	Anxiety (1.2)	Falls (0.77)
Colorado	Back and neck (0.8)	Depression (1.48)	Skin (1.1)	Drugs (3.38)	Sense organ (0.79)	Other MSK (2.45)	Migraine (0.88)	Anxiety (1.28)	Falls (0.9)	Diabetes (0.87)
Connecticut	Back and neck (0.85)	Skin (1.34)	Drugs (4.23)	Sense organ (0.89)	Depression (1.17)	Diabetes (1.52)	Other MSK (2.42)	Migraine (0.87)	Anxiety (1.28)	Falls (0.86)
Delaware	Back and neck (0.88)	Skin (1.11)	Drugs (4.36)	Depression (1.32)	Diabetes (1.92)	Sense organ (0.89)	Other MSK (2.42)	Migraine (0.87)	Anxiety (1.27)	Falls (0.85)
District of Columbia	Skin (1.43)	Back and neck (0.57)	Violence (4.39)	Depression (1.16)	Other MSK (2.24)	Sense organ (0.69)	Migraine (0.8)	Anxiety (1.32)	Diabetes (0.94)	Falls (0.71)
Florida	Back and neck (1.03)	Skin (1.22)	Sense organ (1.01)	Depression (1.27)	Diabetes (1.83)	Drugs (3.48)	Migraine (0.84)	Other MSK (2.25)	Anxiety (1.27)	Falls (0.97)
Georgia	Back and neck (0.86)	Skin (1.23)	Depression (1.21)	Diabetes (1.6)	Sense organ (0.77)	Drugs (3.07)	Migraine (0.87)	Other MSK (2.24)	Anxiety (1.28)	Falls (0.81)
Hawaii	Back and neck (0.73)	Skin (1.28)	Depression (1.29)	Sense organ (0.91)	Diabetes (1.52)	Migraine (0.81)	Anxiety (1.25)	Other MSK (1.98)	Drugs (2.5)	Falls (0.86)
Idaho	Back and neck (0.87)	Depression (1.45)	Skin (1.08)	Sense organ (0.85)	Drugs (3.27)	Other MSK (2.39)	Migraine (0.82)	Diabetes (1.32)	Anxiety (1.24)	Falls (0.97)
Illinois	Back and neck (0.85)	Skin (1.11)	Depression (1.16)	Sense organ (0.82)	Drugs (3.24)	Other MSK (2.4)	Diabetes (1.31)	Migraine (0.79)	Anxiety (1.28)	Falls (0.77)
Indiana	Back and neck (0.96)	Skin (1.1)	Depression (1.39)	Drugs (3.51)	Diabetes (1.67)	Sense organ (0.84)	Other MSK (2.42)	Migraine (0.89)	Anxiety (1.26)	COPD (3.86)
Iowa	Back and neck (0.93)	Skin (1.07)	Depression (1.23)	Sense organ (0.9)	Other MSK (2.54)	Diabetes (1.36)	Migraine (0.8)	Anxiety (1.26)	Falls (0.94)	Drugs (1.98)
Kansas	Back and neck (0.85)	Skin (1.07)	Depression (1.32)	Sense organ (0.83)	Other MSK (2.32)	Diabetes (1.44)	Migraine (0.78)	Anxiety (1.25)	Drugs (2.4)	Falls (0.86)
Kentucky	Back and neck (1.08)	Drugs (5.69)	Skin (1.13)	Depression (1.39)	Diabetes (1.81)	Sense organ (0.88)	Other MSK (2.45)	Migraine (0.91)	COPD (4.73)	Anxiety (1.26)
Louisiana	Back and neck (0.97)	Skin (1.18)	Drugs (4.33)	Depression (1.23)	Diabetes (1.64)	Sense organ (0.81)	Other MSK (2.22)	Migraine (0.81)	Anxiety (1.26)	Falls (0.76)
Maine	Back and neck (0.83)	Depression (1.41)	Sense organ (1.02)	Skin (1.01)	Other MSK (2.83)	Diabetes (1.6)	Drugs (3.28)	Migraine (0.81)	Anxiety (1.28)	Falls (1.02)
Maryland	Back and neck (0.83)	Skin (1.26)	Depression (1.32)	Sense organ (0.81)	Diabetes (1.55)	Other MSK (2.42)	Migraine (0.86)	Drugs (2.97)	Anxiety (1.28)	Falls (0.75)
Massachusetts	Back and neck (0.72)	Skin (1.29)	Drugs (4.56)	Depression (1.28)	Sense organ (0.86)	Other MSK (2.55)	Migraine (0.88)	Diabetes (1.27)	Anxiety (1.29)	Falls (0.81)
Michigan	Back and neck (0.77)	Skin (1.18)	Depression (1.33)	Diabetes (1.78)	Sense organ (0.88)	Drugs (3.55)	Other MSK (2.64)	Migraine (0.83)	Anxiety (1.27)	COPD (3.85)
Minnesota	Back and neck (0.63)	Skin (1.08)	Depression (1.27)	Sense organ (0.83)	Other MSK (2.24)	Migraine (0.79)	Anxiety (1.27)	Diabetes (1.21)	Falls (0.93)	Drugs (2.32)
Mississippi	Back and neck (0.8)	Skin (0.98)	Depression (1.25)	Diabetes (1.77)	Sense organ (0.85)	Drugs (3.05)	Migraine (0.8)	Anxiety (1.28)	Other MSK (1.9)	Falls (0.92)
Missouri	Back and neck (0.88)	Skin (1.08)	Depression (1.37)	Sense organ (0.89)	Diabetes (1.63)	Other MSK (2.44)	Drugs (3.07)	Migraine (0.85)	Anxiety (1.26)	Falls (0.93)
Montana	Back and neck (0.88)	Depression (1.46)	Skin (1.03)	Sense organ (0.94)	Other MSK (2.48)	Migraine (0.79)	Drugs (2.63)	Anxiety (1.25)	Falls (1.07)	Diabetes (1.23)
Nebraska	Back and neck (0.86)	Skin (1.07)	Depression (1.21)	Sense organ (0.83)	Other MSK (2.21)	Diabetes (1.38)	Migraine (0.75)	Anxiety (1.25)	Falls (0.91)	Drugs 1.88)
