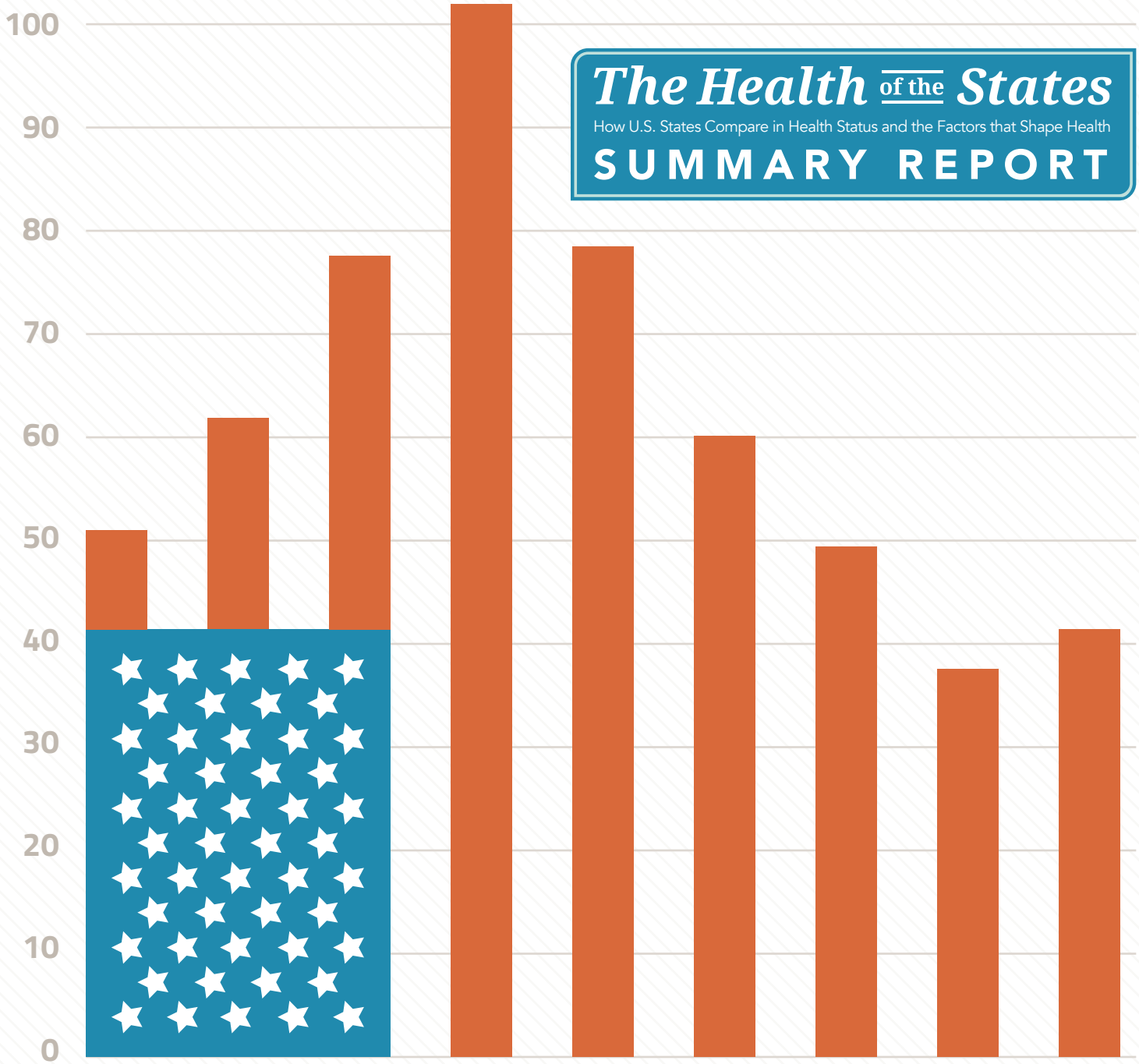


# The Health of the States

How U.S. States Compare in Health Status and the Factors that Shape Health

## SUMMARY REPORT

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# Contents

# Introduction

In 1946, the preamble to the Constitution of the World Health Organization, as adopted by the International Health Conference on June 19–22 in New York, defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[a] This serves as a powerful reminder of the many dimensions of health (physical, mental, and social) and also its positive and negative aspects (well-being versus disease and illness).

No single measure can accurately reflect an individual person's health, and describing and measuring the health of a nation presents even greater challenges. For instance, what are the best ways to represent the health of an entire population – people at different ages and stages of life, in different types of places and communities, and living under very different social, economic, and physical conditions? The need to better understand the nation's health, and especially the factors that shape and drive it, has never been greater. The prevalence of chronic diseases and the high costs of health care continue to pose major challenges to the country — challenges that will only deepen in step with the demographic changes we know are underway. The U.S. population is aging, urbanizing, and becoming more racially and ethnically diverse—all of which affect health. Any efforts to improve the health of Americans will need to account for these underlying changes in the population of the country.

## THE U.S. HEALTH DISADVANTAGE

The inspiration for this *Health of the States (HOTS)* effort, to look deeply and comparatively at health across the United States, was a ground-breaking 2013 report from the National Research Council (NRC) and the Institute of Medicine (IOM) entitled, *U.S. Health in International Perspective: Shorter Lives, Poorer Health*.[1] The report showed that Americans are dying earlier and experiencing poorer health compared to residents in other high-income countries. This U.S. "health disadvantage" is seen among young and old, rich and poor, and among Americans of all races. Further, the problem has been developing over several decades and is especially pronounced among women.[b] As worrying as these cross-national comparisons are, the U.S. health disadvantage relative to other affluent countries is dwarfed by health differences within the U.S. Ever since the publication of the *Eight Americas* study,[2] there has been growing awareness of how greatly health varies by region and by race-ethnicity. One study found that Asian Americans living in New Jersey live an average of 26 years longer than Native Americans in South Dakota.[3] In many U.S.

a. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, June 19-22, 1946; signed on July 22, 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on April 7, 1948.

b. These findings continue to be confirmed by more recent studies. In March 2013, Kindig and Cheng reported that mortality rates for U.S. women had increased in 43 percent of U.S. counties.[176] In August 2013, an international study reported that the U.S. mortality rate exceeded that of 26 Organisation for Economic Co-operation and Development (OECD) countries.[177] A 2015 study reported the rise of mortality rates among middle-aged whites.[178] A 2016 reported widening gaps in life expectancy based on income.[87]

cities, life expectancy varies by as much as 20 years between neighborhoods.[4]

Despite comparing a variety of factors which might help explain this U.S. health disadvantage, the NRC/IOM report was only able to scratch the surface. The available cross-national data pointed to many possible reasons, including a lack of universal health insurance and weak primary care; health behaviors that increase risks of disease and injury; social and economic conditions such as higher rates of child poverty, greater income inequality, and lower rates of social mobility; and built environments that may undermine health. Of course, all of these are influenced by a variety of public policies and social values that shape living conditions in the United States today. Ultimately, however, it is clear that the existing cross-national evidence gives rise to more questions than answers.

# About This Project

Following the release of the NRC/IOM report, the Robert Wood Johnson Foundation decided to sponsor this study in an effort to shed a much brighter light on the status of Americans' health at the state level, along with the diverse factors associated with health — from social and economic conditions to health systems and public policy. The Foundation has long understood that many drivers of health fall outside the formal health care system and that there is a need to build a Culture of Health across the nation by:

- Making health a shared value
- Fostering cross-sector collaboration to improve well-being
- Creating healthier, more equitable communities
- Strengthening the integration of health services and systems[5]

The socioecological framework recognizes the role of "upstream factors" in shaping health outcomes.[6–9] As stated by Nancy Krieger, "the primary drivers of population health and health inequities are to be found within our body politic, not within our bodies."[10]

This project comes at a time of growing concerns about health inequities. Health disparities have been a longstanding interest of academia and medicine,[11–15] but they are now increasingly important to national and state policymakers, economists, and the public.[16–20] Recent media reports have focused public attention on income inequality and how it is widening the gap in health outcomes among Americans.[21,22]

The decision to focus this effort on states was a critical one. Health varies

across many dimensions (e.g., age, gender, race-ethnicity, socioeconomic status), only one of which is geography. State borders are not always the most logical boundary for making geographic comparisons. States are large and diverse (some even larger than independent countries) and contain substantial within-state variation in health. States include inner cities, suburban rings, rural and frontier communities, as well as tribal lands. Many large metropolitan areas and commuting zones span multiple states.

But there are also important advantages to looking at health at the state level. First, there is a wealth of state data and many of these measures (especially those that fall outside of the health care system) have yet to be systematically assembled or examined with a view towards health outcomes. Second, given that so many state-level policies, programs, and practices affect health and its determinants, states are exactly the right level of geography on which to focus. States have considerable autonomy to implement policies that can strengthen health outcomes.[23] Finally, states are familiar and well understood by policymakers and the public at large. This practical familiarity, along with the fact that there is a manageable number of them (50, plus the District of Columbia) is an important advantage.

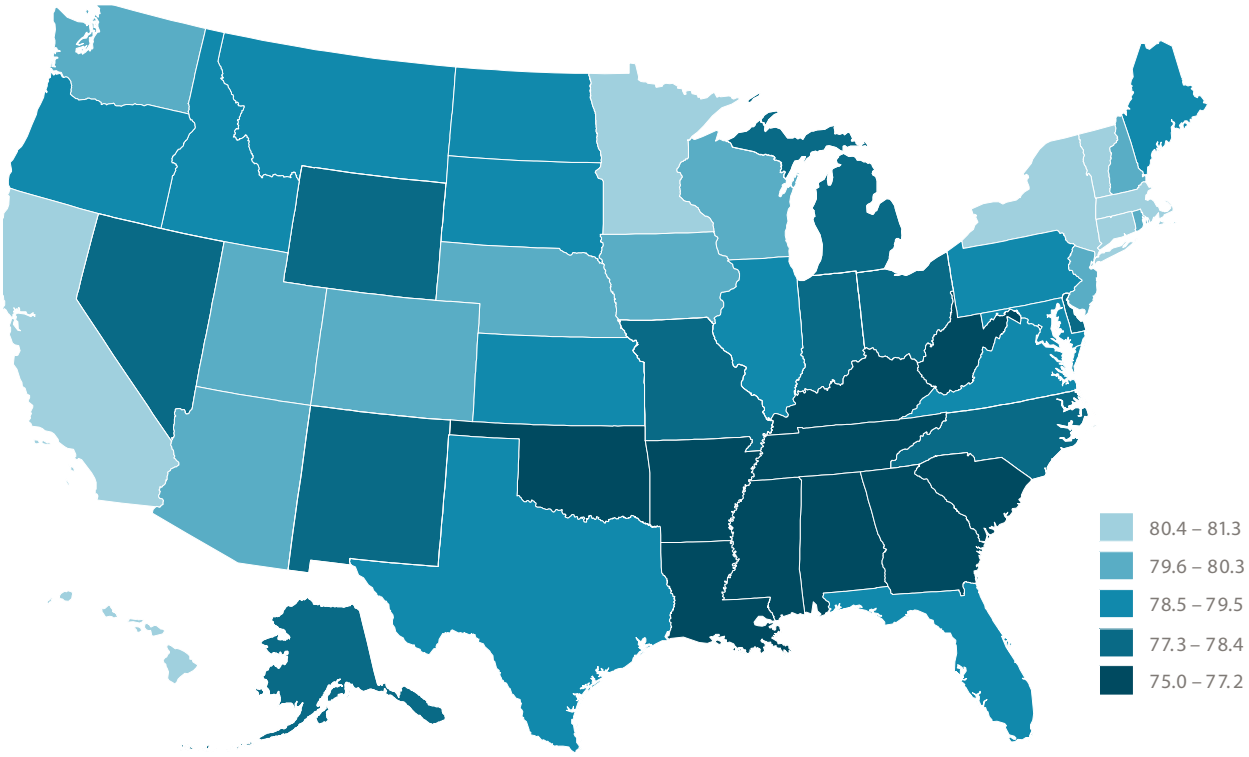
*"Our goal here is to start the conversation—to raise questions about intriguing patterns observable in the state-level data and to encourage researchers and policymakers to explore them further"*

This work is hardly the first effort to compare the health of the states. America's Health Rankings[24] has looked at health across U.S. states for more than 25 years and also gave rise to the County Health Rankings and Roadmaps project, including that project's own recent effort to track health disparities by state.[25] Other groups have also assembled important state comparisons, usually focused on some specific aspect of health or health care: these include work by the Commonwealth Fund,[26] the Robert Wood Johnson Foundation,[27,28] Henry J. Kaiser Family Foundation,[29] and the Agency for Healthcare Research and Quality.[30] The American Human Development Index has been applied to the states,[3,31,32] and other organizations have produced state scorecards for factors that affect health, such as poverty[33] and community livability.[34] However, even the most comprehensive of these focus on either a small, parsimonious set of health outcomes and determinants, or on a specific sub-population of interest, such as children.[35]

HOTS is distinct from these other efforts in both its breadth and depth. This series of reports presents our first look at the HOTS data, data that include 39 different health outcomes — spanning the

FIGURE 1.

**LIFE EXPECTANCY AT BIRTH (YEARS) BY STATE (2010)**




life course — and 123 health determinants from five major domains: (1) health systems, (2) health behaviors, (3) social and economic factors, (4) physical and social environmental factors, and (5) public policies and social spending. These include many well-recognized drivers of health (e.g., health insurance coverage and smoking) alongside other less-studied factors (e.g., social support for children, spending on social services). HOTS allows us to start to relate the environmental and policy backdrop with state health patterns and to shed a brighter light on what is happening in states across the country. We also include state spending data (not just health-related spending) in an effort to uncover previously unexplored associations and patterns between population health and investments in areas like education, income support, and infrastructure (e.g., mass transit).

## THIS REPORT AND THE SPOTLIGHT SUPPLEMENTS

This report is a summary of our findings, to be followed by a series of nine *Spotlight* supplements (Table 1) that will unpack the details and will include maps and charts to clarify the results. The first supplement provides background details on our data sources, the methods we used

TABLE 1.
## *"SPOTLIGHT"* SUPPLEMENTS TO SUMMARY REPORT

| |
|---|
| Supplement 1: *The Health of the States: Spotlight on methods* |
| Supplement 2: *The Health of the States: Spotlight on life expectancy and mortality* |
| Supplement 3: *The Health of the States: Spotlight on birth outcomes* |
| Supplement 4: *The Health of the States: Spotlight on child and adolescent health* |
| Supplement 5: *The Health of the States: Spotlight on sexually transmitted infections* |
| Supplement 6: *The Health of the States: Spotlight on injury fatalities* |
| Supplement 7: *The Health of the States: Spotlight on adult health status* |
| Supplement 8: *The Health of the States: Spotlight on overweight/obesity, diabetes, and cardiovascular conditions* |
| Supplement 9: *The Health of the States: Spotlight on cancer, lower respiratory disease, influenza and pneumonia, and Alzheimer's disease* |

for obtaining and analyzing the data, and important caveats and limitations that readers should keep in mind. The next *Spotlight* supplement examines how life expectancy and death rates vary across the states, followed by seven supplements that take a life course perspective, examining health at all stages, from birth outcomes to Alzheimer's disease. Specifically, the supplements examine state-level variation in birth outcomes; child and adolescent health; sexually transmitted infections; injuries (both unintentional, such as motor vehicle fatalities, and intentional, such as homicides and suicides); and a variety of measures of adult health and functioning—especially the chronic diseases of middle and older age, which are the major causes of poor health and high health care costs in the country today.

Each supplement examines how state-level variations in a health outcome correlate with variations in factors thought to shape or influence health. Using the data we have compiled on (1) health behaviors, (2) physical and social environmental factors, (3) social and economic factors of individuals and households, (4) health systems, and (5) public policies and social spending, we identify which factors correlate most strongly with the 39 health outcomes we examined.

## *Methods*

We examined 123 indicators and calculated how strongly they correlated with 39 health conditions. We report the results throughout this and supplemental reports. The data consist of Spearman rank-order correlation coefficients ($r_s$), which measure the degree to which the state ranking for the indicator (e.g., poverty) matches the state ranking for the health outcome (e.g., strokes), where zero represents no association between the two rankings and 1.0 represents an exact match. A positive correlation means that a high rank on the indicator is linked to a high rank on the health outcome, or vice versa; a negative correlation means that a high rank on the indicator is linked to a low rank on the health outcome, or vice versa. More details are available in *Supplement 1: The Health of the States: Spotlight on methods.*

# The Big Picture

Health varies dramatically across the 50 states of the union. For example, as of 2010, the average life expectancy of newborns varied by 6.3 years, from 75.0 years in Mississippi to 81.3 years in Hawaii (Figure 1). The prevalence of diabetes ranged 2.5-fold, from 5.4 percent in Alaska to 13.5 percent in Alabama. HOTS provides a detailed snapshot of the geographic footprint of the diseases and injuries that afflict America. Supplements to this report detail our findings for conditions in different stages of the life-course (Table 1).

Our analysis confirms many well-known patterns: southern states along the Gulf Coast and the Appalachian Ridge often have more adverse health conditions, epitomized by the "stroke belt," the band of states where the prevalence of cerebrovascular disease is especially high. But closer analysis reveals exceptions to the rule. We found that states with generally favorable health rankings sometimes scored poorly on specific conditions, and vice versa. Certain health issues are worst in Mountain states or are especially favorable (or unfavorable) in the Northern Plains. The Pacific states stand out for some health conditions, as do states bordering Mexico, with large Hispanic/Latino populations.

To summarize these differences, we produced two "heat maps" that color-code the performance of states across the 39 health conditions we examined, including measures of mortality (Figure 2) and morbidity (Figure 3). Lighter shading reflects favorable health outcomes relative to other states, and darker shading reflects less favorable ones. Scanning the row for any individual state reveals outlier conditions with distinctly different shading compared to the state's typical rankings on most of the other health conditions. For example, Hawaii, the state with the highest life expectancy, has high rates of asthma and deaths from influenza and pneumonia. Southern states with generally low health rankings (mostly dark shades) are at the top of the list (light shades) for some conditions. This portrait of health across states exposes exceptions to the rule that can be instructive.

## WHAT MIGHT EXPLAIN THE VARIATIONS?

The heat map raises intriguing questions about what might explain state-level variations for specific conditions like motor vehicle fatalities, asthma, or suicide. This project allows us to start to document the relationships between health outcomes and factors that may be shaping them, such

FIGURE 2.

## HEAT MAP 1: HOW STATES RANK BY LENGTH OF LIFE AND DEATH RATES (BY CAUSE)

Numbers and colors correspond with each state's rank for a given outcome

| | LENGTH OF LIFE | | | | | UNINTENTIONAL INJURY MORTALITY | | | INTENTIONAL INJURY | |
|---|---|---|---|---|---|---|---|---|---|---|
| | All-cause mortality | Newborn life expectancy | Years of life lost before age 75 | Life expectancy at age 65 | Infant mortality | Unintentional injury | Motor vehicle fatalities | Drug overdose | Suicide | Homicide |
| **Mortality rate (median)*** | 726.8 | | | | 6.6 | 43.1 | 11.97 | 11.23 | 14 | 5 |
| Hawaii | 1 | 1 | 10 | 1 | 17 | 4 | 7 | 9 | 11 | 8 |
| California | 2 | 4 | 6 | 3 | 5 | 3 | 12 | 12 | 8 | 24 |
| Connecticut | 3 | 3 | 4 | 4 | 18 | 15 | 8 | 37 | 5 | 12 |
| New York | 4 | 7 | 7 | 7 | 11 | 1 | 4 | 13 | 3 | 15 |
| Minnesota | 5 | 2 | 1 | 6 | 10 | 17 | 9 | 6 | 13 | 9 |
| Colorado | 6 | 11 | 15 | 10 | 19 | 33 | 18 | 24 | 44 | 16 |
| Florida | 7 | 22 | 29 | 2 | 31 | 14 | 26 | 19 | 24 | 34 |
| Massachusetts | 8 | 6 | 2 | 12 | 3 | 6 | 2 | 36 | 4 | 5 |
| Arizona | 9 | 17 | 25 | 5 | 23 | 40 | 33 | 39 | 42 | 32 |
| New Jersey | 10 | 8 | 9 | 13 | 8 | 5 | 3 | 33 | 2 | 23 |
| New Hampshire | 11 | 9 | 3 | 16 | 1 | 22 | 21 | 30 | 19 | 1 |
| South Dakota | 12 | 21 | 24 | 11 | 30 | 35 | 44 | 2 | 43 | 10 |
| Washington | 13 | 13 | 8 | 18 | 4 | 13 | 6 | 23 | 26 | 13 |
| Rhode Island | 14 | 14 | 16 | 20 | 21 | 32 | 5 | 48 | 14 | 11 |
| North Dakota | 15 | 19 | 21 | 8 | 26 | 20 | 46 | 51 | 40 | NR |
| Maryland | 16 | 26 | 23 | 24 | 41 | 2 | 13 | 1 | 6 | 43 |
| Utah | 17 | 10 | 13 | 9 | 2 | 27 | 14 | 34 | 48 | 2 |
| Vermont | 18 | 5 | 5 | 17 | 9 | 41 | 25 | 22 | 37 | NR |
| Nebraska | 19 | 15 | 11 | 22 | 15 | 9 | 29 | 3 | 9 | 19 |
| Oregon | 20 | 18 | 17 | 23 | 6 | 18 | 15 | 10 | 36 | 7 |
| Wisconsin | 21 | 12 | 12 | 15 | 22 | 36 | 22 | 29 | 30 | 14 |
| Iowa | 22 | 16 | 14 | 19 | 7 | 16 | 24 | 4 | 29 | 4 |
| Illinois | 23 | 24 | 22 | 27 | 29 | 7 | 11 | 18 | 7 | 33 |
| Alaska | 24 | 33 | 36 | 28 | 24 | 43 | 10 | 31 | 50 | 28 |
| Virginia | 25 | 25 | 20 | 33 | 33 | 10 | 16 | 8 | 17 | 18 |
| Delaware | 26 | 31 | 34 | 26 | 45 | 25 | 28 | 40 | 16 | 29 |
| Idaho | 27 | 20 | 18 | 21 | 16 | 39 | 40 | 16 | 46 | 3 |
| Wyoming | 28 | 34 | 35 | 31 | 28 | 45 | 41 | 35 | 49 | NR |
| New Mexico | 29 | 32 | 41 | 14 | 12 | 49 | 39 | 46 | 47 | 38 |
| Texas | 30 | 28 | 26 | 34 | 20 | 11 | 36 | 7 | 10 | 25 |
| District of Columbia | 31 | 43 | 45 | 32 | 51 | 8 | 1 | 26 | 1 | 47 |
| Maine | 32 | 23 | 19 | 29 | 13 | 23 | 27 | 21 | 41 | 6 |
| Kansas | 33 | 27 | 27 | 30 | 36 | 28 | 34 | 14 | 31 | 20 |
| Montana | 34 | 29 | 33 | 25 | 25 | 48 | 51 | 11 | 51 | 17 |
| Pennsylvania | 35 | 30 | 28 | 35 | 34 | 30 | 19 | 44 | 23 | 26 |
| Nevada | 36 | 36 | 30 | 37 | 14 | 21 | 20 | 43 | 45 | 27 |
| North Carolina | 37 | 38 | 32 | 38 | 46 | 24 | 35 | 20 | 18 | 30 |
| Michigan | 38 | 35 | 31 | 36 | 40 | 19 | 23 | 28 | 20 | 40 |
| Georgia | 39 | 41 | 38 | 43 | 42 | 12 | 32 | 15 | 12 | 37 |
| Missouri | 40 | 40 | 40 | 41 | 32 | 37 | 31 | 38 | 34 | 39 |
| Ohio | 41 | 37 | 37 | 39 | 39 | 31 | 17 | 47 | 21 | 31 |
| Indiana | 42 | 39 | 39 | 40 | 35 | 26 | 30 | 32 | 27 | 35 |
| South Carolina | 43 | 42 | 42 | 42 | 44 | 34 | 42 | 27 | 25 | 41 |
| Tennessee | 44 | 44 | 43 | 45 | 47 | 44 | 38 | 41 | 32 | 36 |
| Arkansas | 45 | 46 | 46 | 44 | 38 | 29 | 47 | 5 | 39 | 44 |
| Louisiana | 46 | 48 | 48 | 46 | 48 | 42 | 43 | 42 | 15 | 48 |
| Kentucky | 47 | 45 | 44 | 48 | 27 | 47 | 37 | 49 | 33 | 22 |
| Oklahoma | 48 | 47 | 47 | 47 | 43 | 50 | 48 | 45 | 38 | 42 |
| West Virginia | 49 | 50 | 50 | 50 | 37 | 51 | 45 | 50 | 35 | 21 |
| Alabama | 50 | 49 | 49 | 49 | 49 | 38 | 49 | 25 | 28 | 45 |
| Mississippi | 51 | 51 | 51 | 51 | 50 | 46 | 50 | 17 | 22 | 46 |

**Age-adjusted rate per 100,000 persons*

FIGURE 2. (cont.)