Nevada	Back and neck (0.99)	Depression (1.44)	Skin (1.08)	Drugs (4.13)	Sense organ (0.84)	Diabetes (1.55)	Migraine (0.86)	Other MSK (2.17)	Anxiety (1.27)	COPD (3.45)
New Hampshire	Back and neck (0.84)	Drugs (4.57)	Depression (1.44)	Skin (1.08)	Sense organ (0.91)	Other MSK (2.6)	Diabetes (1.43)	Migraine (0.86)	Anxiety (1.29)	Falls (0.95)
New Jersey	Back and neck (0.84)	Skin (1.3)	Sense organ (0.87)	Drugs (3.55)	Depression (1.1)	Diabetes (1.58)	Other MSK (2.42)	Migraine (0.77)	Anxiety (1.28)	Falls (0.74)
New Mexico	Back and neck (0.92)	Depression (1.47)	Drugs (4.35)	Skin (1.06)	Sense organ (0.92)	Diabetes (1.62)	Other MSK (2.44)	Migraine (0.9)	Falls (1.12)	Anxiety (1.25)
New York	Back and neck (0.87)	Skin (1.4)	Depression (1.47)	Diabetes (1.72)	Drugs (3.69)	Sense organ (0.87)	Other MSK (2.64)	Migraine (0.86)	Anxiety (1.28)	COPD (3.47)
North Carolina	Back and neck (0.79)	Skin (1.13)	Depression (1.18)	Sense organ (0.85)	Diabetes (1.65)	Drugs (3.33)	Other MSK (2.28)	Migraine (0.86)	Anxiety (1.08)	Falls (0.9)
North Dakota	Back and neck (0.75)	Skin (1.02)	Other MSK (3.07)	Depression (1.2)	Sense organ (0.8)	Migraine (0.81)	Diabetes (1.29)	Anxiety (1.24)	Drugs (2.33)	Falls (0.9)
Ohio	Back and neck (0.92)	Skin (1.14)	Drugs (4.41)	Depression (1.32)	Diabetes (1.75)	Sense organ (0.89)	Other MSK (2.44)	Migraine (0.9)	Anxiety (1.26)	COPD (4.1)
Oklahoma	Back and neck (1.0)	Skin (1.12)	Depression (1.39)	Drugs (4.35)	Sense organ (0.84)	Diabetes (1.58)	Other MSK (2.38)	Migraine (0.87)	Anxiety (1.25)	Falls (0.96)
Oregon	Back and neck (0.81)	Skin (1.21)	Drugs (4.38)	Depression (1.37)	Sense organ (0.89)	Other MSK (2.61)	Migraine (0.93)	Diabetes (1.3)	Falls (0.88)	Anxiety (1.01)
Pennsylvania	Back and neck (1.01)	Skin (1.18)	Drugs (4.47)	Depression (1.26)	Sense organ (0.93)	Diabetes (1.66)	Other MSK (2.63)	Migraine (0.91)	Anxiety (1.26)	Falls (0.95)
Rhode Island	Back and neck (0.77)	Drugs (5.45)	Skin (1.22)	Depression (1.4)	Sense organ (0.93)	Diabetes (1.52)	Migraine (0.92)	Other MSK (2.35)	Anxiety (1.29)	Falls (0.96)
South Carolina	Back and neck (0.94)	Skin (1.21)	Depression (1.31)	Drugs (3.87)	Diabetes (1.85)	Sense organ (0.89)	Other MSK (2.4)	Migraine (0.87)	Anxiety (1.27)	Falls (0.9)
South Dakota	Back and neck (0.86)	Skin (1.07)	Sense organ (0.88)	Depression (1.14)	Other MSK (2.62)	Diabetes (1.31)	Anxiety (1.24)	Migraine (0.74)	Falls (1.07)	Drugs (2.15)
Tennessee	Back and neck (0.9)	Skin (1.07)	Depression (1.39)	Drugs (4.37)	Diabetes (1.73)	Sense organ (0.86)	Other MSK (2.34)	Migraine (0.86)	Anxiety (1.27)	Falls (0.87)
Texas	Back and neck (0.87)	Skin (1.23)	Depression (1.13)	Sense organ (0.74)	Migraine (0.85)	Diabetes (1.44)	Other MSK (2.17)	Drugs (2.8)	Anxiety (1.27)	Falls (0.77)
Utah	Back and neck (0.8)	Depression (1.62)	Skin (1.15)	Drugs (3.79)	Migraine (0.86)	Other MSK (2.21)	Sense organ (0.68)	Anxiety (1.23)	Diabetes (1.15)	Falls (0.75)
Vermont	Back and neck (0.76)	Depression (1.37)	Skin (1.02)	Sense (0.95)	Drugs (3.48)	Other MSK (2.43)	Migraine (0.84)	Diabetes (1.33)	Falls (1.06)	Anxiety (1.29)
Virginia	Back and neck (0.83)	Skin (1.21)	Depression (1.38)	Sense (0.81)	Diabetes (1.55)	Migraine (0.92)	Other MSK (2.39)	Drugs (2.88)	Anxiety (1.28)	Falls (0.78)
Washington	Back and neck (0.78)	Skin (1.18)	Depression (1.44)	Drugs (3.58)	Other MSK (2.62)	Sense organ (0.81)	Migraine (0.89)	Diabetes (1.27)	Anxiety (1.27)	Falls (0.87)
West Virginia	Back and neck (1.04)	Drugs (5.68)	Depression (2.23)	Depression (1.42)	Skin (1.08)	Sense organ (0.98)	COPD (5.53)	Migraine (0.92)	Other MSK (2.38)	Anxiety (1.26)
Wisconsin	Back and neck (0.85)	Skin (1.08)	Depression (1.36)	Sense organ (0.88)	Drugs (3.4)	Other MSK (2.32)	Migraine (0.84)	Diabetes (1.38)	Anxiety (1.27)	Falls (1.0)
Wyoming	Back and neck (1.0)	Depression (1.47)	Skin (0.97)	Sense organ (0.8)	Other MSK (2.29)	Drugs (2.91)	Migraine (0.79)	Anxiety (1.24)	Diabetes (1.12)	Falls (0.95)