## HEAT MAP 1: HOW STATES RANK BY LENGTH OF LIFE AND DEATH RATES (BY CAUSE)

Numbers and colors correspond with each state's rank for a given outcome

| | CHRONIC DISEASE MORTALITY | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Heart disease mortality | Cerebrovascular (stroke) mortality | Cancer mortality | Lower respiratory mortality | Diabetes mortality | Renal disease mortality | Influenza/ pneumonia mortality | Alzheimer's mortality |
| **Mortality rate (median)*** | 217.1 | 36.4 | 168.2 | 44.1 | 20.6 | 13.3 | 16.2 | 23.6 |
| Hawaii | 4 | 18 | 2 | 1 | 6 | 20 | 50 | 2 |
| California | 22 | 19 | 5 | 10 | 26 | 6 | 28 | 41 |
| Connecticut | 11 | 5 | 7 | 3 | 3 | 22 | 8 | 5 |
| New York | 34 | 1 | 12 | 4 | 8 | 12 | 47 | 1 |
| Minnesota | 1 | 12 | 16 | 11 | 13 | 15 | 6 | 22 |
| Colorado | 2 | 11 | 3 | 29 | 5 | 10 | 7 | 33 |
| Florida | 12 | 9 | 15 | 19 | 17 | 19 | 2 | 7 |
| Massachusetts | 3 | 3 | 20 | 6 | 1 | 34 | 36 | 12 |
| Arizona | 5 | 6 | 6 | 24 | 37 | 2 | 4 | 44 |
| New Jersey | 27 | 14 | 17 | 5 | 18 | 24 | 9 | 6 |
| New Hampshire | 8 | 2 | 19 | 21 | 12 | 18 | 13 | 21 |
| South Dakota | 20 | 32 | 11 | 15 | 34 | 3 | 26 | 48 |
| Washington | 7 | 22 | 14 | 18 | 27 | 4 | 3 | 51 |
| Rhode Island | 21 | 4 | 38 | 9 | 14 | 17 | 10 | 24 |
| North Dakota | 17 | 13 | 9 | 14 | 31 | 23 | 19 | 49 |
| Maryland | 31 | 24 | 23 | 8 | 16 | 21 | 33 | 3 |
| Utah | 16 | 34 | 1 | 7 | 44 | 31 | 40 | 13 |
| Vermont | 14 | 10 | 25 | 26 | 7 | 1 | 1 | 46 |
| Nebraska | 18 | 26 | 21 | 34 | 29 | 13 | 18 | 26 |
| Oregon | 9 | 30 | 27 | 23 | 36 | 5 | 5 | 34 |
| Wisconsin | 24 | 23 | 28 | 20 | 11 | 29 | 23 | 25 |
| Iowa | 29 | 17 | 32 | 35 | 15 | 8 | 34 | 39 |
| Illinois | 30 | 27 | 35 | 17 | 20 | 40 | 30 | 16 |
| Alaska | 6 | 39 | 36 | 13 | 23 | 14 | 15 | 11 |
| Virginia | 25 | 35 | 22 | 12 | 10 | 42 | 32 | 14 |
| Delaware | 26 | 28 | 31 | 25 | 19 | 37 | 12 | 9 |
| Idaho | 13 | 21 | 13 | 31 | 38 | 7 | 21 | 20 |
| Wyoming | 19 | 20 | 8 | 49 | 2 | 11 | 38 | 19 |
| New Mexico | 10 | 7 | 4 | 27 | 48 | 25 | 20 | 4 |
| Texas | 33 | 37 | 18 | 22 | 28 | 36 | 17 | 27 |
| District of Columbia | 45 | 8 | 41 | 2 | 9 | 9 | 11 | 15 |
| Maine | 15 | 16 | 39 | 36 | 24 | 27 | 14 | 23 |
| Kansas | 28 | 33 | 24 | 38 | 22 | 41 | 45 | 18 |
| Montana | 23 | 31 | 10 | 39 | 21 | 16 | 25 | 17 |
| Pennsylvania | 35 | 29 | 33 | 16 | 33 | 35 | 27 | 8 |
| Nevada | 38 | 15 | 26 | 43 | 4 | 26 | 39 | 10 |
| North Carolina | 32 | 44 | 29 | 30 | 30 | 39 | 37 | 38 |
| Michigan | 42 | 25 | 34 | 32 | 39 | 28 | 24 | 31 |
| Georgia | 36 | 42 | 30 | 28 | 35 | 44 | 31 | 29 |
| Missouri | 41 | 38 | 42 | 41 | 25 | 43 | 42 | 36 |
| Ohio | 40 | 36 | 40 | 37 | 45 | 30 | 29 | 30 |
| Indiana | 39 | 40 | 43 | 46 | 46 | 45 | 22 | 40 |
| South Carolina | 37 | 50 | 37 | 40 | 32 | 38 | 16 | 45 |
| Tennessee | 46 | 49 | 45 | 42 | 43 | 33 | 48 | 50 |
| Arkansas | 48 | 50 | 48 | 47 | 41 | 49 | 49 | 35 |
| Louisiana | 47 | 45 | 47 | 33 | 47 | 51 | 41 | 47 |
| Kentucky | 44 | 43 | 51 | 51 | 40 | 48 | 43 | 43 |
| Oklahoma | 49 | 47 | 46 | 48 | 49 | 32 | 35 | 37 |
| West Virginia | 43 | 41 | 49 | 50 | 51 | 46 | 46 | 28 |
| Alabama | 50 | 51 | 44 | 45 | 42 | 47 | 44 | 32 |
| Mississippi | 51 | 48 | 50 | 44 | 50 | 50 | 51 | 42 |

*Age-adjusted rate per 100,000 persons

FIGURE 3.

## HEAT MAP 2: HOW STATES RANK BY THE PREVALENCE OF CONDITIONS

Numbers and colors correspond with each state's rank for a given outcome

| | CHILDREN AND ADOLESCENTS | | | | | | COMMUNICABLE DISEASES | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low birth weight | Dental problems | Obesity | Asthma | Teen births | Health status | Chlamydia | Gonorrhea | HIV |
| Hawaii | 27 | 24 | 12 | 49 | 26 | 15 | 32 | 16 | 15 |
| California | 10 | 48 | 26 | 16 | 21 | 46 | 28 | 26 | 39 |
| Connecticut | 21 | 16 | 22 | 46 | 3 | 4 | 12 | 17 | 27 |
| New York | 25 | 43 | 33 | 37 | 8 | 30 | 40 | 35 | 46 |
| Minnesota | 38 | 14 | 11 | 12 | 6 | 33 | 8 | 15 | 18 |
| Colorado | 9 | 46 | 2 | 11 | 19 | 18 | 23 | 14 | 23 |
| Florida | 37 | 39 | 13 | 45 | 25 | 45 | 19 | 33 | 47 |
| Massachusetts | 19 | 2 | 27 | 41 | 2 | 7 | 10 | 9 | 37 |
| Arizona | 14 | 45 | 48 | 31 | 40 | 48 | 34 | 27 | 31 |
| New Jersey | 30 | 29 | 4 | 24 | 5 | 27 | 7 | 23 | 45 |
| New Hampshire | 15 | 5 | 5 | 22 | 1 | 9 | 1 | 4 | 8 |
| South Dakota | 6 | 11 | 9 | 1 | 33 | 2 | 35 | 25 | 6 |
| Washington | 3 | 41 | 6 | 9 | 14 | 16 | 11 | 11 | 21 |
| Rhode Island | 20 | 8 | 15 | 42 | 9 | 31 | 21 | 12 | 22 |
| North Dakota | 8 | 10 | 46 | 10 | 22 | 1 | 24 | 13 | 3 |
| Maryland | 39 | 18 | 31 | 39 | 11 | 20 | 30 | 29 | 49 |
| Utah | 13 | 33 | 1 | 2 | 13 | 22 | 4 | 6 | 12 |
| Vermont | 4 | 1 | 3 | 20 | 4 | 12 | 5 | 5 | 1 |
| Nebraska | 12 | 26 | 19 | 7 | 23 | 19 | 13 | 19 | 13 |
| Oregon | 2 | 50 | 7 | 25 | 16 | 28 | 9 | 8 | 20 |
| Wisconsin | 17 | 6 | 18 | 14 | 10 | 17 | 22 | 21 | 11 |
| Iowa | 11 | 12 | 16 | 3 | 17 | 21 | 15 | 18 | 9 |
| Illinois | 28 | 38 | 38 | 19 | 24 | 25 | 42 | 41 | 43 |
| Alaska | 1 | 23 | 24 | 4 | 37 | 5 | 49 | 32 | 10 |
| Virginia | 24 | 13 | 23 | 30 | 12 | 13 | 26 | 24 | 33 |
| Delaware | 35 | 31 | 32 | 50 | 18 | 32 | 37 | 31 | 41 |
| Idaho | 5 | 28 | 14 | 6 | 27 | 26 | 6 | 2 | 4 |
| Wyoming | 34 | 17 | 10 | 8 | 38 | 35 | 14 | 1 | 1 |
| New Mexico | 40 | 47 | 35 | 18 | 51 | 38 | 45 | 28 | 17 |
| Texas | 33 | 49 | 47 | 15 | 47 | 44 | 38 | 38 | 44 |
| District of Columbia | 48 | 9 | 44 | 51 | 42 | 40 | 51 | 51 | 51 |
| Maine | 7 | 3 | 21 | 27 | 7 | 14 | 2 | 7 | 7 |
| Kansas | 16 | 34 | 25 | 21 | 36 | 11 | 17 | 20 | 16 |
| Montana | 18 | 40 | 20 | 5 | 28 | 6 | 16 | 3 | 5 |
| Pennsylvania | 26 | 30 | 8 | 38 | 15 | 8 | 25 | 37 | 32 |
| Nevada | 29 | 51 | 36 | 17 | 34 | 47 | 20 | 22 | 34 |
| North Carolina | 43 | 32 | 29 | 29 | 30 | 37 | 41 | 45 | 38 |
| Michigan | 32 | 4 | 34 | 32 | 20 | 24 | 36 | 39 | 26 |
| Georgia | 46 | 19 | 43 | 43 | 35 | 29 | 43 | 46 | 50 |
| Missouri | 23 | 35 | 17 | 34 | 31 | 10 | 33 | 40 | 29 |
| Ohio | 36 | 20 | 28 | 26 | 29 | 3 | 31 | 43 | 30 |
| Indiana | 22 | 25 | 30 | 33 | 32 | 23 | 29 | 34 | 24 |
| South Carolina | 47 | 22 | 49 | 23 | 39 | 41 | 46 | 47 | 40 |
| Tennessee | 44 | 44 | 41 | 35 | 41 | 50 | 39 | 42 | 36 |
| Arkansas | 42 | 36 | 40 | 13 | 48 | 51 | 44 | 44 | 19 |
| Louisiana | 50 | 37 | 51 | 36 | 45 | 49 | 47 | 49 | 48 |
| Kentucky | 41 | 27 | 45 | 48 | 44 | 34 | 18 | 30 | 28 |
| Oklahoma | 31 | 42 | 39 | 40 | 50 | 36 | 27 | 36 | 25 |
| West Virginia | 45 | 7 | 37 | 28 | 46 | 42 | 3 | 10 | 14 |
| Alabama | 49 | 15 | 42 | 44 | 43 | 39 | 48 | 48 | 35 |
| Mississippi | 51 | 21 | 50 | 47 | 49 | 43 | 50 | 50 | 42 |

FIGURE 3. (cont.)

## HEAT MAP 2: HOW STATES RANK BY THE PREVALENCE OF CONDITIONS

Numbers and colors correspond with each state's rank for a given outcome

| | NON-COMMUNICABLE/CHRONIC DISEASES OF ADULTS | | | | | HEALTH-RELATED QUALITY OF LIFE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Obesity | Angina or CHD* | Stroke | Diabetes | Lung cancer | Adult health status | Physically unhealthy days | Mentally unhealthy days | Activity limitations |
| Hawaii | 2 | 1 | 22 | 21 | 10 | 22 | 8 | 4 | 1 |
| California | 15 | 8 | 15 | 25 | 3 | 42 | 14 | 18 | 11 |
| Connecticut | 8 | 9 | 1 | 11 | 26 | 4 | 5 | 14 | 3 |
| New York | 13 | 31 | 12 | 30 | 23 | 26 | 9 | 21 | 23 |
| Minnesota | 18 | 12 | 3 | 4 | 13 | 3 | 12 | 7 | 5 |
| Colorado | 3 | 5 | 2 | 2 | 2 | 12 | 13 | 9 | 24 |
| Florida | 30 | 48 | 45 | 45 | 43 | 38 | 40 | 44 | 42 |
| Massachusetts | 6 | 26 | 7 | 13 | 30 | 7 | 24 | 34 | 10 |
| Arizona | 28 | 25 | 38 | 31 | 11 | 31 | 36 | 29 | 34 |
| New Jersey | 14 | 17 | 18 | 32 | 19 | 24 | 20 | 35 | 4 |
| New Hampshire | 19 | 33 | 9 | 18 | 36 | 8 | 18 | 23 | 20 |
| South Dakota | 33 | 39 | 8 | 6 | 18 | 6 | 26 | 12 | 19 |
| Washington | 16 | 6 | 14 | 15 | 14 | 18 | 22 | 17 | 47 |
| Rhode Island | 21 | 28 | 19 | 17 | 29 | 14 | 21 | 33 | 15 |
| North Dakota | 27 | 30 | 16 | 12 | 21 | 16 | 4 | 2 | 9 |
| Maryland | 38 | 14 | 20 | 33 | 12 | 15 | 10 | 24 | 12 |
| Utah | 4 | 4 | 10 | 3 | 1 | 10 | 2 | 5 | 18 |
| Vermont | 5 | 15 | 11 | 5 | 40 | 2 | 6 | 6 | 29 |
| Nebraska | 29 | 21 | 17 | 16 | 15 | 11 | 11 | 8 | 14 |
| Oregon | 10 | 11 | 21 | 10 | 24 | 32 | 39 | 22 | 50 |
| Wisconsin | 22 | 16 | 5 | 8 | 22 | 19 | 25 | 13 | 8 |
| Iowa | 39 | 22 | 30 | 14 | 33 | 5 | 15 | 10 | 6 |
| Illinois | 20 | 18 | 26 | 28 | 25 | 29 | 3 | 1 | 7 |
| Alaska | 37 | 3 | 6 | 1 | 5 | 1 | 7 | 11 | 21 |
| Virginia | 11 | 24 | 25 | 27 | 16 | 21 | 31 | 36 | 17 |
| Delaware | 25 | 35 | 34 | 29 | 46 | 20 | 29 | 32 | 28 |
| Idaho | 17 | 10 | 13 | 19 | 8 | 28 | 30 | 16 | 37 |
| Wyoming | 24 | 19 | 4 | 9 | 7 | 13 | 16 | 15 | 26 |
| New Mexico | 9 | 23 | 24 | 22 | 4 | 43 | 42 | 39 | 36 |
| Texas | 42 | 34 | 31 | 37 | 6 | 39 | 23 | 26 | 13 |
| District of Columbia | 1 | 2 | 41 | 20 | 9 | 9 | 1 | 3 | 2 |
| Maine | 23 | 44 | 29 | 26 | 48 | 25 | 19 | 27 | 39 |
| Kansas | 26 | 27 | 23 | 23 | 20 | 17 | 17 | 19 | 22 |
| Montana | 12 | 13 | 28 | 7 | 27 | 27 | 28 | 20 | 41 |
| Pennsylvania | 34 | 41 | 39 | 44 | 42 | 30 | 27 | 28 | 31 |
| Nevada | 7 | 20 | 37 | 24 | 51 | 37 | 37 | 30 | 25 |
| North Carolina | 31 | 40 | 36 | 38 | 32 | 41 | 43 | 43 | 27 |
| Michigan | 43 | 45 | 32 | 41 | 34 | 23 | 33 | 25 | 35 |
| Georgia | 35 | 7 | 27 | 36 | 17 | 33 | 38 | 42 | 16 |
| Missouri | 36 | 36 | 48 | 34 | 44 | 35 | 45 | 40 | 44 |
| Ohio | 32 | 29 | 35 | 42 | 39 | 34 | 34 | 38 | 30 |
| Indiana | 40 | 37 | 33 | 39 | 37 | 36 | 32 | 31 | 33 |
| South Carolina | 46 | 38 | 47 | 47 | 31 | 40 | 44 | 37 | 38 |
| Tennessee | 48 | 42 | 42 | 49 | 45 | 45 | 50 | 50 | 40 |
| Arkansas | 44 | 43 | 46 | 35 | 47 | 44 | 35 | 41 | 43 |
| Louisiana | 41 | 46 | 40 | 43 | 28 | 47 | 41 | 45 | 32 |
| Kentucky | 47 | 50 | 44 | 40 | 50 | 49 | 47 | 48 | 45 |
| Oklahoma | 45 | 47 | 50 | 46 | 35 | 46 | 46 | 49 | 49 |
| West Virginia | 49 | 51 | 43 | 48 | 49 | 50 | 51 | 51 | 51 |
| Alabama | 51 | 49 | 51 | 51 | 41 | 48 | 48 | 47 | 48 |
| Mississippi | 50 | 32 | 49 | 50 | 38 | 51 | 49 | 46 | 46 |

**CHD = Coronary heart disease*

as neighborhood conditions, housing, income, employment, activity limitations, and education. Other possible drivers of health include things like the food environment, child care, transportation, and violence. This analysis covers many of these (all at the state level), in an effort to start to look at relationships and patterns — ones that we know are important based on existing studies and evidence, and ones that are not yet well understood or have not been examined.

Health is the product of multiple determinants that accumulate over time and vary by place. Conditions in states that may optimize some health outcomes may appear alongside other conditions that compromise health in other ways. The HOTS project looks at associations between state health outcomes and potential health determinants in five broad domains:

- Health behaviors
- The physical and social environment
- Social and economic conditions of individuals and households
- Health systems
- Public policies and spending

This opportunity to look comprehensively at the living conditions and resources available to individuals, families, and communities and how they correlate with state health is a first step. While others have already developed indicators and metrics for some of these domains,[36–40] our goal was to take a "deep dive" to explore each domain in greater detail, across multiple determinants and outcomes. We present a wide range of data and examine those patterns and associations that correspond with better or worse health across the states.

The companion supplement, *Spotlight on methods*, provides a detailed discussion of the caveats about this analysis that readers should keep in mind. For example, the findings rely heavily on cross-sectional analyses—comparing the characteristics of groups at a single point in time—and this approach carries inherent limitations. Chief among these is the *ecological fallacy*, the mistake of drawing inferences about individuals based on data for the groups to which they belong rather than on their own characteristics. Health and disease are dynamic processes that evolve over time; longitudinal or prospective studies provide more definitive evidence, especially if they can capture data at the individual level and follow people's experiences over a period of years.

The causal relationship between a given measure or health determinant and a given health outcome is often complex—there may be multiple pathways linking them (e.g., high levels of education may improve life expectancy because of higher levels of health literacy and because higher education often leads to higher incomes, which often leads to better health), and causality may work in both directions

(e.g., poor health can interrupt schooling and lead to lower levels of educational attainment).[41] Many measures that appear closely related to a health outcome may actually reflect the common influence of a third factor. And our results are only as good as our data, which are themselves subject to error; for example, some states may appear to be doing well in regard to particular conditions simply because there are relatively low rates of diagnosis due to inadequate access to health care.

This project does not attempt to fully unravel these complexities. Future research will continue to assemble more definitive data and begin to understand the complex causal pathways that lead to health disparities. This first look sets the stage for subsequent multivariate analyses and the use of machine learning and data mining to test potential causal pathways. From there, we can begin to disentangle the linkages between health determinants as they act on a given health outcome. This discovery process is an undertaking that will require more than the two years available for this project. Our goal here is to start the conversation—to raise questions about intriguing patterns observable in the state-level data and to encourage researchers and policymakers to explore them further.

# What We Learned

More than 20 years have passed since publication of the seminal 1993 article, *The Actual Causes of Death*, in which Michael McGinnis and William Foege advanced the notion that the leading causes of death in the United States were health behaviors.[42] Subsequent studies have continued to emphasize that unhealthy or risky behaviors—especially tobacco use, physical inactivity, poor diet, and problem drinking—are largely responsible for the chronic conditions afflicting Americans, such as diabetes, heart disease, cancer, strokes, and chronic obstructive pulmonary disease (e.g., emphysema). Heath systems, payers, and government officials understand the enormous economic implications and are looking for ways to encourage Americans to pursue healthier lifestyles.

Our findings support this thesis. Across the five domains we examined, the highest correlations with health outcomes involved health behaviors ($r_s$ as high as 0.87), followed by social and economic factors ($r_s$ as high as 0.87), health systems ($r_s$ as high as 0.84), the physical and social environment ($r_s$ as high as 0.84), and

public policies and spending ($r_s$ as high as 0.79). Social and economic factors emerged as an important domain. Of the 175 correlations in this project that qualify as "very high" ($r_s \geq \pm 0.70$) , 69 involve social and economic factors, 48 involve the physical and social environment, 27 involve health behaviors, 24 involve the health system, and 7 involve public policies and spending. This list includes certain indicators that correlated with multiple health outcomes. This occurred most often with physical inactivity (10 times), median household income (9 times), annual dental visits (8 times), smokers in households (7 times), having a Bachelor's degree or higher (7 times), overall poverty and child poverty (6 times each), avoidable hospitalization (6 times), childhood trauma (6 times), current smokers (6 times), and neighborhood resources for children (6 times). Below we examine these findings in more detail, by domain.

## HEALTH BEHAVIORS

Consistent with the literature, this project found that disparities in health across states correlated highly with health behaviors. For example, tobacco use and physical inactivity correlated highly with life expectancy, birth outcomes, and a long list of adult diseases (Figure 4). Similarly, childhood nutrition and physical activity[c] correlated highly with childhood conditions, but even more extensively with adult conditions (Figure 5). As research has shown,[43] the risk of adult diseases can be reduced if healthier behaviors are adopted at these younger ages.

Our data revealed other expected associations between health outcomes and health behaviors. Unsafe sexual practices correlated with teen pregnancy, sexually transmitted infections, and adverse birth outcomes.[d] Teen texting and driving correlated with motor vehicle fatalities ($r_s$= 0.57). Non-medical use of prescription drugs correlated with drug overdose deaths ($r_s$ = 0.50) and activity limitations ($r_s$= 0.58). States where more children lived with someone with an alcohol or drug problem had higher rates of unintentional injury mortality ($r_s$= 0.61), suicides ($r_s$= 0.69), and activity limitations ($r_s$= 0.53).

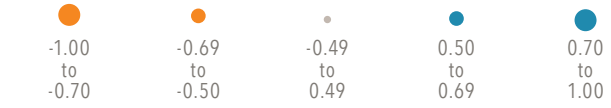
We also observed interesting patterns of *co-occurrence*—states where people often engage in a behavior that causes one disease may also rank highly on behaviors that cause other diseases or injuries. For example, we found that states with high smoking rates had a higher prevalence of teens carrying weapons or using alcohol or drugs before sex. States where children got more physical activity reported less dating (intimate partner) violence among youth. Where teens engaged in more unsafe sex, motor vehicle fatalities and homicides occurred more frequently. We

c. Rankings for adult physical inactivity also correlated highly with pediatric obesity.

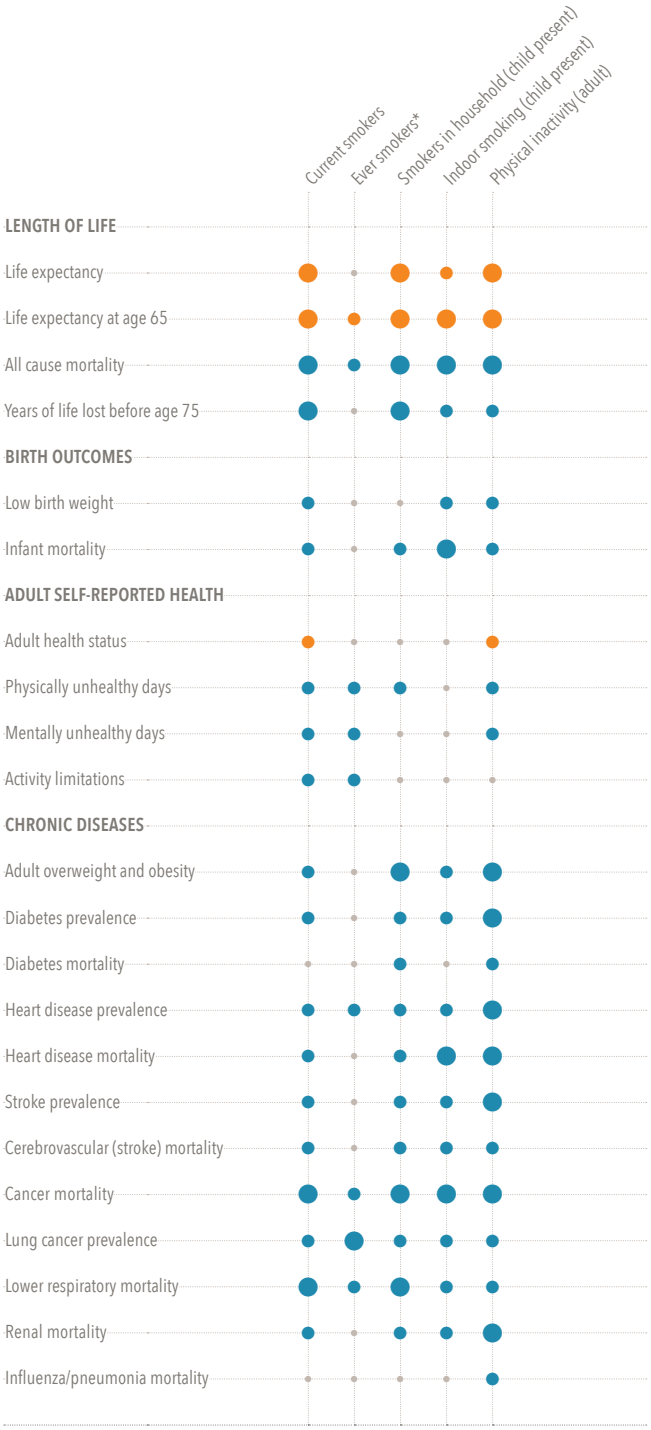
d. Teen births correlated with sexual activity before age 18 ($r_s$= 0.56) and correlated inversely with teen use of birth control ($r_s$= -0.65). Use of birth control was also inversely correlated with rates of chlamydia ($r_s$= -0.53) and gonorrhea ($r_s$= -0.56). Sexual activity before age 18 also correlated with low birth weight ($r_s$= 0.53) and infant mortality ($r_s$= 0.60).

FIGURE 4.

## WHAT CORRELATES THE MOST WITH SMOKING AND PHYSICAL ACTIVITY?



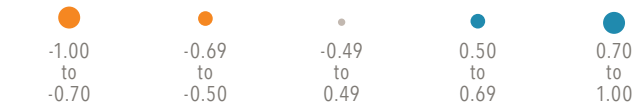

The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.



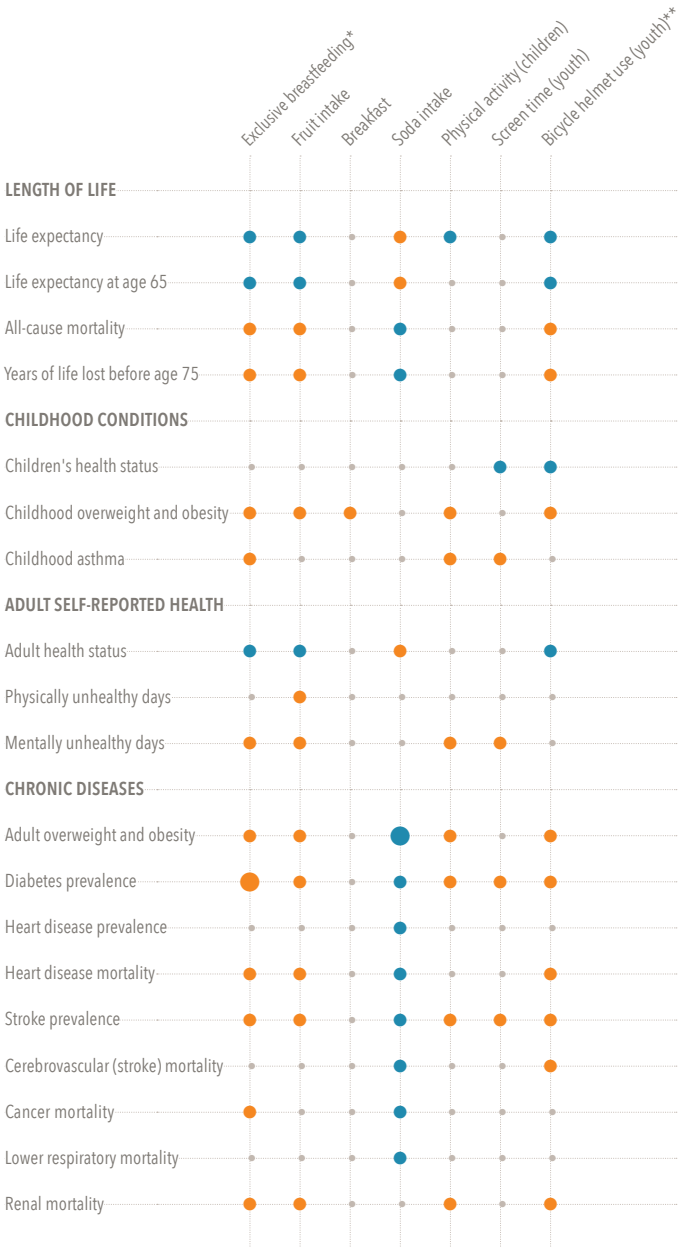

*Ever smoker = current and former smokers.

FIGURE 5.

## WHAT CORRELATES THE MOST WITH CHILD HEALTH BEHAVIORS?




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.




* A history of any breastfeeding (versus exclusive breastfeeding), correlated very highly with adult overweight ($r_s$= -0.70), CVD mortality ($r_s$= -0.74), cancer mortality ($r_s$= -0.74). The link between breastfeeding and adult health can be attributed to both the known health benefits of breastfeeding and its co-occurrence with healthy childhood behaviors. Exclusive breastfeeding correlated with physical activity ($r_s$= 0.64) and bicycle helmet use ($r_s$= 0.71), as well as with adult behaviors, such as walking/cycling to work ($r_s$= 0.68) and physical inactivity ($r_s$= -0.71). It also correlated with fewer avoidable hospitalizations and readmissions for heart failure.