Ratio of observed to expected YLDs
- (0.0-0.66)
- (0.67-0.83)
- (0.84-0.95)
- (0.96-1.10)
- (1.11-1.22)
- (1.23-1.44)
- (1.45-1.81)
- (1.82-2.56)
- >2.56

See Figure 7 caption for details. See Appendix Table 2 in Supplement 2 for explanation of terms.

Figure 9. Ratio of Observed Disability-Adjusted Life-Years (DALYs) to Expected DALYs Based on the Sociodemographic Index (SDI) for the United States Overall, the 50 States, and the District of Columbia in 2016 for the 10 Leading Causes in Each Jurisdiction

	1	2	3	4	5	6	7	8	9	10
United States	IHD (0.74)	Back and neck (0.86)	Drugs (4.37)	Lung cancer (1.11)	COPD (2.16)	Diabetes (1.68)	Skin (1.21)	Stroke (0.66)	Depression (1.29)	Road injury (1.11)
Alabama	IHD (1.02)	Back and neck (1.09)	Lung cancer (1.72)	COPD (3.09)	Stroke (1.02)	Diabetes (2.21)	Road injury (1.75)	Drugs (4.37)	Skin (1.11)	Depression (1.29)
Alaska	IHD (0.49)	Back and neck (0.86)	Drugs (4.64)	Lung cancer (1.0)	Self-harm (1.63)	Skin (1.04)	Depression (1.36)	Diabetes (1.31)	COPD (1.56)	Stroke (0.5)
Arizona	IHD (0.64)	Back and neck (0.99)	Drugs (5.4)	COPD (2.13)	Diabetes (1.66)	Skin (1.21)	Lung cancer (0.95)	Depression (1.44)	Stroke (0.58)	Road injury (1.18)
Arkansas	IHD (1.1)	Lung cancer (1.77)	COPD (2.9)	Back and neck (0.84)	Stroke (0.96)	Diabetes (1.92)	Road injury (1.64)	Drugs (3.87)	Depression (1.47)	Skin (1.02)
California	IHD (0.57)	Back and neck (0.74)	Skin (1.26)	Drugs (3.69)	Diabetes (1.33)	Depression (1.23)	Stroke (0.54)	COPD (1.49)	Lung cancer (0.68)	Sense organ (0.78)
Colorado	IHD (0.48)	Back and neck (0.8)	Drugs (4.29)	COPD (2.06)	Depression (1.48)	Skin (1.12)	Self-harm (1.41)	Stroke (0.51)	Road injury (1.08)	Other MSK (2.39)
Connecticut	IHD (0.63)	Back and neck (0.85)	Drugs (5.0)	Skin (1.36)	Lung cancer (0.98)	Diabetes (1.58)	COPD (1.99)	Alzheimer (1.29)	Stroke (0.57)	Sense organ (0.89)
Delaware	IHD (0.78)	Back and neck (0.88)	Drugs (5.25)	Lung cancer (1.35)	Diabetes (2.05)	COPD (2.34)	Stroke (0.67)	Skin (1.14)	Depression (1.32)	Road injury (1.19)
District of Columbia	IHD (0.72)	Drugs (5.16)	Skin (1.48)	Back and neck (0.57)	Lung cancer (0.85)	Diabetes (1.28)	Violence (6.16)	Depression (1.16)	Stroke (0.49)	Alzheimer (0.92)
Florida	IHD (0.81)	Back and neck (1.03)	Lung cancer (1.28)	COPD (2.57)	Diabetes (1.98)	Drugs (4.48)	Skin (1.24)	Stroke (0.71)	Alzheimer (1.4)	Sense organ (1.01)
Georgia	IHD (0.73)	Back and neck (0.86)	Lung cancer (1.17)	Stroke (0.77)	COPD (2.19)	Diabetes (1.74)	Skin (1.26)	Drugs (3.84)	Road injury (1.26)	Depression (1.21)
Hawaii	IHD (0.59)	Back and neck (0.73)	Skin (1.3)	Alzheimer (1.5)	Stroke (0.67)	Diabetes (1.54)	Lung cancer (0.88)	Depression (1.29)	Drugs (3.01)	Sense organ (0.91)
Idaho	IHD (0.58)	Back and neck (0.87)	COPD (2.12)	Drugs (3.61)	Diabetes (1.46)	Depression (1.45)	Lung cancer (0.97)	Skin (1.1)	Stroke (0.62)	Road injury (1.14)
Illinois	IHD (0.73)	Back and neck (0.85)	Lung cancer (1.1)	Drugs (4.12)	Skin (1.13)	COPD (1.93)	Stroke (0.65)	Diabetes (1.48)	Depression (1.16)	Alzheimer (1.09)
Indiana	IHD (0.86)	Back and neck (0.96)	COPD (2.81)	Lung cancer (1.44)	Drugs (4.49)	Diabetes (1.87)	Stroke (0.73)	Skin (1.12)	Depression (1.39)	Alzheimer (1.36)
Iowa	IHD (0.77)	Back and neck (0.93)	Lung cancer (1.21)	COPD (2.36)	Stroke (0.69)	Diabetes (1.48)	Skin (1.09)	Depression (1.23)	Alzheimer (1.17)	Sense organ (0.9)
Kansas	IHD (0.72)	Back and neck (0.85)	COPD (2.43)	Lung cancer (1.19)	Stroke (0.7)	Diabetes (1.59)	Skin (1.09)	Road injury (1.29)	Depression (1.32)	Drugs (3.02)
Kentucky	IHD (1.02)	Drugs (7.31)	Lung cancer (1.98)	Back and neck (1.08)	COPD (3.43)	Diabetes (2.01)	Stroke (0.78)	Road injury (1.42)	Skin (1.15)	Depression (1.39)
Louisiana	IHD (0.96)	Back and neck (0.97)	Lung cancer (1.47)	Drugs (5.36)	Diabetes (2.0)	Stroke (0.86)	COPD (2.24)	Road injury (1.54)	Skin (1.22)	CKD (3.05)
Maine	IHD (0.74)	Lung cancer (1.6)	Back and neck (0.83)	COPD (2.95)	Diabetes (1.85)	Stroke (0.74)	Drugs (3.96)	Alzheimer (1.47)	Depression (1.41)	Skin (1.03)
Maryland	IHD (0.7)	Back and neck (0.83)	Skin (1.29)	Diabetes (1.71)	Lung cancer (0.98)	Stroke (0.62)	Depression (1.32)	COPD (1.77)	Drugs (3.08)	Alzheimer (1.16)
Massachusetts	IHD (0.63)	Drugs (5.61)	Back and neck (0.72)	Lung cancer (1.06)	Skin (1.31)	COPD (2.0)	Alzheimer (1.24)	Diabetes (1.37)	Stroke (0.59)	Depression (1.28)
Michigan	IHD (0.95)	Back and neck (0.77)	Lung cancer (1.31)	Drugs (4.84)	COPD (2.51)	Diabetes (1.93)	Stroke (0.69)	Skin (1.2)	Depression (1.33)	Alzheimer (1.29)