**Correlations observed for bicycle helmet use likely represent the benefits of physical activity and cycling, rather than the intended purpose of preventing head injuries.

Rankings for youth soda consumption correlated highly with deaths from cancer ($r_s$= 0.51), lower respiratory disease ($r_s$= 0.63), and Alzheimer's disease ($r_s$= 0.56). Although obesity may play a causal role with cancer and other adult diseases, a direct causal link with soda intake is less well established.

FIGURE 6.

## WHAT ELSE CORRELATES WITH HEALTH BEHAVIORS?

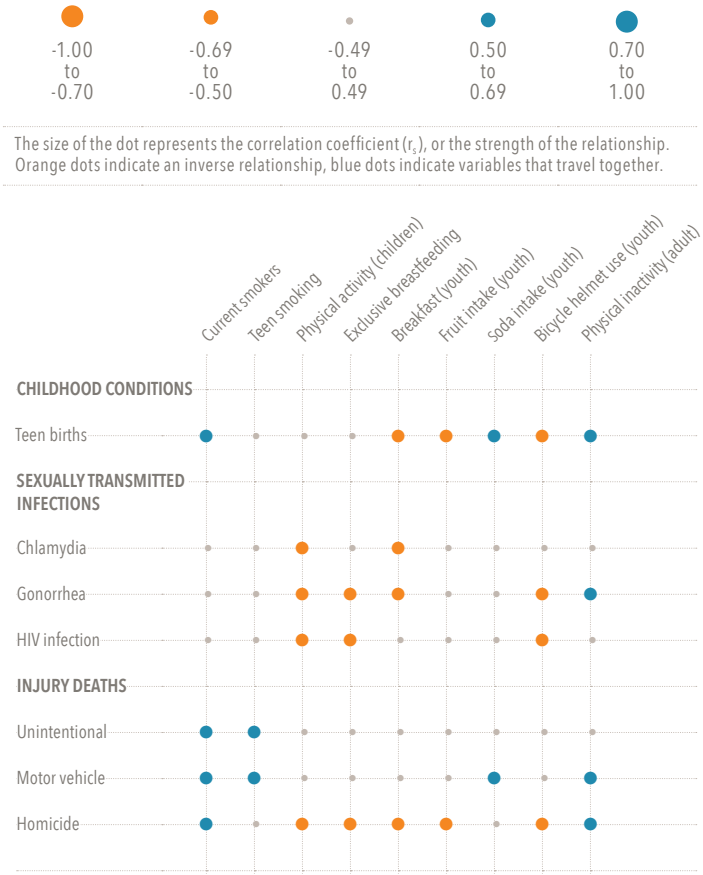
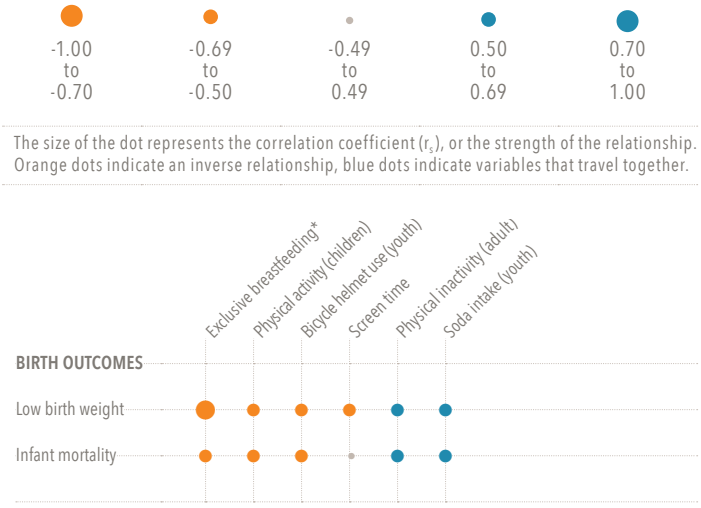



FIGURE 7.

## HEALTH BEHAVIORS AND BIRTH OUTCOMES




emphasize that these associations do not reflect causal relationships but rather a pattern of *co-occurrence*, where conditions in states seem to "travel together." The co-occurrence of conditions helps to explain why rankings for some behaviors, such as smoking and physical inactivity, correlate highly with conditions related to sexual practices or unsafe behaviors that cause negative health outcomes—unintentional (e.g., motor vehicle fatalities) or otherwise (e.g., homicide) (Figure 6). Similarly, co-occurrence of different health behaviors may explain why breastfeeding correlated with such conditions as gonorrhea, HIV, homicide, and strokes.

We found other examples where the co-occurrence of behaviors may explain correlations with birth outcomes, child health, and adult health:

### Birth outcomes

We found that birth weight and infant mortality, which are affected by behaviors before and during pregnancy, correlated with behaviors that occur after pregnancy. One might predict that women who breastfeed are more likely to engage in healthier habits during pregnancy. States where children and adults have healthier habits—and where presumably pregnant women might also be healthier—also appear to have better birth outcomes (Figure 7).

## Child health

Certain childhood conditions correlated with behaviors that cause other childhood conditions, or even adult disorders. For example, teen use of birth control correlated very strongly (inversely) with pediatric obesity ($r_s$= -0.71); we reasoned that states where teens practice safe sex may also be states where youth eat healthier or get more physical activity. Conversely, states where violent behaviors cause a higher rate of one type of injury may be where other violent or risky behaviors, or access to dangerous weapons, cause different injuries. For example, states where youth were more likely to carry weapons (e.g., guns, knives) had higher rates of suicide and unintentional injury deaths, especially motor vehicle fatalities ($r_s$= 0.72).[e] The violent crime rate correlated highly with teen births: unprotected sexual intercourse often results from unsafe sexual behaviors or intimate partner violence.[44]

## Adult health

Unhealthy youth behaviors also correlated with adult diseases caused by different behaviors. For example, sexual activity before age 18 was correlated with a long list of adult diseases, most of which have strong behavioral causes.[f] Again, we suspect that co-occurrence, in which certain health behaviors "travel together," may explain these correlations.

# THE ENVIRONMENT

States have high or low rates of health behaviors for a reason. It is not simply because they are populated by people who do not take responsibility for their health. Advocates of personal responsibility have often seized on the important role of behavior in disease and too often have "blamed the victim," arguing that people are responsible for the health consequences if they choose to smoke, eat poorly, or avoid exercise.[45] However, it is widely understood—both through research and lived experience—that our ability to change our lifestyle depends on whether we live in an environment that is safe and conducive to good health.[46] We also know that "many of today's food environments exploit people's biological, psychological, social, and economic vulnerabilities, making it easier for them to eat unhealthy foods. This reinforces preferences and market demands for foods of poor nutritional quality, furthering the unhealthy food environments."[47] People with the best intentions to live healthier or to encourage their children to adopt

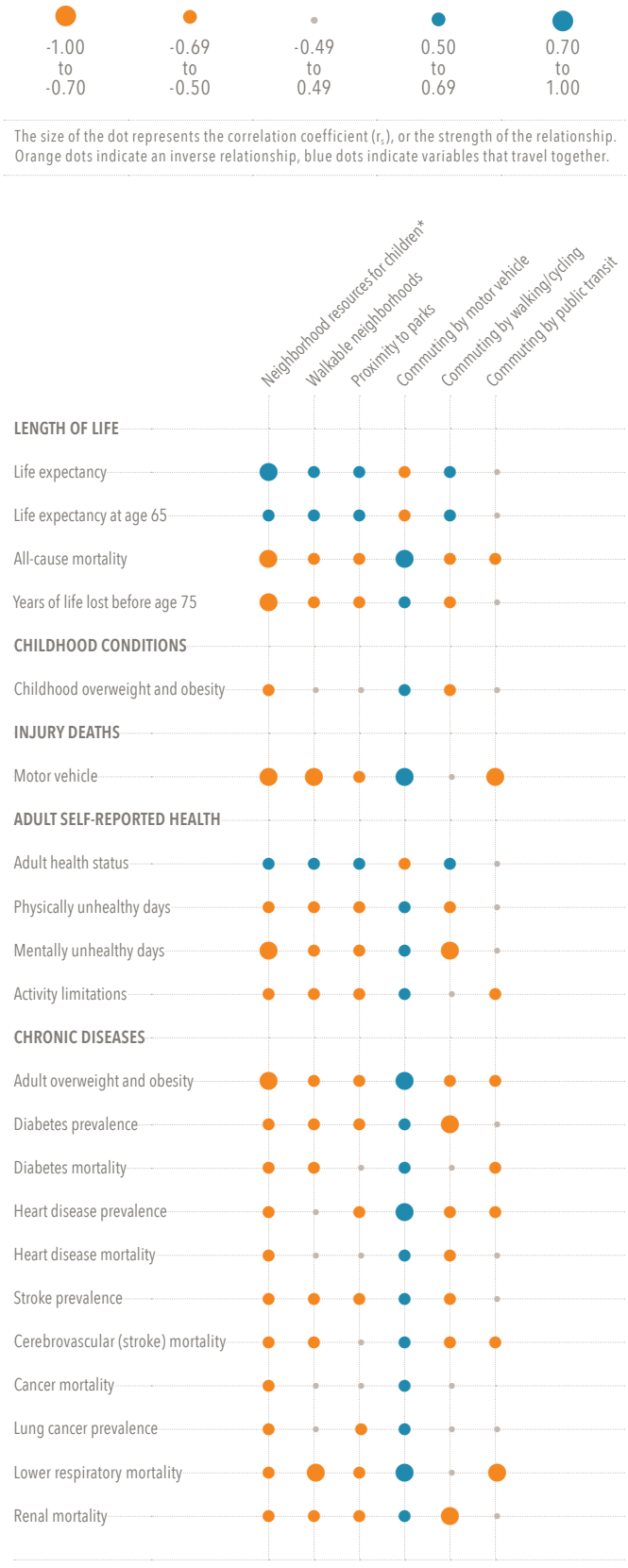
***"healthier habits may fail if community conditions present barriers that stand in the way"***

e. States where youth carry weapons more often had fewer annual dental visits by adults ($r_s$= 0.67), less state spending on mass transit per capita ($r_s$ = -0.65) and colorectal cancer screening ($r_s$= -0.64), and had fewer persons with college degrees ($r_s$ =-0.60).

f. These include adult health status, physically and mentally unhealthy days, activity limitations, adult overweight/obesity, diabetes prevalence, heart disease prevalence/mortality, stroke prevalence/mortality, lung cancer prevalence, and deaths from lower respiratory and renal disease.

FIGURE 8.

## WHAT CORRELATES THE MOST WITH THE BUILT ENVIRONMENT?




healthier habits may fail if they live in a state where community conditions—including both the *physical* and *social* environments—present barriers that stand in the way.

### The Physical Environment

Physical activity—a means to control obesity and reduce the risk of heart disease and other chronic conditions—is far easier when one lives in a built environment that promotes walking and cycling over driving and that provides safe, accessible green space (e.g., parks, playgrounds) where children can replace idleness and screen time with outdoor activity.[48–51] We found that certain states performed better in creating these conditions: states with more neighborhood resources for children that promoted active play (e.g., sidewalks, parks, and community centers) had higher walkability scores ($r_s$= 0.76) and fewer residents commuting by motor vehicle ($r_s$= -0.76). States where more people commuted to work by walking or cycling had fewer motor vehicle commuters ($r_s$= -0.81)—and commuting patterns have health implications because they affect activity levels. For example, in Denmark, where the bike lane system enables 25 percent of the population to cycle to work, mortality is 30 percent lower among cycle commuters than among those who use passive transport.[52] In the United States as well, we found that states with healthier

built environments had dramatically better health outcomes. As shown in Figure 8, these states had longer life expectancy, were more likely to describe their health as good or excellent, and had fewer unhealthy days per month. These states had fewer motor vehicle fatalities, fewer overweight and obese people, and lower rates of chronic diseases such as heart disease, diabetes, and lower respiratory disease.

Interaction with the natural environment (e.g., green space) has been linked with improved mental health and wellbeing, positive emotions, and lower stress.[53] We found that states with greater access to parks, neighborhood resources for children to be active, and opportunities for walking and cycling had fewer mentally unhealthy days (Figure 8). We also found an inverse correlation between public transportation and suicide rates ($r_s$= -0.52). Further research is necessary to understand which factors are causal.

The physical environment can of course affect health in other ways. For example, we found a high correlation between air pollution (airborne fine particulate matter) and poor birth outcomes and cardiovascular mortality,[g] a pattern reported in the literature.[54–57] We also noted that the built environment and commuting practices correlated with conditions seemingly unrelated to physical activity or motor vehicle crashes—e.g., infant mortality, teen births, gonorrhea, unintentional injury,[h] and homicide (Figure 9). We suspect that much of this association is due to confounding variables: for example, these diseases and injuries may have no causal relationship but co-occur in places with unhealthy built environments because each of these factors (the listed conditions and poor built environments) are more common in places with low socioeconomic status.[58]

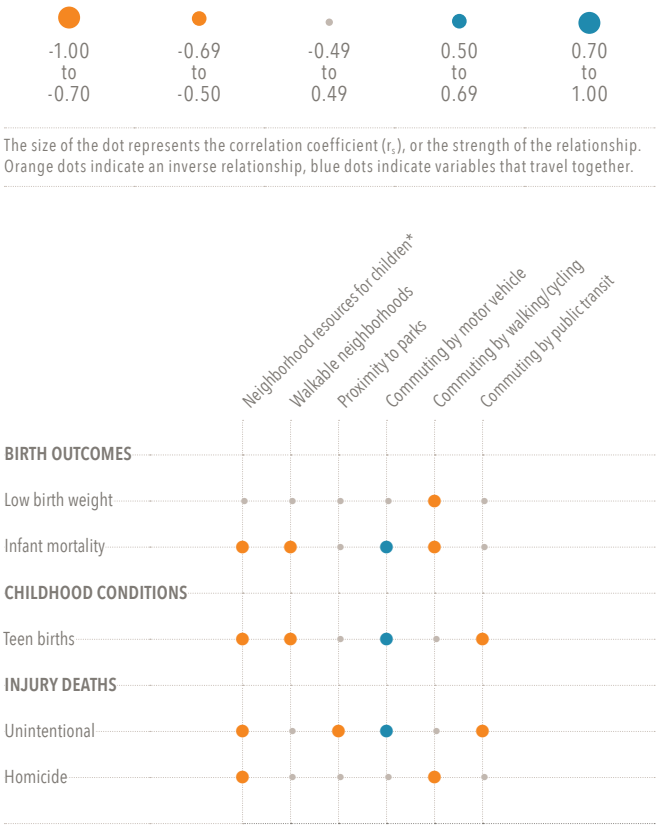
## The Social Environment

Our data support research that links

g. The concentration of fine particulate matter was correlated with low birth weight ($r_s$= 0.58) and infant mortality ($r_s$= 0.53) and with cardiovascular mortality ($r_s$=0.50), as well as with lower life expectancy at age 65 ($r_s$= -0.50).

h. Unintentional injuries include motor vehicle fatalities but also other injuries such as poisonings, falls, drownings, and burns.

FIGURE 9.
### OTHER CONDITIONS ASSOCIATED WITH THE BUILT ENVIRONMENT




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

our health with the social fabric of our communities. Studies have shown that neighborhood social resources, such as social cohesion and opportunities for engagement, correlate with health behaviors, improved psychological wellbeing (e.g., lower rates of depression), and lower mortality rates.[59–61] Although we could not compare the social environment of *adults* at the state level, our data did shed light on state differences in social support for *children*. Communities where more parents read and talked to children and where children found more support from neighbors—the measures we did examine—may also be places with healthier social environments for adults. Further research to examine social capital, which can be measured by various indices,[62–64] may help clarify how the social environment affects adult health.

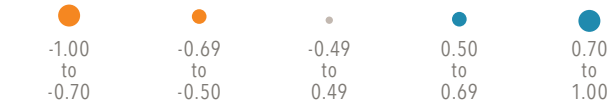
***"Our data support research that links our health with the social fabric of our communities"***

The social environment experienced by children is, of course, very important to their growth and development. A large and growing literature has documented how early childhood and brain development are influenced by nurturing and maternal bonding. Children's social environments can affect their success in school and, later, their work life and social mobility.[65] According to Chetty et al., children's prospects for intergenerational upward mobility—where children face a better economic future than their parents—are keyed to living in areas with "(1) less residential segregation, (2) less income inequality, (3) better primary schools, (4) greater social capital, and (5) greater family stability."[66]

Conversely, exposure to childhood trauma and adverse childhood events (ACEs) predicts poor health, both in childhood and later in life.[67–69] We observed correlations at the state level—albeit cross-sectional—between rates of adult diseases and childhood trauma (ACEs), and lower disease rates in association with social support for children (Figure 10). Such associations are complex, because early life experiences correlate with other factors that also cause diseases. For example, states with higher ACE exposure also tend to have lower socioeconomic status. In addition, childhood trauma and ACEs can precipitate behaviors that affect health by other means, such as the use of tobacco, alcohol, or drugs. Finally, the socioeconomic status of the neighborhood can act as a confounding variable: for example, youth in areas with deep poverty may face greater exposure to ACEs and also receive inadequate social support for education,[70] and the latter may be the

FIGURE 10.

## WHAT CORRELATES THE MOST WITH THE SOCIAL ENVIRONMENT OF CHILDREN?

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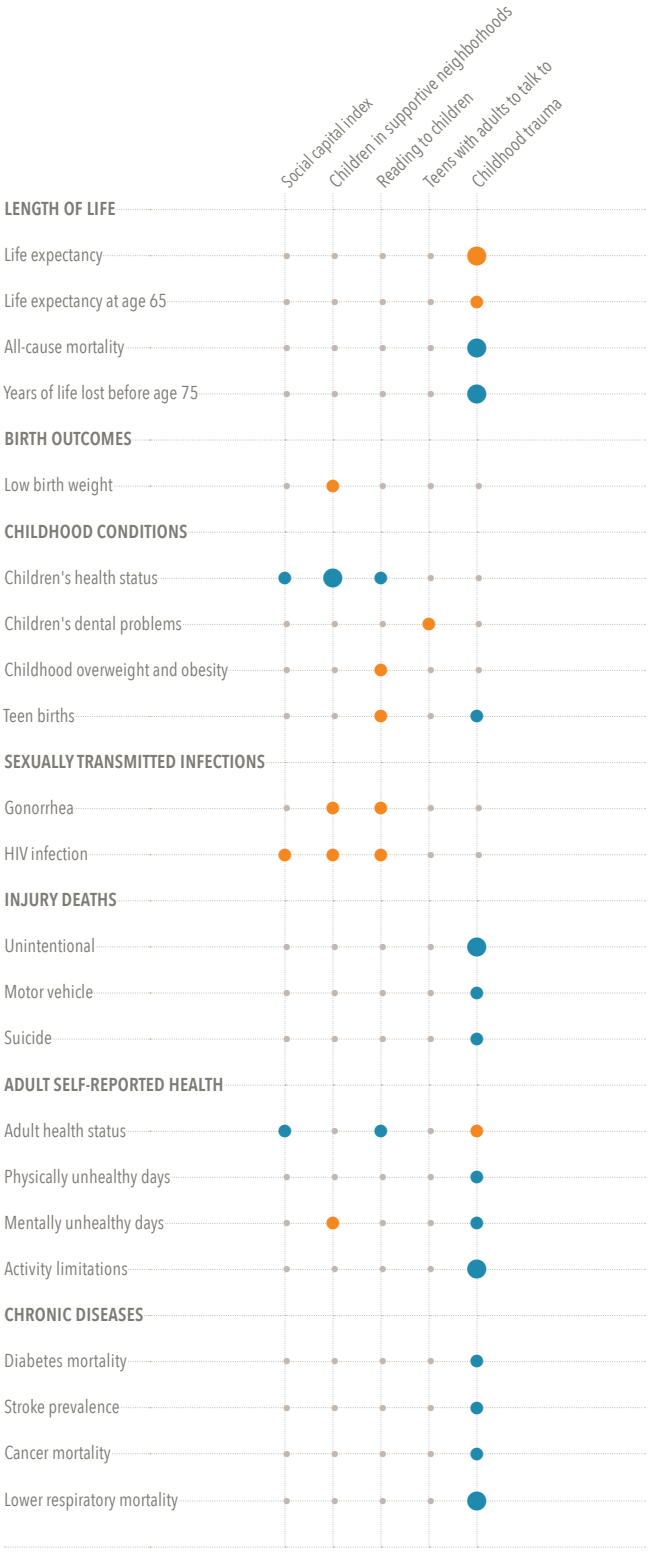
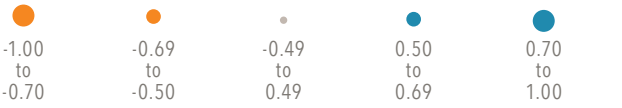



FIGURE 11.

## WHAT CORRELATES THE MOST WITH YOUTH SAFETY?

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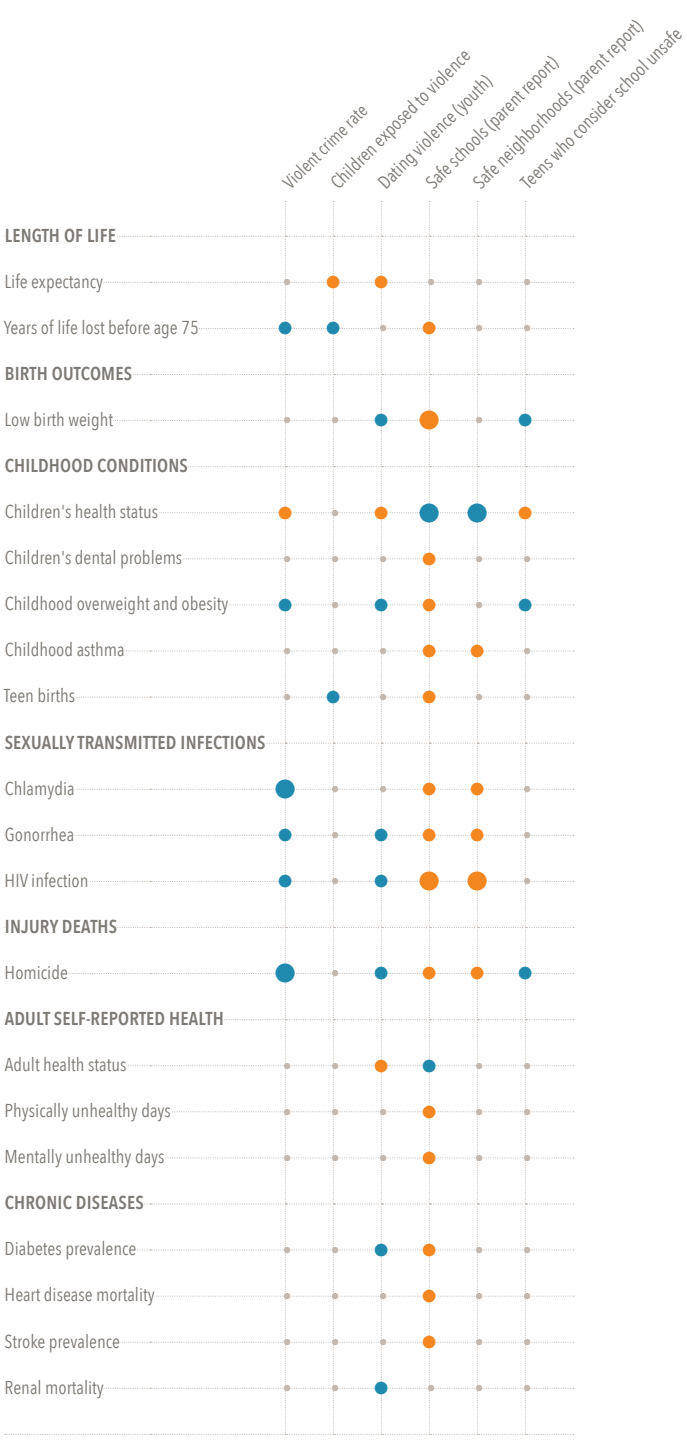


causal link to certain health problems. All this may explain why we observed correlations between ACE exposure and such conditions as lower respiratory mortality and motor vehicle fatalities (Figure 10). Further research will be necessary to know for sure.

Vital to a healthy social environment for adults, youth, and children is a sense of safety—protection from being harmed physically, emotional, and sexually—in our homes and communities. Some states have cities where street violence is common. As expected, we found that violent crime rates correlated with homicide rates and premature death (years of life lost), but fear of crime and inadequate safety can affect health in other ways, such as discouraging outdoor physical activity.[71]

***"the health of the states correlated highly with the population's level of education, employment, and income"***

We also found that sexually transmitted infections and teen births were more likely in states with more violent crime and dating violence, and they were less likely in states where children and parents described their schools and neighborhoods as safe (Figure 11). One explanation is obvious: young people in violent environments may be at risk for non-consensual and unsafe sexual practices that lead to infections and unplanned pregnancies. But safe communities also have less poverty; better education; more young adults in school, employed, or in the military; less residential segregation; and fewer single-parent households. Again, confounding variables may play an important causal role.

Stress related to living under these conditions may also influence the risk of developing some of the diseases listed in Figure 11. Research shows that stress, including that induced by exposure to violence or other traumas, can affect chromosomes[72] and the function of the endocrine and immune systems.[73] Stress induces a phenomenon called *allostatic load*, which can lead to heart disease, diabetes, and other adult diseases listed in Figure 11.[74] Stress can affect birth outcomes and harm young children, causing alterations in brain development and other biological effects.[75,76]

In summary, while our health—and the health of our families, communities, and states—is driven by the lifestyle choices we make and by avoiding behaviors that cause disease and injuries, our behaviors and our health are shaped strongly by our environments. Regardless of how seriously we take our health, our success in staying healthy depends on whether we live in a physical environment that is unpolluted, safe, and