Minnesota	IHD (0.48)	Back and neck (0.63)	Lung cancer (0.97)	Skin (1.09)	Stroke (0.61)	Diabetes (1.35)	COPD (1.74)	Depression (1.27)	Alzheimer (1.13)	IHD (2.73)
Mississippi	IHD (1.11)	Lung cancer (1.75)	Stroke (0.96)	Road injury (1.93)	COPD (2.63)	Back and neck (0.8)	Diabetes (2.1)	Drugs (3.78)	CKD (3.14)	Skin (1.03)
Missouri	IHD (0.94)	Back and neck (0.88)	Lung cancer (1.48)	COPD (2.73)	Drugs (4.31)	Diabetes (1.78)	Stroke (0.75)	Skin (1.11)	Road injury (1.31)	Depression (1.37)
Montana	IHD (0.68)	Back and neck (0.88)	COPD (2.69)	Lung cancer (1.15)	Road injury (1.56)	Stroke (0.67)	Depression (1.46)	Diabetes (1.45)	Alzheimer (1.38)	Self-harm (1.48)
Nebraska	IHD (0.59)	Back and neck (0.86)	COPD (2.3)	Lung cancer (1.1)	Stroke (0.66)	Diabetes (1.51)	Skin (1.08)	Road injury (1.2)	Depression (1.21)	Alzheimer (1.16)
Nevada	IHD (0.73)	Back and neck (0.99)	Drugs (5.46)	COPD (2.5)	Lung cancer (1.16)	Stroke (0.65)	Diabetes (1.49)	Depression (1.44)	Skin (1.1)	Self-harm (1.34)
New Hampshire	IHD (0.67)	Back and neck (0.84)	Drugs (5.19)	Lung cancer (1.24)	COPD (2.55)	Diabetes (1.64)	Alzheimer (1.34)	Depression (1.44)	Skin (1.1)	Stroke (0.6)
New Jersey	IHD (0.71)	Back and neck (0.84)	Drugs (4.48)	Skin (1.33)	Diabetes (1.77)	Lung cancer (0.93)	COPD (1.77)	Stroke (0.57)	Sense organ (0.87)	Alzheimer (1.07)
New Mexico	IHD (0.67)	Drugs (6.37)	Back and neck (0.92)	Diabetes (1.96)	COPD (2.26)	Road injury (1.53)	Depression (1.47)	Self-harm (1.48)	Stroke (0.58)	
New York	IHD (0.81)	Back and neck (0.87)	Skin (1.42)	Drugs (4.28)	Diabetes (1.74)	Lung cancer (0.93)	Depression (1.47)	COPD (1.86)	Alzheimer (1.13)	Sense organ (0.87)
North Carolina	IHD (0.74)	Back and neck (0.79)	Lung cancer (1.32)	Stroke (0.83)	COPD (2.26)	Diabetes (1.81)	Drugs (4.2)	Skin (1.16)	Road injury (1.27)	Depression (1.18)
North Dakota	IHD (0.62)	Back and neck (0.75)	Road injury (1.42)	Lung cancer (0.95)	Diabetes (1.47)	Other MSK (2.97)	Stroke (0.59)	Skin (1.03)	COPD (1.7)	Alzheimer (1.27)
Ohio	IHD (0.88)	Back and neck (0.92)	Drugs (5.86)	Lung cancer (1.45)	COPD (2.85)	Diabetes (2.04)	Stroke (0.76)	Skin (1.17)	Alzheimer (1.35)	Depression (1.32)
Oklahoma	IHD (1.08)	Back and neck (1.0)	COPD (3.1)	Drugs (5.58)	Lung cancer (1.49)	Diabetes (1.88)	Stroke (0.81)	Road injury (1.61)	Skin (1.15)	Depression (1.39)
Oregon	IHD (0.56)	Back and neck (0.81)	Drugs (4.9)	COPD (2.39)	Lung cancer (1.14)	Stroke (0.73)	Skin (1.23)	Diabetes (1.6)	Depression (1.37)	Alzheimer (1.19)
Pennsylvania	IHD (0.85)	Back and neck (1.01)	Drugs (5.95)	Lung cancer (1.28)	COPD (2.41)	Diabetes (1.86)	Stroke (0.73)	Skin (1.21)	Alzheimer (1.36)	Depression (1.26)
Rhode Island	IHD (0.78)	Drugs (6.13)	Back and neck (0.77)	Lung cancer (1.24)	COPD (2.23)	Skin (1.24)	Diabetes (1.64)	Alzheimer (1.43)	Depression (1.4)	Stroke (0.58)
South Carolina	IHD (0.88)	Back and neck (0.94)	Lung cancer (1.49)	Stroke (0.94)	COPD (2.65)	Diabetes (2.03)	Drugs (4.64)	Road injury (1.54)	Skin (1.24)	Depression (1.31)
South Dakota	IHD (0.72)	Back and neck (0.86)	Lung cancer (1.12)	COPD (2.07)	Road injury (1.42)	Stroke (0.65)	Diabetes (1.5)	Skin (1.08)	Other MSK (2.61)	Alzheimer (1.18)
Tennessee	IHD (1.02)	Lung cancer (1.67)	Back and neck (0.9)	Drugs (5.59)	COPD (2.81)	Stroke (0.89)	Diabetes (1.96)	Road injury (1.45)	Skin (1.12)	Depression (1.39)
Texas	IHD (0.65)	Back and neck (0.87)	Skin (1.25)	Diabetes (1.54)	Drugs (3.46)	COPD (1.72)	Stroke (0.6)	Road injury (1.24)	Lung cancer (0.88)	Depression (1.13)
Utah	Back and neck (0.8)	IHD (0.4)	Drugs (4.39)	Depression (1.62)	Self-harm (1.59)	Skin (1.16)	Diabetes (1.31)	Stroke (0.48)	Other MSK (2.21)	COPD (1.17)
Vermont	IHD (0.67)	Back and neck (0.76)	Lung cancer (1.27)	COPD (2.58)	Drugs (3.88)	Diabetes (1.55)	Alzheimer (1.31)	Stroke (0.61)	Depression (1.37)	Skin (1.04)
Virginia	IHD (0.66)	Back and neck (0.83)	Lung cancer (1.08)	Diabetes (1.67)	Skin (1.23)	Stroke (0.67)	COPD (1.94)	Drugs (3.46)	Depression (1.38)	Alzheimer (1.11)
Washington	IHD (0.53)	Back and neck (0.78)	Drugs (4.51)	Skin (1.2)	Lung cancer (0.93)	Depression (1.44)	Diabetes (1.47)	COPD (1.88)	Stroke (0.61)	Other MSK (2.53)
West Virginia	IHD (1.14)	COPD (3.99)	Drugs (7.77)	Lung cancer (2.05)	Back and neck (1.04)	Diabetes (2.72)	Stroke (0.89)	Road injury (1.48)	Alzheimer (1.5)	Skin (1.11)
Wisconsin	IHD (0.69)	Back and neck (0.85)	Lung cancer (1.13)	Drugs (4.08)	COPD (1.96)	Stroke (0.67)	Diabetes (1.48)	Skin (1.1)	Depression (1.36)	Alzheimer (1.22)
Wyoming	IHD (0.66)	Back and neck (1.0)	Lung cancer (2.78)	Road injury (1.63)	Drugs (3.8)	Lung cancer (0.93)	Depression (1.47)	Self-harm (1.51)	Diabetes (1.33)	Stroke (0.58)