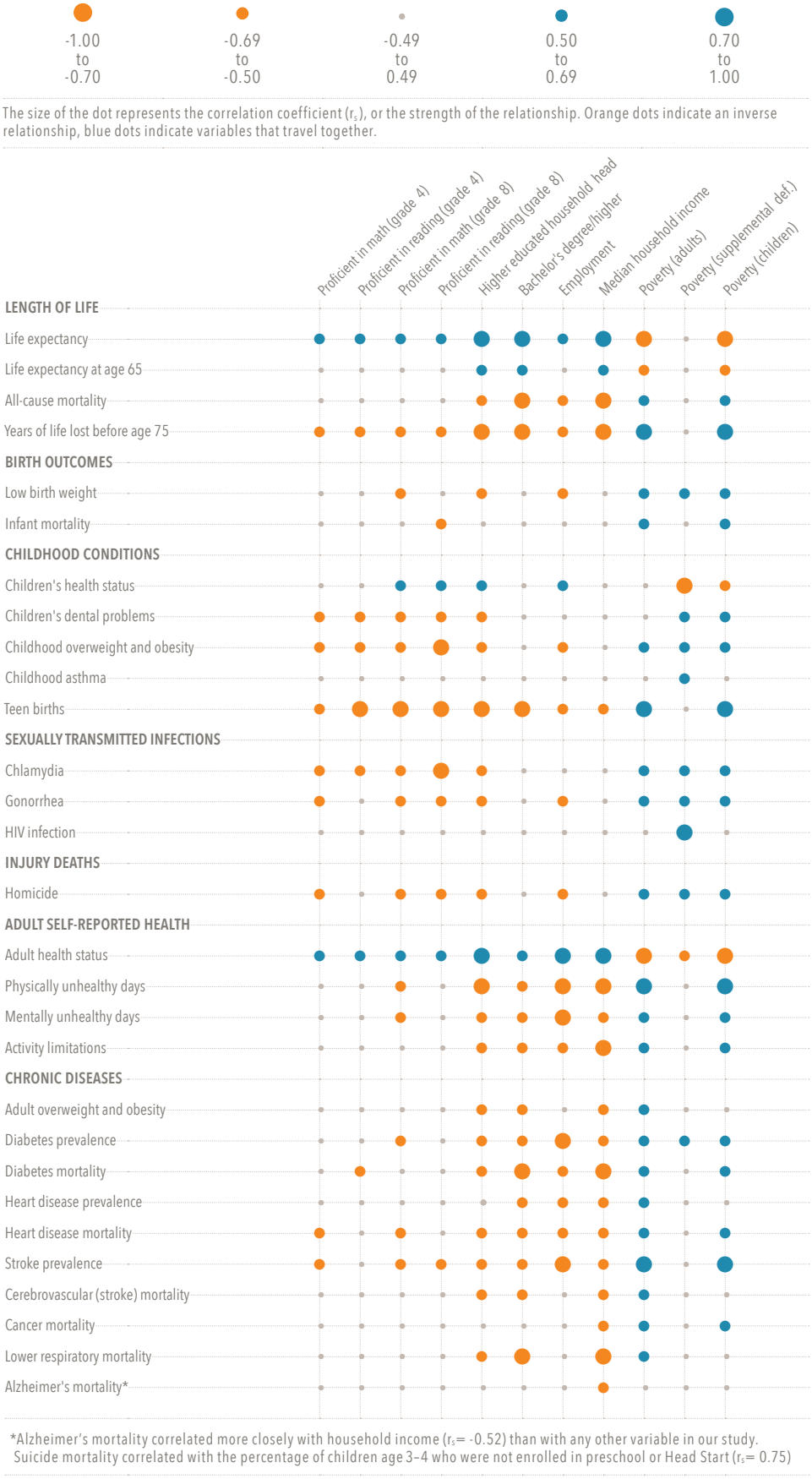
designed with features that encourage healthy choices. Perhaps as important, the social environments in our homes and neighborhoods determine whether our children and youth escape the long-term damage of trauma, develop healthy bodies and minds, and achieve physical and mental wellbeing as adults.[46]

## SOCIAL AND ECONOMIC CONDITIONS

Economic circumstances matter greatly to the previous two domains (health behaviors and the environment) because they determine how easily people can live a healthy lifestyle and whether they can afford to live in places with healthy physical and social environments—those with nice homes, clean air, green space, and good groceries and schools.[46] People working two jobs to make ends meet may lack the time for regular exercise or access to recreational facilities.[77] Fast foods may be more affordable and convenient than healthier meals.[78] Low-income families may lack adequate savings and assets to cushion themselves during difficult times. "The typical household with less than $25,000 in income has enough savings to replace only six days of household income."[79] These conditions have disproportionate impact on racial and ethnic minorities, who tend to face greater socioeconomic disadvantages and other health consequences from discrimination.

FIGURE 12.

### WHAT CORRELATES THE MOST WITH HOUSEHOLD EDUCATION AND INCOME?




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

*Alzheimer's mortality correlated more closely with household income ($r_s$= -0.52) than with any other variable in our study. Suicide mortality correlated with the percentage of children age 3–4 who were not enrolled in preschool or Head Start ($r_s$= 0.75)

## What about race?

Any examination of health disparities in the United States is incomplete without a discussion of race and ethnicity and their alarming associations with health outcomes.[103] Compared with non-Hispanic whites, African Americans, Native Americans, and some Latinos and Asian Americans experience higher disease rates; they are more likely to get sick, injured, disabled, and die prematurely. The health of African Americans especially lags significantly behind that of whites. For example, the life expectancy of African Americans in 2010 (74.7 years) was seen among whites three decades earlier, in 1980.[3] People of color face barriers to education, income, and the resources to live in healthy neighborhoods. History and generations of disinvestment have left them in segregated communities that pose health and safety risks and limit economic opportunity and social mobility.[104]

Despite the enormous importance of this issue, this study does not systematically quantify the health inequities that exist by racial or ethnic groups. Other commissions, reports, and interagency initiatives focus on the many ways that race and racism shape health. Race is a social, not a biological construct. The many pathways through which race influences health in our society are complex and operate at multiple levels—structural, institutional, interpersonal, and internal.[105,106] Health and wellbeing are damaged by growing up in concentrated poverty, being subject to routine prejudice and discrimination in housing or employment, and internalizing racist ideology in the form of risky behaviors and harmful attitudes.[107–111]

Instead of race, the focus of this analysis is on the wider (non-medical) determinants of health, with an understanding that the major drivers of health are life conditions and opportunities such as education, income, stable families, and safe homes and communities. It is denied access to these health-promoting opportunities that accounts for much of the health inequity we observe across different groups of people and places. Opening the doors to these health-promoting conditions through stronger policies and concerted action—including efforts to eliminate structural racism—will improve population health, wellbeing, and equity for all Americans.[112]

"One quarter of black households would have less than $5 if they liquidated all of their financial assets."[79]

Education provides the key to opportunity in today's knowledge economy, the jobs of the future, and social mobility (the ability to climb the economic ladder). Together, education and income are among the most powerful predictors of good health.[80–84] We found that the health of the states—measured across multiple childhood and adult diseases/injuries—correlated highly with the population's level of education, employment, and income (Figure 12). This relationship is also complex and can operate in two directions: education can affect income, and income can affect education—and this is true for both individuals and communities. For example, public schools depend on property taxes, which are lower in poor districts.[85] According to one study, children in school districts with the highest poverty rates scored more than four grade levels lower on reading and math than did children in the richest districts.[86]

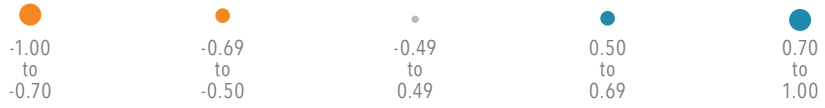
Much of our data emphasize poverty rates, but it bears emphasis that the relationship between income and health is a *continuum*: the middle class and even those with higher incomes have poorer health than people who are higher on the economic ladder.[87] Health is also linked to the economic wellbeing of neighborhoods and communities.[46]

Researchers distinguish between the economic status of *households*—the net worth (assets, or wealth) of families[88]—and the economic status of the *neighborhoods* in which they live.[89] Apart from whether families are rich or poor, their health depends on "place-based" socioeconomic circumstances. Living in areas of concentrated disadvantage can affect physical and mental health.[90] Our state data showed that multiple outcomes correlated with the percentage of people living in census tracts with concentrated poverty, and with the percentage of poor people who lived in such census tracts. The neighborhood economy determines property values, the tax base, and the capital resources on which communities depend to invest in schools, parks, transportation systems, and mixed-income housing—which, as noted earlier, can affect health.

Income inequality, independent of absolute income, has also been linked with poor health.[91] In our state data, income inequality (as measured by the Gini coefficient) correlated with low birth weight ($r_s$= 0.57), child and adolescent overweight and obesity ($r_s$= 0.55), asthma ($r_s$= 0.55), gonorrhea ($r_s$= 0.58), HIV infection ($r_s$= 0.74), mentally unhealthy days ($r_s$= 0.51), and the prevalence of diabetes ($r_s$= 0.53). Income inequality was inversely correlated with self-reports of good or excellent health among children ($r_s$= -0.57) and adults ($r_s$= -0.51). These

FIGURE 13.

## WHAT CORRELATES THE MOST WITH HOUSEHOLD LIVING CONDITIONS?




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.


FIGURE 14.

## INJURY MORTALITY AND SOCIOECONOMIC STATUS


The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

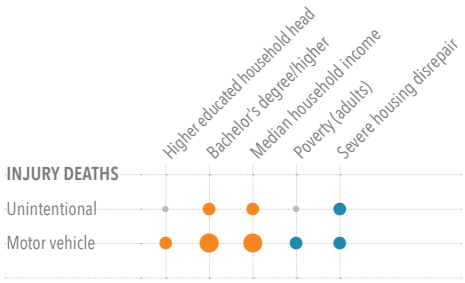



FIGURE 15.

## WHAT CORRELATES THE MOST WITH ECONOMIC BARRIERS TO HEALTH CARE?


The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

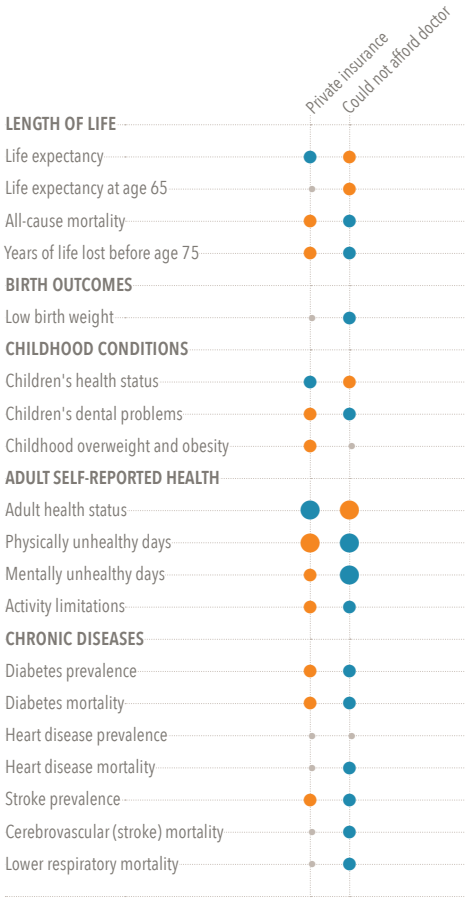
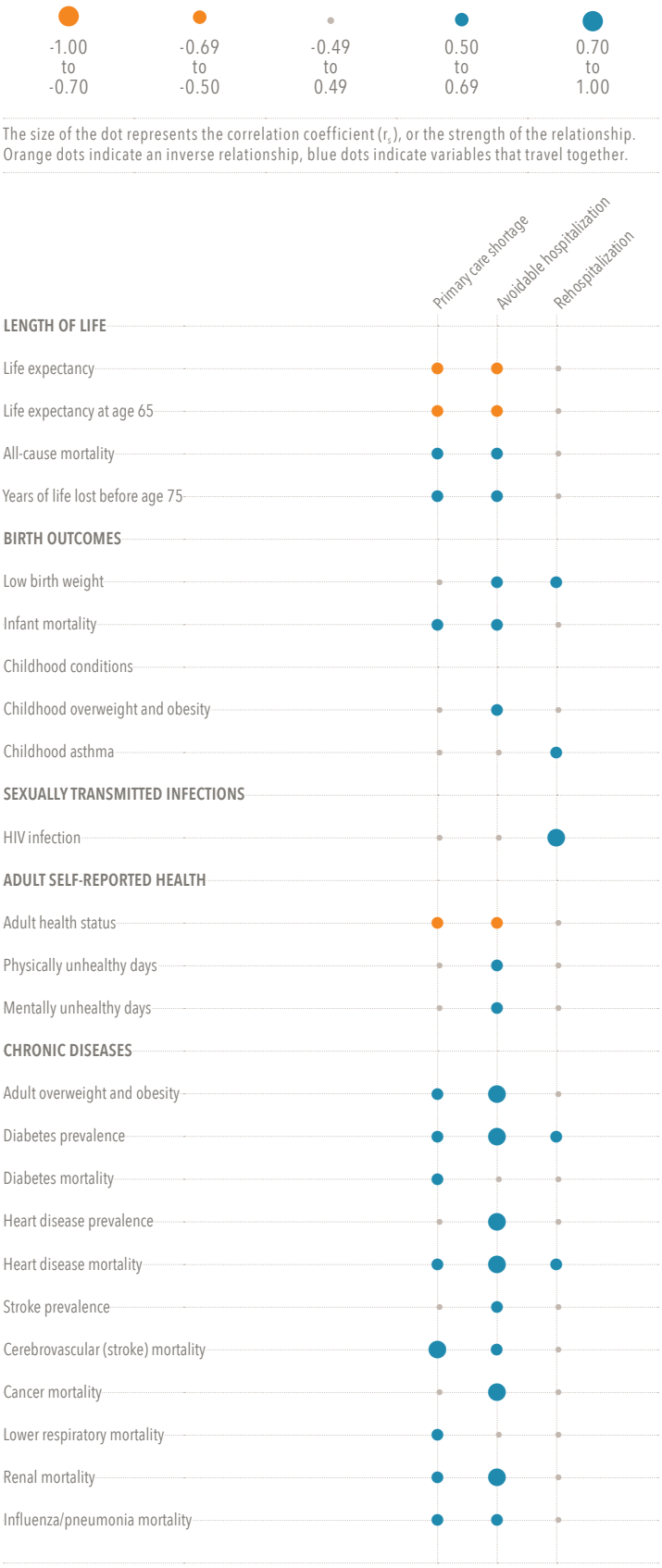


FIGURE 16.

## WHAT CORRELATES THE MOST WITH INADEQUATE AMBULATORY CARE?




associations are important at a time of widening income inequality, during which the middle class has experienced economic pressures,[92,93] severe poverty has increased,[94] and both households and communities are struggling to recover from the Great Recession[95,96] due to losses of businesses, jobs, investment, and tax revenue.[97] The economic pressures of income inequality are often greatest in racially segregated communities.[98] [F13]

Given the strong links between income and health, it came as no surprise in this study that characteristics associated with lower household income—e.g., single parents, food insecurity, housing problems, and racial segregation—correlated highly with a variety of income-sensitive health conditions (Figure 13). For example, we found very high correlations between housing disrepair and all-cause mortality and between racial segregation and infectious diseases like HIV and chlamydia. And adult incarceration, which is more common among racial-ethnic minorities and people living in poverty,[99] correlated highly with lower life expectancy and poorer health outcomes.