Ratio of observed to expected DALYs

Range
(0.0-0.66)
(0.67-0.83)
(0.84-0.95)
(0.96-1.10)
(1.11-1.22)
(1.23-1.44)
(1.45-1.81)
(1.82-2.56)
>2.56

See Figure 7 caption for details. See Appendix Table 2 in Supplement 2 for explanation of terms.

Table 7. Percent Change in Age-Standardized Summary Exposure Values for the Leading 10 Risk Factors for the United States, the 50 States, and Washington, DC, 1990-2016, Both Sexes

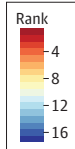|	% Change (95% Uncertainty Interval)									
	High BMI	Smoking	High Fasting Plasma Glucose	High Systolic BP	Drug Use	Alcohol Use	High Total Cholesterol	Diet Low in Whole Grains	Impaired Kidney Function	Diet Low in Fruits
United States	53.2 (41.5 to 67.2)	-42.8 (-47.1 to -37.2)	76.0 (44.4 to 144.2)	-13.3 (-13.9 to -12.6)	10.1 (7.5 to 12.8)	6.0 (-24.2 to 42.1)	-17.2 (-19.4 to -15.4)	-8.0 (-12.5 to -0.8)	0.5 (-0.6 to 2.1)	-11.1 (-14.5 to -8.7)
Alabama	66.7 (48.0 to 94.3)	-24.3 (-33.0 to -15.2)	123.2 (53.3 to 289.8)	-12.7 (-15.8 to -9.7)	9.1 (5.6 to 11.8)	4.7 (-51.0 to 99.5)	-15.9 (-19.2 to -12.8)	-8.3 (-14.4 to -0.6)	2.9 (1.4 to 5.0)	4.4 (1.8 to 8.2)
Alaska	32.2 (19.0 to 49.3)	-32.0 (-41.2 to -22.9)	36.4 (7.8 to 101.6)	-12.0 (-14.8 to -9.1)	39.2 (26.5 to 53.5)	12.0 (-50.8 to 139.6)	-17.7 (-21.5 to -14.4)	-7.8 (-14.4 to -0.5)	2.6 (0.7 to 5.4)	-0.8 (-4.6 to 3.0)
Arizona	60.7 (40.6 to 88.9)	-48.4 (-54.5 to -40.8)	61.7 (22.9 to 164.9)	-12.6 (-15.4 to -9.6)	6.5 (3.2 to 9.3)	7.5 (-48.7 to 120.4)	-15.4 (-19.0 to -12.2)	-8.3 (-14.7 to -0.7)	1.0 (-0.5 to 3.3)	-33.5 (-41.2 to -28.0)
Arkansas	56.0 (36.8 to 80.3)	-27.3 (-34.6 to -19.4)	78.6 (30.1 to 205.2)	-12.7 (-15.7 to -9.7)	-0.9 (-4.3 to 1.8)	3.1 (-49.8 to 103.7)	-15.6 (-19.3 to -12.4)	-8.2 (-14.3 to -0.6)	3.9 (2.0 to 5.6)	-5.0 (-8.5 to -2.2)
California	54.4 (36.6 to 75.6)	-60.5 (-67.2 to -51.3)	42.6 (16.3 to 117.8)	-12.9 (-15.8 to -9.7)	11.3 (8.4 to 14.5)	10.6 (-43.1 to 124.6)	-17.9 (-19.6 to -13.1)	-7.9 (-14.2 to -0.6)	0.6 (-0.8 to 1.9)	-35.0 (-47.9 to -27.6)
Colorado	45.4 (29.9 to 64.8)	-48.2 (-54.9 to -40.6)	31.2 (10.7 to 78.0)	-13.5 (-16.3 to -10.6)	31.2 (19.1 to 47.5)	6.7 (-49.3 to 130.5)	-17.2 (-20.7 to -13.8)	-7.9 (-14.1 to -0.5)	-0.4 (-1.9 to 1.6)	-11.0 (-17.0 to -7.3)
Connecticut	53.6 (35.6 to 76.2)	-47.2 (-54.4 to -38.7)	83.6 (25.9 to 235.6)	-14.3 (-17.2 to -11.3)	4.4 (1.5 to 7.5)	4.6 (-49.6 to 109.9)	-18.3 (-21.9 to -15.1)	-7.4 (-13.5 to -0.5)	-0.5 (-2.7 to 2.1)	-9.5 (-16.3 to -5.2)
Delaware	40.0 (25.3 to 57.7)	-36.6 (-42.8 to -29.9)	96.5 (32.8 to 247.9)	-13.1 (-16.1 to -10.0)	7.3 (2.5 to 12.8)	8.8 (-48.3 to 119.5)	-17.1 (-20.8 to -13.8)	-8.0 (-14.3 to -0.6)	-0.8 (-3.1 to 1.9)	7.9 (4.5 to 12.9)
Florida	51.0 (34.9 to 71.4)	-47.6 (-54.4 to -39.0)	100.2 (37.9 to 249.5)	-12.3 (-15.3 to -9.2)	16.9 (12.6 to 21.6)	5.4 (-46.1 to 117.0)	-16.8 (-20.3 to -13.8)	-8.1 (-14.8 to -0.5)	3.0 (1.3 to 5.0)	-0.0 (-3.5 to 3.9)
Georgia	57.5 (38.9 to 81.5)	-43.1 (-50.4 to -34.1)	110.5 (47.0 to 273.2)	-13.7 (-16.7 to -10.2)	15.2 (11.7 to 19.8)	-8.9 (-57.4 to 75.8)	-17.4 (-20.9 to -14.1)	-8.3 (-14.8 to -0.7)	0.7 (-0.8 to 2.9)	-20.5 (-28.2 to -15.4)
Hawaii	47.5 (30.3 to 67.1)	-36.2 (-43.4 to -27.3)	64.8 (22.8 to 181.6)	-14.9 (-17.9 to -12.0)	29.7 (17.8 to 44.8)	9.7 (-47.5 to 114.3)	-15.1 (-18.6 to -11.9)	-8.0 (-14.2 to -0.5)	2.7 (1.1 to 4.5)	7.7 (4.4 to 13.1)
Idaho	61.9 (39.7 to 90.2)	-29.5 (-38.1 to -20.8)	71.5 (22.5 to 201.7)	-12.8 (-15.9 to -9.8)	3.7 (-2.1 to 10.8)	2.9 (-53.0 to 99.2)	-16.4 (-20.0 to -13.3)	-8.3 (-14.7 to -0.7)	3.5 (1.7 to 5.4)	4.8 (2.5 to 8.2)
Illinois	48.6 (33.2 to 69.5)	-47.2 (-53.1 to -39.3)	56.0 (18.8 to 166.8)	-13.6 (-16.6 to -10.6)	16.9 (12.1 to 22.1)	7.6 (-47.7 to 118.1)	-17.2 (-20.8 to -14.4)	-7.9 (-14.2 to -0.5)	-1.1 (-2.8 to 1.0)	7.1 (4.3 to 11.3)
Indiana	55.4 (37.6 to 77.3)	-25.4 (-34.3 to -15.7)	116.7 (45.3 to 265.0)	-12.6 (-15.5 to -9.5)	8.5 (4.8 to 11.8)	4.2 (-49.4 to 118.6)	-17.4 (-20.8 to -14.3)	-8.2 (-15.0 to -0.5)	2.9 (1.3 to 5.0)	-2.4 (-5.5 to 0.1)
Iowa	57.2 (37.4 to 82.6)	-26.6 (-34.2 to -18.3)	59.4 (20.2 to 151.8)	-13.2 (-16.0 to -10.2)	40.8 (32.6 to 48.5)	3.0 (-52.7 to 116.9)	-17.7 (-21.0 to -14.4)	-7.9 (-13.9 to -0.5)	2.4 (0.9 to 4.1)	-8.6 (-13.2 to -5.4)
Kansas	51.7 (34.1 to 73.9)	-29.4 (-38.2 to -19.2)	81.4 (27.2 to 235.4)	-12.7 (-15.6 to -9.6)	32.7 (25.0 to 40.6)	4.3 (-52.2 to 111.6)	-17.1 (-20.6 to -13.6)	-8.0 (-14.2 to -0.5)	3.2 (1.5 to 5.0)	-4.9 (-8.5 to -2.2)
Kentucky	57.0 (38.0 to 79.2)	-19.8 (-26.8 to -12.9)	115.8 (49.5 to 281.7)	-12.5 (-15.6 to -9.5)	11.2 (5.2 to 18.6)	7.9 (-45.9 to 116.6)	-16.9 (-20.7 to -13.9)	-8.2 (-14.6 to -0.7)	4.5 (2.4 to 6.4)	-4.3 (-7.5 to -1.7)
Louisiana	52.0 (36.8 to 71.6)	-31.9 (-38.7 to -24.7)	108.0 (40.0 to 277.3)	-12.7 (-15.5 to -9.5)	4.5 (1.2 to 7.3)	10.6 (-47.2 to 132.5)	-15.3 (-18.7 to -11.9)	-8.0 (-14.2 to -0.5)	2.6 (1.1 to 4.5)	-5.3 (-9.4 to -2.5)
Maine	47.9 (32.1 to 68.4)	-29.1 (-35.8 to -22.0)	81.2 (26.7 to 217.5)	-13.1 (-16.1 to -10.1)	9.5 (5.8 to 12.8)	10.3 (-49.5 to 134.0)	-16.9 (-20.4 to -13.5)	-8.2 (-14.5 to -0.6)	1.8 (0.3 to 3.9)	-19.7 (-26.4 to -15.2)
Maryland	48.1 (32.7 to 66.3)	-51.5 (-57.2 to -44.7)	98.9 (32.4 to 247.8)	-13.8 (-16.8 to -10.6)	-9.7 (-15.0 to -5.2)	6.8 (-50.4 to 125.4)	-18.2 (-21.8 to -15.1)	-7.7 (-13.6 to -0.4)	-3.6 (-6.5 to -0.4)	-57.3 (-69.6 to -48.7)
Massachusetts	52.0 (34.0 to 75.4)	-46.0 (-52.3 to -38.7)	45.3 (16.0 to 129.6)	-14.1 (-16.9 to -11.1)	2.5 (-1.0 to 6.1)	9.0 (-49.2 to 123.2)	-19.6 (-23.1 to -16.7)	-7.6 (-13.8 to -0.4)	-0.2 (-1.6 to 1.3)	-7.2 (-13.1 to -3.0)
Michigan	41.9 (28.3 to 60.0)	-37.3 (-43.9 to -30.0)	114.8 (46.6 to 276.7)	-13.4 (-16.3 to -10.1)	13.7 (10.0 to 16.8)	5.6 (-49.8 to 112.7)	-17.5 (-21.4 to -14.4)	-8.3 (-14.7 to -0.7)	0.9 (-0.5 to 2.9)	2.5 (-1.2 to 7.0)
Minnesota	52.9 (36.2 to 74.8)	-37.3 (-44.1 to -28.6)	48.0 (19.1 to 140.3)	-14.0 (-17.0 to -10.9)	23.5 (16.2 to 31.9)	5.6 (-48.3 to 115.5)	-18.3 (-21.5 to -15.2)	-7.8 (-13.9 to -0.4)	2.2 (0.7 to 4.1)	-4.1 (-8.2 to -0.9)
Mississippi	54.3 (37.1 to 77.0)	-20.3 (-30.3 to -10.3)	127.2 (56.6 to 298.8)	-11.8 (-15.1 to -8.6)	7.0 (4.4 to 10.0)	8.8 (-45.3 to 115.6)	-14.8 (-18.3 to -11.8)	-8.2 (-14.6 to -0.7)	4.1 (2.2 to 6.1)	0.1 (-2.9 to 2.9)
Missouri	54.3 (35.8 to 78.0)	-29.6 (-36.7 to -22.2)	111.8 (44.2 to 271.5)	-12.6 (-15.6 to -9.5)	42.8 (38.1 to 46.7)	5.4 (-50.3 to 122.2)	-16.4 (-19.7 to -13.1)	-8.1 (-14.2 to -0.7)	2.5 (1.0 to 4.6)	-2.2 (-5.5 to 0.7)

(continued)

Table 7. Percent Change in Age-Standardized Summary Exposure Values for the Leading 10 Risk Factors for the United States, the 50 States, and Washington, DC, 1990-2016, Both Sexes (continued)

% Change (95% Uncertainty Interval)

	High BMI	Smoking	High Fasting Plasma Glucose	High Systolic BP	Drug Use	Alcohol Use	High Total Cholesterol	Diet Low in Whole Grains	Impaired Kidney Function	Diet Low in Fruits
Montana	53.6 (36.9 to 77.2)	-26.5 (-35.5 to -16.0)	40.6 (14.9 to 116.1)	-12.9 (-15.5 to -10.1)	22.0 (15.1 to 29.2)	8.1 (-50.3 to 127.1)	-16.8 (-20.3 to -13.4)	-8.0 (-14.2 to -0.5)	0.0 (-1.6 to 2.3)	-5.0 (-8.9 to -2.1)
Nebraska	57.1 (39.5 to 80.5)	-30.1 (-37.2 to -22.1)	88.0 (31.4 to 229.0)	-13.6 (-16.4 to -10.6)	25.2 (17.5 to 33.5)	4.0 (-51.2 to 116.2)	-17.6 (-21.1 to -14.4)	-7.8 (-13.9 to -0.6)	2.3 (0.9 to 4.3)	-9.2 (-14.2 to -5.8)
Nevada	36.7 (21.5 to 54.2)	-51.2 (-57.7 to -43.7)	81.1 (23.6 to 228.6)	-12.2 (-15.2 to -9.4)	14.6 (11.7 to 17.9)	5.9 (-51.6 to 122.6)	-17.6 (-21.0 to -14.4)	-8.2 (-14.7 to -0.6)	0.7 (-1.0 to 3.1)	6.2 (2.7 to 10.9)
New Hampshire	57.7 (38.1 to 83.6)	-37.0 (-42.9 to -29.5)	79.5 (25.7 to 210.3)	-13.0 (-16.1 to -10.0)	2.2 (-2.0 to 7.1)	14.0 (-47.1 to 142.8)	-17.8 (-21.3 to -14.5)	-7.8 (-14.0 to -0.5)	0.4 (-1.4 to 3.0)	-3.5 (-7.8 to 0.1)
New Jersey	48.0 (32.4 to 67.8)	-52.5 (-59.1 to -44.7)	75.4 (24.4 to 198.9)	-14.6 (-17.5 to -11.6)	9.2 (5.5 to 13.5)	3.5 (-52.0 to 115.9)	-18.2 (-22.1 to -15.0)	-7.6 (-13.8 to -0.4)	-2.4 (-4.5 to 0.1)	-2.7 (-6.6 to 0.9)
New Mexico	68.2 (45.6 to 99.7)	-37.5 (-45.6 to -29.3)	74.3 (27.3 to 190.2)	-11.7 (-14.7 to -8.6)	23.8 (19.0 to 29.2)	10.4 (-46.9 to 121.0)	-15.3 (-18.8 to -12.0)	-8.2 (-14.4 to -0.7)	3.5 (1.6 to 5.6)	-10.2 (-15.7 to -6.5)
New York	51.3 (34.6 to 72.4)	-51.4 (-58.5 to -42.4)	105.4 (42.2 to 262.3)	-14.0 (-17.1 to -11.0)	1.3 (-1.3 to 3.9)	4.5 (-48.4 to 115.5)	-18.6 (-22.1 to -15.6)	-7.8 (-14.1 to -0.5)	-2.3 (-4.7 to 0.5)	-5.8 (-10.6 to -2.4)
North Carolina	54.1 (38.2 to 73.7)	-37.1 (-44.6 to -28.8)	109.2 (42.2 to 272.4)	-13.9 (-17.1 to -10.6)	14.2 (9.2 to 19.6)	6.9 (-46.7 to 105.5)	-17.4 (-20.9 to -14.3)	-8.2 (-14.3 to -0.6)	1.6 (0.1 to 3.6)	-6.5 (-10.5 to -3.6)
North Dakota	60.8 (41.8 to 87.7)	-19.4 (-29.4 to -8.6)	68.6 (23.9 to 190.9)	-13.8 (-16.6 to -10.9)	71.3 (58.2 to 86.3)	7.1 (-49.9 to 118.2)	-17.7 (-21.6 to -14.4)	-7.5 (-13.6 to -0.4)	1.9 (0.4 to 3.6)	-24.8 (-33.8 to -19.2)
Ohio	49.6 (34.0 to 70.6)	-28.1 (-35.0 to -20.5)	118.3 (50.1 to 297.7)	-12.5 (-15.5 to -9.3)	12.1 (8.3 to 15.6)	9.2 (-49.2 to 118.8)	-17.1 (-20.8 to -13.9)	-8.1 (-14.5 to -0.5)	2.2 (0.8 to 4.5)	-37.2 (-50.5 to -29.4)
Oklahoma	69.3 (47.7 to 99.6)	-26.6 (-33.5 to -19.3)	118.0 (50.9 to 292.2)	-13.2 (-15.9 to -10.0)	12.1 (8.2 to 16.6)	1.8 (-49.9 to 113.6)	-15.1 (-18.6 to -12.1)	-8.0 (-14.0 to -0.6)	3.7 (1.8 to 5.6)	-5.2 (-9.2 to -2.4)
Oregon	48.1 (33.0 to 67.0)	-44.0 (-50.5 to -36.0)	40.9 (14.1 to 110.0)	-13.7 (-16.8 to -10.5)	-0.2 (-3.8 to 3.0)	5.5 (-47.6 to 119.8)	-16.9 (-20.4 to -13.7)	-8.1 (-14.4 to -0.6)	1.9 (0.6 to 3.8)	-8.1 (-12.7 to -4.8)
Pennsylvania	46.4 (28.9 to 66.0)	-38.6 (-44.9 to -31.4)	1.7 (-36.4 to 50.1)	-13.5 (-16.6 to -10.4)	12.9 (9.4 to 16.5)	6.9 (-48.0 to 113.8)	-17.5 (-21.3 to -14.3)	-7.9 (-14.2 to -0.6)	-1.2 (-3.0 to 0.9)	-7.8 (-13.2 to -4.5)
Rhode Island	58.2 (40.4 to 78.5)	-37.7 (-46.2 to -28.8)	87.5 (32.7 to 230.9)	-13.2 (-16.4 to -10.2)	2.9 (0.7 to 5.0)	7.1 (-49.2 to 123.8)	-16.9 (-20.6 to -13.7)	-7.9 (-14.2 to -0.5)	-0.4 (-2.1 to 1.9)	0.6 (-2.8 to 4.5)
South Carolina	59.7 (41.9 to 83.9)	-32.1 (-40.6 to -22.7)	123.2 (54.8 to 304.8)	-13.1 (-16.2 to -10.0)	2.1 (-0.8 to 4.6)	9.3 (-46.5 to 126.1)	-16.4 (-19.8 to -13.4)	-8.2 (-14.4 to -0.6)	2.3 (0.8 to 4.6)	4.1 (1.5 to 7.4)
South Dakota	59.0 (38.7 to 88.1)	-21.5 (-31.4 to -10.1)	51.1 (21.6 to 129.6)	-13.2 (-16.1 to -10.1)	75.4 (60.2 to 92.0)	4.6 (-49.4 to 131.0)	-17.3 (-20.8 to -14.1)	-7.7 (-14.0 to -0.4)	1.9 (0.6 to 3.9)	-38.8 (-52.8 to -30.6)
Tennessee	64.3 (46.4 to 88.2)	-25.1 (-32.5 to -17.6)	110.4 (44.7 to 269.2)	-12.8 (-15.9 to -9.8)	6.6 (3.2 to 9.7)	5.9 (-47.4 to 105.7)	-15.9 (-19.3 to -12.8)	-8.0 (-14.6 to -0.5)	3.2 (1.5 to 5.1)	-8.1 (-12.2 to -5.2)
Texas	62.5 (42.9 to 86.9)	-51.2 (-54.2 to -40.1)	95.1 (34.5 to 251.3)	-13.4 (-16.5 to -10.3)	19.6 (12.9 to 27.1)	6.9 (-49.5 to 121.1)	-18.0 (-21.7 to -14.9)	-8.0 (-14.0 to -0.6)	3.8 (2.1 to 5.1)	-10.3 (-15.9 to -7.0)
Utah	59.4 (40.6 to 84.1)	-34.9 (-44.5 to -23.2)	72.4 (21.3 to 199.0)	-12.9 (-15.8 to -9.9)	1.4 (-1.9 to 4.2)	3.8 (-45.6 to 96.4)	-16.8 (-20.5 to -13.4)	-8.2 (-14.5 to -0.6)	2.1 (0.7 to 3.7)	-5.7 (-9.8 to -2.7)
Vermont	47.8 (32.9 to 69.8)	-29.8 (-37.5 to -21.3)	38.6 (15.6 to 103.5)	-12.9 (-16.0 to -10.0)	5.3 (-2.3 to 14.6)	14.3 (-46.9 to 146.4)	-17.2 (-20.6 to -14.0)	-7.8 (-14.3 to -0.5)	-2.4 (-5.0 to 0.6)	-2.3 (-6.1 to 0.7)
Virginia	54.3 (37.1 to 76.3)	-44.4 (-50.3 to -37.6)	96.8 (33.7 to 247.8)	-14.4 (-17.5 to -11.5)	13.9 (9.1 to 19.3)	9.0 (-46.6 to 123.0)	-17.9 (-21.4 to -14.8)	-7.8 (-13.9 to -0.5)	1.0 (-0.6 to 3.3)	-6.6 (-11.2 to -3.1)
Washington	56.9 (39.5 to 79.7)	-47.9 (-54.2 to -40.1)	44.8 (18.3 to 113.4)	-13.6 (-16.4 to -10.5)	16.0 (13.3 to 18.8)	5.2 (-48.7 to 116.7)	-18.0 (-21.8 to -15.0)	-7.9 (-14.0 to -0.5)	1.6 (0.3 to 3.6)	-7.7 (-12.6 to -4.4)
West Virginia	53.7 (38.4 to 75.4)	-11.2 (-18.6 to -2.3)	129.2 (51.7 to 301.8)	-13.1 (-16.2 to -10.1)	10.3 (6.5 to 13.7)	5.4 (-47.1 to 100.6)	-16.7 (-20.2 to -13.6)	-8.3 (-14.6 to -0.7)	5.2 (2.8 to 7.2)	-7.0 (-11.3 to -4.1)
Wisconsin	52.3 (36.7 to 72.8)	-32.6 (-39.8 to -24.4)	53.2 (15.7 to 156.5)	-13.1 (-16.0 to -9.8)	15.4 (10.3 to 21.6)	5.6 (-50.3 to 114.4)	-17.5 (-21.3 to -14.0)	-8.0 (-14.3 to -0.5)	2.4 (0.9 to 4.3)	-4.8 (-8.9 to -1.5)
Wyoming	52.3 (34.4 to 76.6)	-31.9 (-39.9 to -22.6)	41.1 (16.8 to 109.1)	-13.7 (-16.6 to -10.8)	116.0 (91.2 to 141.9)	10.3 (-49.4 to 146.5)	-17.7 (-21.3 to -14.5)	-7.5 (-13.8 to -0.4)	1.2 (-0.2 to 3.4)	-3.9 (-7.7 to -0.8)
Washington, DC	46.3 (31.2 to 65.0)	-51.5 (-59.6 to -40.3)	41.1 (7.3 to 120.5)	-15.6 (-18.6 to -12.5)	9.3 (5.8 to 15.9)	0.4 (-56.0 to 112.8)	-18.8 (-22.4 to -15.2)	-7.3 (-13.2 to -0.4)	-10.3 (-13.7 to -5.8)	5.6 (1.1 to 12.2)

Figure 10. Ranking of Risk Factors in 2016 for the United States Overall, the 50 States, and the District of Columbia According to the Number of Disability-Adjusted Life-Years Related to Each Risk Factor

	Tobacco use	High body mass index	Dietary risks	Alcohol and drug use	High fasting plasma glucose	High systolic blood pressure	High total cholesterol	Impaired kidney function	Occupational risks	Air pollution	Low physical activity	Child and maternal malnutrition	Low bone mineral density	Unsafe sex	Sexual abuse and violence	Residential radon and lead exposure	Unsafe water, sanitation, and handwashing
United States	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Alabama	1	3	2	6	4	5	7	8	9	10	11	12	13	14	16	15	17
Alaska	2	3	4	1	5	6	7	9	8	12	11	10	14	15	13	16	17
Arizona	3	2	4	1	5	6	7	9	8	10	11	12	13	15	14	16	17
Arkansas	1	3	2	6	4	5	7	8	9	10	11	12	13	14	16	15	17
California	4	1	3	2	5	6	7	8	9	10	11	12	13	14	15	16	17
Colorado	2	3	4	1	6	5	7	9	8	10	12	11	13	15	14	16	17
Connecticut	2	1	4	3	5	6	7	9	8	10	11	12	13	14	15	16	17
Delaware	1	2	3	5	4	6	7	8	9	10	11	12	14	13	15	16	17
District of Columbia	4	2	3	1	6	5	7	8	9	12	13	11	16	10	15	14	17
Florida	1	2	3	5	4	6	7	8	9	10	11	13	14	12	15	16	17
Georgia	1	2	3	4	5	6	7	8	9	10	11	12	14	13	15	16	17
Hawaii	3	1	2	5	4	6	7	8	9	12	10	11	13	14	15	16	17
Idaho	1	3	2	4	5	6	7	9	8	10	11	12	13	16	14	15	17
Illinois	2	1	3	4	6	5	7	9	8	10	11	12	13	14	16	15	17
Indiana	1	2	3	5	4	6	7	9	8	10	11	12	13	15	14	16	17
Iowa	1	3	2	6	4	5	7	9	8	10	11	13	12	16	15	14	17
Kansas	1	3	2	5	4	6	7	9	8	10	11	12	13	16	14	15	17
Kentucky	1	3	2	4	5	6	7	9	8	10	11	12	13	16	15	14	17
Louisiana	1	3	2	5	4	6	7	8	9	10	11	12	14	13	16	15	17
Maine	1	2	3	5	4	6	7	9	8	10	11	12	13	16	14	15	17
Maryland	2	1	3	5	4	6	7	8	9	10	12	11	14	13	15	16	17
Massachusetts	2	3	4	1	5	6	7	9	8	10	11	12	13	14	15	16	17
Michigan	1	2	3	5	4	6	7	8	9	10	11	12	13	16	15	14	17
Minnesota	1	2	3	4	5	6	8	9	7	10	11	12	13	16	14	15	17
Mississippi	1	3	2	6	4	5	7	8	9	10	11	12	14	13	16	15	17
Missouri	1	3	2	6	4	5	7	8	9	10	11	12	13	15	14	16	17
Montana	1	3	2	4	5	6	7	9	8	10	11	13	12	16	14	15	17
Nebraska	1	2	3	6	4	5	7	9	8	10	11	12	13	16	14	15	17
Nevada	1	3	4	2	5	6	7	9	8	10	11	12	14	15	13	16	17
New Hampshire	1	3	4	2	5	6	7	9	8	10	11	13	12	16	14	15	17
New Jersey	3	1	2	5	4	6	7	8	9	10	11	12	14	13	16	15	17
New Mexico	4	2	3	1	5	6	7	8	9	11	10	12	13	15	14	16	17
New York	3	1	2	5	4	6	7	8	9	10	11	13	14	12	15	16	17
North Carolina	1	3	2	5	4	6	7	8	9	10	11	12	13	14	15	16	17
North Dakota	2	1	3	5	4	6	7	9	8	12	10	11	13	16	14	15	17
Ohio	1	2	3	5	4	6	7	9	8	10	11	12	13	15	16	14	17
Oklahoma	1	3	2	5	4	6	7	8	9	10	11	12	13	15	14	16	17
Oregon	1	3	4	2	5	6	8	9	7	10	11	13	12	15	14	16	17
Pennsylvania	1	2	3	4	5	6	7	9	8	10	11	12	13	14	16	15	17
Rhode Island	1	2	4	3	5	6	7	8	9	10	11	12	13	14	16	15	17
South Carolina	1	3	2	5	4	6	7	8	9	10	11	12	14	13	15	16	17
South Dakota	1	2	3	6	4	5	7	9	8	10	11	12	13	16	15	14	17
Tennessee	1	3	2	4	5	6	7	9	8	10	11	12	13	14	15	16	17
Texas	3	1	2	5	4	6	7	9	8	10	11	12	14	13	16	15	17
Utah	6	2	3	1	4	5	8	9	7	11	12	10	14	16	13	15	17
Vermont	1	3	2	4	5	6	7	9	8	10	11	13	12	16	14	15	17
Virginia	2	1	3	5	4	6	7	8	9	10	11	12	13	14	15	16	17
Washington	3	2	4	1	5	6	7	9	8	10	11	12	13	15	14	16	17
West Virginia	1	3	2	5	4	6	7	9	8	10	11	12	13	15	16	14	17
Wisconsin	1	2	3	4	5	6	7	9	8	10	11	12	13	16	14	15	17
Wyoming	1	3	4	2	6	5	7	9	8	10	11	12	13	16	14	15	17

Rank
- 4
- 8
- 12
- 16

recently garnered attention. The increases in these causes of death have been underway for 20 years, but the US health policy community has been slow to recognize this rising set of problems.

This study shows that high BMI, smoking, and high fasting plasma glucose are the 3 most important risk factors in the United States, and that although smoking is decreasing, BMI

and fasting plasma glucose levels are steadily increasing. These 2 risk factors pose unique challenges in the United States given that unabated, they have the potential to change the health trajectory for individuals in many states. Levels of overweight and obesity increased during the study period. US residents need to do more to maintain their weight or reduce it, when needed, as well as access systems to support these intentions.[57] Although physical activity increased during the study period, the levels of increase were not enough to control weight gain.[8] Physical inactivity is a risk factor for many diseases, but increasing activity is not enough on its own to reduce weight or prevent weight gain.[58] Obesity is associated with increased diabetes, cardiovascular diseases, some neoplasms, and poor health-related quality of life. This study calls for renewed efforts to control weight gain at the community level.

Several studies have reported on the effect of taxes on sugary drinks or subsidies to encourage consumption of healthy foods, although only a small fraction of obesity can be linked to sugar-sweetened beverages.[59] A comprehensive plan is needed to address obesity because it adversely affects health and drives use of health care resources.[4,60-62] Rising BMI is driving up fasting plasma glucose levels and diabetes, and diabetes increased as a cause of burden in almost all states during the study period. Diabetes is a costly disease that consumes approximately 4.82% of the US health care budget.[4] A recent study estimated that the cost of diabetes care increased by 6.1% from 1996 to 2013.[4] Diabetes is associated with many conditions and disabilities.[63] This rise in burden and its cost is noteworthy given the projected increase in diabetes as obesity increases in the United States.

This study shows that there were reductions in the death rates from cardiovascular diseases for all age groups. This progress has been, in part, influenced by reductions in systolic blood pressure and cholesterol, but the role of increased access to effective treatment has also been considerable.[64] In fact, age-standardized CVD death rates have decreased in the United States by 32.8% over the last 20 years. The important role of treatment in reducing death rates highlights the ongoing importance of ensuring financial and physical access to care and the importance of quality of care. As declines in the rate of CVD may be slowing down, adverse trends due to the diseases of despair and adverse risk trends may mean that historical progress in improved life expectancy may not continue in the future.

The strategies for dealing with the remaining inequalities and new threats are 3-fold: (1) address some of the key modifiable risks, including diet; tobacco, alcohol, and drug use; insufficient physical activity; and obesity; (2) improve access to and, more importantly, quality of care in key areas, such as chronic kidney disease and ongoing care for substance use disorders; and (3) address the social determinants of health. We have previously shown an association between socioeconomic and race/ethnicity factors and a 60% county-level variation in life expectancy, behavioral and metabolic risk factors and a 74% variation, and health care factors and a 27% variation.[65] Combined, these factors are associated with 74% of overall variation. We also reported that most of the association between socioeconomic and race/ethnicity factors and life expectancy was mediated through behavioral and metabolic risk factors. Research has shown that

some environmental factors have an effect on risk factors such as obesity and low physical activity. Low socioeconomic settings often have an imbalance of few grocery stores and numerous fast food options, and access to safe outdoor places spaces for recreation is limited.[66,67]

To date, the strategies for addressing the social determinants of health in the United States have been elusive. Lack of progress and rising social inequalities should not engender complacency. Therefore, addressing risk factors may prove to be an important opportunity to reduce disparities and deal with some of the challenges for improving US health. Opportunities to decrease the burden of disease through reducing tobacco, alcohol, drug use, blood pressure, and cholesterol; increasing physical activity; and improving diet emphasize that the United States should invest more in prevention that targets these risks. To increase the likelihood of prevention to succeed, it has to be a priority for all stakeholders—physicians, nurses, hospital systems, policy makers, health insurance companies, patients and their families, and advocacy groups.

This study showed a wide range of challenges encountered by different states and by some counties within states. Given the diversity of risks, communities, and workplaces there is no simple menu of effective programs for risk reduction. Indeed, local experimentation to determine what works in a given community is likely to be necessary. There is a need to change strategies of funding and evaluation of innovative interventions and policies, and independent evaluation of whether these efforts work or not should be documented. To succeed, these innovative programs should forge a connection between health care provision and progress for individuals and communities in health outcomes. The notion of accountability should be broadened beyond providing high-quality care to encompass achieving risk reduction in partnership with patients and communities.

The interpersonal violence burden in the United States has to be properly addressed, although declines have been observed: the age-standardized death rate decreased 32.43% from 1990 to 2016 in the United States. However, self-harm by firearm accounted for 6.39 deaths per 100 000 persons in the United States in 2016, and physical violence by firearm accounted for 3.98 deaths per 100 000 persons. There is evidence that gun control achieved through background checks reduces homicide and suicide.[68-72] Previous studies reported success in reducing the burden of gun deaths through policy changes in Brazil and other countries.[71] Indeed, enforcing gun control policies has proven effective in reducing mortality in a variety of contexts. There is a need for comprehensive studies of the epidemiology of gun violence in the United States to inform the ongoing gun control debate.

Age-standardized death rates due to alcohol increased by 17.50% from 1990 to 2016 in the United States, and alcohol use disorders accounted for 2.89 deaths per 100 000 persons in 2016. Previous studies have shown that alcohol consumption and binge drinking have increased in the United States, especially among females.[6,73] Alcohol is a major risk factor for burden in the United States[10] and is associated with adverse outcomes including sexually transmitted diseases, violence, and accidents.[16] Traffic injuries have received a considerable amount of attention, but the true burden of alcohol is much bigger and goes beyond driving

while intoxicated. Programs to educate US residents about the true harms of excessive drinking are needed.

Many of the risk factors that contribute to the disparities in burden are amenable to medical treatment within the context of supportive behavioral and lifestyle changes. For example, many cardiovascular risk factors, such as high blood pressure and high cholesterol levels, can now be treated more effectively with early detection and proper follow-up. Safe, effective, and affordable antihypertensive medications are now widely available, often as generic preparations, especially at discount pharmacies, and in many cases, without the need for health insurance for medications. The Affordable Care Act (ACA) allows for the expansion of insurance coverage, which ultimately increases access to care. Indeed, the ACA expansion of Medicaid coverage in participating states to all nonelderly adults with incomes below 133% of the federal poverty level provides an opportunity for early detection and follow-up of some of the main health risk factors. However, many US residents do not have health insurance, even after the ACA was introduced, and hence have little access to medical diagnosis and treatment. Therefore, expanding health coverage for certain conditions and medications should be considered and adopted to reduce burden.

This study showed that the United States overall and many individual states have made progress in reducing mortality but have had limited success in reducing disability. For instance, the burden of drug use disorders in total DALYs increased in the United States during the study period by 61.4% and accounted for about 3.81 million DALYs in 2016, depressive disorders increased 17.32% and accounted for 2.72 million DALYs, and anxiety disorders increased by 16.7% and accounted for approximately 1.76 million DALYs in 2016. These findings point to an urgent need to address mental health and drug use disorders in the United States. There is a need for improved access to quality mental health care and screening to improve outcomes, as well as programs to prevent mental disorders and promote mental health.

As the US population ages, the burden of musculoskeletal disorders will increase. More US residents have neck and back pain, and the incidence of falls is increasing. Musculoskeletal disorders are associated with a high medical cost.[4] Preventive measures to reduce the burden of these risk factors in all stages of life are urgently needed. Programs for avoiding harm and injuries at work among both younger and older ages are needed. The programs should include prevention of falls in the older population through examining the risk factors that lead to falls among adults. Screening tools and interventions to address this burden should be implemented.

The results of GBD 2016 have shown that occupational risks and air pollution were the 9th and 10th leading causes for DALYs. Although the findings show reductions in attributable burden from 1990 to 2016, occupational risks still account for 948.75 DALYS per 100 000 persons, and air pollution accounts for 584.97 DALYs per 100 000 persons—large numbers in the United States. Indeed, renewed efforts to reduce the burden of environmental and occupational risks are needed to ensure continued progress in reducing their effect on health in the United States.

Several studies have shown that poor diet is a major challenge in the United States, and little improvement has occurred over the past decades. US residents are not consuming a healthy diet; they tend to consume more calories than needed, and composition is not ideal.[49,62] Some recent studies have shown modest improvement in certain aspects of US diet, especially decreases in consumption of sugary drinks. The United States needs a comprehensive program to improve dietary intake at national and local levels. This program should offer financial incentives and disincentives for more vs less healthful food products by agriculture producers, food manufacturers, and retailers, as well as for choices by consumers. This effort should also implement comprehensive wellness programs in schools, workplaces, and government offices, and inform the public of the importance of a healthful diet.

Limitations

Given the scope of this analysis, this study has several important limitations. The overall limitations of the GBD methods, as noted in other publications, apply to the US analysis. First, the accuracy of the estimates depends on the availability of data by time period and state. Second, it is challenging to separate measurement error from variation in disease occurrence. GBD corrects for known bias from nonreference methods or case definitions, but often has to rely on sparse data at the state level to make those adjustments. Third, GBD applies garbage code redistribution for 13% of causes of deaths in the United States; this ranged from 8.4% in South Dakota to 21.3% in Alabama. Therefore, the causes of death may not match those in other publications but are more robust because they control for the between-states variation in the prevalence of garbage codes. Fourth, GBD methods adjust for hospital admissions using a large nonrepresentative source of medical claims data. The generalizability of claims data, the use of primary diagnosis only or all diagnostic fields, and the trends of claims data have been questioned.[13] Also, there may be considerable interstate variation in how diseases are treated between inpatient and outpatient settings. GBD methods adjust for such potential biases by using a covariate on claims and hospital admissions data to correct for systematic error. Fifth, GBD includes risk-outcome pairs that meet the World Cancer Research Fund criteria of causality. However, some risk-outcome pairs might not meet criteria that develop as evidence from new studies is published. Sixth, there is limited information on dietary intake at the state level. The Behavioral Risk Factors Surveillance System has 6 dietary questions attempting to capture fruit and vegetable consumption. Therefore, GBD 2016 used commercial sales data to adjust estimates of dietary intake. Seventh, some of the data used in the analyses have a lower quality and consistency across states and age groups. GBD 2016 reports 95% UIs to show the effect of this limitation on the estimates. Eighth, the study reports disparities between states but does not examine the within-state variations of burden, which could be substantial, especially in large states. Ninth, claims data were only available through 2012 at the time of these analyses. Additionally, this study does not report the burden of the social determinants of health; it focuses only on behavioral, environmental, and metabolic risks.

Conclusions

There are wide differences in the burden of disease at the state level. Specific diseases and risk factors, such as drug use disorders, high BMI, poor diet, high fasting plasma glucose level, and alcohol use disorders are increasing and warrant increased attention. These data can be used to inform national health priorities for research, clinical care, and policy.

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