As others have reported,[100] we found a correlation between state death rates from injuries (specifically motor vehicle crash fatalities) and levels of education and income (Figure 14). Although strong economic conditions and employment put more motorists on the road and thus

increase exposure to accidents, death rates from crashes are more common among low-income persons for a combination of reasons that include individual factors, locale (e.g., rural areas with poorer road design and limited access to trauma services), and the conditions of their vehicles.[101,102]

## HEALTH SYSTEMS

Socioeconomic status, among other factors, limits one's ability to access and afford health care. We found that life expectancy and a variety of adult and child health outcomes correlated with state rankings on private health insurance coverage and the percentage of respondents who could not afford their doctor (Figure 15). In other data (not shown in Figure 15), we found that the share of the population that was uninsured correlated inversely with adult health status ($r_s$= -0.65) and correlated positively with children's dental problems ($r_s$= 0.64), teen births ($r_s$= 0.63), physically unhealthy days ($r_s$= 0.61), and activity limitations ($r_s$= 0.52).

Our measures for inadequate primary care—less than one primary care physician per 2,000 persons, high rates of avoidable hospitalizations (for conditions that can be managed outside the hospital), and rehospitalizations within 30 days—were associated with lower life expectancy and higher mortality rates (Figure 16). These variables often correlated highly with the prevalence and mortality rates for chronic diseases such as diabetes, heart disease, cancer, and HIV infection, all of which require long-term medical management to optimize outcomes.

We found that measures of access to health care sometimes correlated with health problems that originate largely outside the clinical setting (Figure 17).[i] Such associations may be spurious,

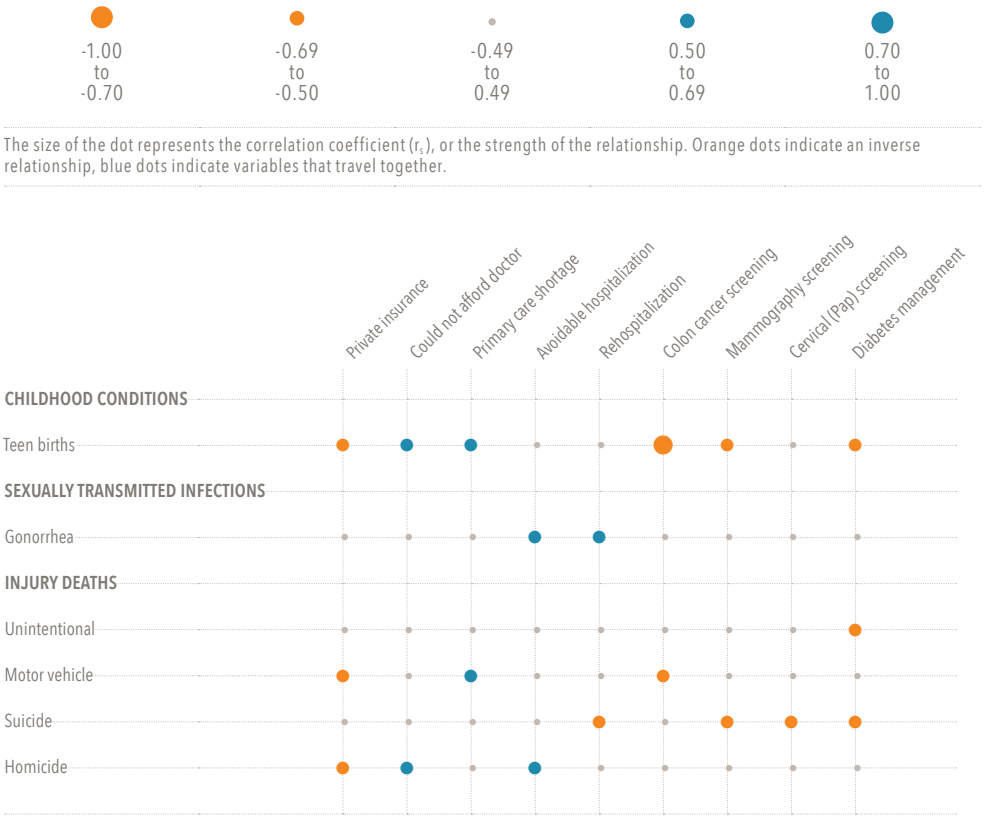
> ***"measures for inadequate primary care correlated with lower life expectancy and higher mortality rates"***

reflecting co-occurring conditions in these states that, taken together, help explain the correlations. For example, the following possibilities might explain the correlation (shown in Figure 17) between private insurance coverage and teen births, car crashes, and homicide: (1) states with fewer uninsured persons may also be states with lower unemployment rates and higher levels of education, (2) states with higher education and income may have higher rates of healthy behaviors, and (3) healthier and less risky behaviors reduce the risk of teen births, car crashes, and homicide. On the other hand, the correlation with conditions such as teen birth may also reflect greater access to primary care services, where patients can receive counseling about safe sex, prescription contraceptives, or screening

i. We suspect that rates of cancer screening and immunizations often acted as a marker of socioeconomic status and access to primary care, as when they correlated with conditions that do not benefit from screening or immunizations but require well-coordinated outpatient care. For example, Pap and mammography screening correlated inversely with children's dental problems, perhaps because states where residents have greater access to cancer screening also have greater access to dental care.

FIGURE 17.

## WHAT ELSE CORRELATES WITH HEALTH SYSTEM CHARACTERISTICS?




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

tests. Only further research can unravel which of these factors are causal.

## PUBLIC POLICIES AND SPENDING

The health of the states and the various determinants of health we reviewed here—health behaviors, the physical and social environment, socioeconomic conditions, and access to health care—are often influenced by policy decisions made by government, industries, and communities.[23] The Institute of Medicine has noted that public policy is "among the most powerful tools to improve population health."[113] A comprehensive examination of how health-relevant policies differ by state was beyond the scope of this project, but we did find some interesting clues. For example, states with higher taxes on cigarettes had lower smoking rates, as well as longer life expectancy and lower death rates, especially from tobacco-related illnesses such as lower respiratory disease and strokes. Some health outcomes were more favorable among states that had expanded Medicaid coverage under the Affordable Care Act.[j]

j. The Affordable Care Act expands coverage for most low-income adults to 138% of the federal poverty level. Whereas all but one of the 10 states with the lowest cerebrovascular mortality rates had adopted Medicaid expansion—some expanding coverage above 200 percent of the federal poverty level—all but two of the 10 states with the highest mortality rates had not adopted Medicaid expansion; these nonparticipating states set eligibility limits between 18 and 67 percent of the federal poverty level, except for Tennessee, which set eligibility at 110 percent. The data reported here refer to Medicaid coverage for adults with dependent children.

k. Bradley et al. calculated the ratio as the sum of social service spending and public health spending divided by the sum of Medicare spending and Medicaid spending.

These states also had better outcomes for unrelated conditions, such as motor vehicle fatalities and teen births, which cannot be attributed to higher tobacco taxes or Medicaid expansion. However, these policies may serve as a marker for states with the economic resources and political constituency to act in other ways to promote public health. For example, research shows that states with higher tobacco taxes are more likely to pass comprehensive smoke-free indoor air laws.[114] We also know that such states tend to have higher socioeconomic status,[115] and this may explain why states with higher tobacco taxes in our study tended to be states where residents had healthier diets, commuted less by motor vehicle, had more walkable neighborhoods, and had fewer shortages of primary care providers. These state governments may be more prepared—economically and politically—to invest public dollars on programs and services to improve education, income, and other factors that shape health. Conversely, states with poorer health rankings may lack the budgets or political base to support economic programs for vulnerable populations.

The United States spends more per capita on health care than any other country.[1] Elizabeth Bradley and colleagues examined the ratio between social and health spending at the state level[k] and found—as they had in a previous international study[116]—that health outcomes are better when governments spend more on social services than on health services. Such states had lower rates of adult obesity; asthma; mentally unhealthy days; days with activity limitations; and mortality rates for lung cancer, acute myocardial infarction, and diabetes.[117]

Our data allowed us to explore this issue further by examining specific areas of social spending, and their correlation with a longer list of health outcomes.[l] For example, we found a correlation between spending on income support[m] and better health outcomes (Figure 18).[n] Interestingly, one of the strongest correlations was the link between income support and motor vehicle mortality; as noted earlier, the risk of motor vehicle crashes decreases with socioeconomic status.[101] In addition, more affluent states—those with the resources and political base to invest in income support—may also be better positioned to invest in road design and maintenance, law enforcement, emergency medical services, and other measures that can reduce crash injuries and fatalities.[102] Further research is necessary to determine which factors are responsible.

The correlation between education spending and health was less robust. Despite extensive evidence in the

l. Rather than comparing the ratio of social to health spending, we compared states on per capita spending in each budget area. Unlike Bradley et al., we included some forms of federal spending over which states exercise control. We also did not follow Bradley's protocol of grouping public health spending as a form of social spending.

m. We measured income support relative to the size of the population living in poverty (incomes below 100 percent of the federal poverty level) or near poverty (below 200 percent of the federal poverty level).

n. Health outcomes did not correlate with per capita spending in some areas—housing and community development, police, and libraries—perhaps because the general population benefits less from these forms of spending. Spending for libraries and police did correlate with health outcomes when spending was divided by the number of persons living in poverty, but this is not persuasive without further research to determine more definitively whether such populations benefit differentially from these services.

FIGURE 18.

## WHAT CORRELATES THE MOST WITH SPENDING ON INCOME SUPPORT?


The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

FPL = Federal poverty level. <100% FPL and <200% FPL refers to spending divided by the population living with incomes below 100 percent and 200 percent of the FPL, respectively. The figure shows correlations with income support provided by state dollars, state and federal dollars combined, and specific subcategories of income support spending (public welfare, unemployment benefits, and federal public assistance.

literature that education itself is a major determinant of health,[41] we did not find a high correlation between per capita spending on education and health outcomes.[o] A variety of factors could help explain this discrepancy, among them the possibility that government investments in education do not always translate into better educational outcomes in the classroom. A notable exception is investment in early childhood education, which is known to markedly improve educational and health outcomes and to yield economic benefits.[118,119]

Although spending on specific health care services (e.g., cancer screening, immunizations) is known to be effective, health care as a whole is thought to account for only 10 to 20 percent of health outcomes.[120] We examined data from the National Health Expenditure Accounts and found that spending on health services did not correlate highly ($r_s \geq +/-0.50$) with any health outcome, and the same was true when we examined data on Medicaid spending. We observed a *positive* correlation between Medicare spending and higher disease rates but did not report these data because they simply reflect the higher demand for health care services that exists in states where

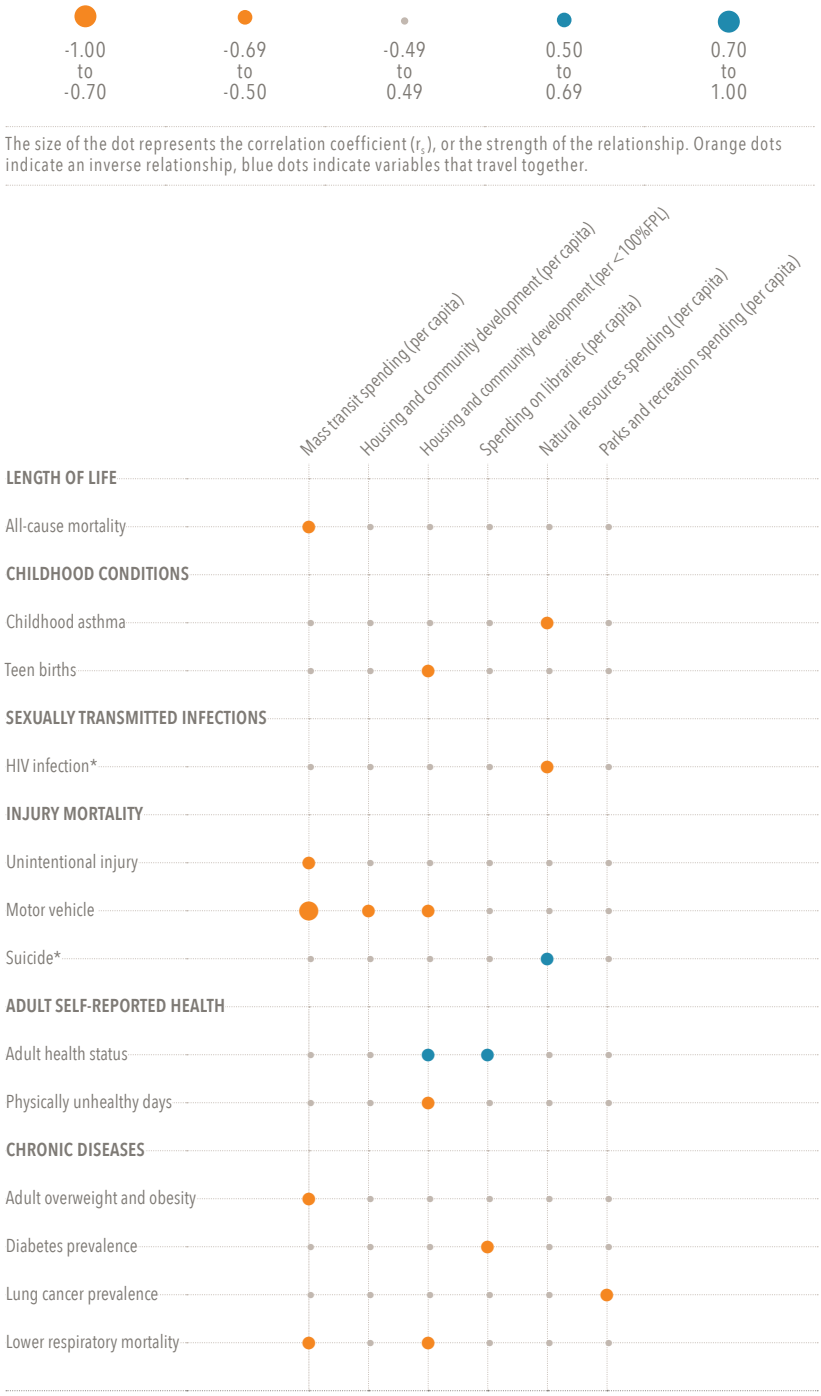
o. Per capita spending on elementary/secondary education was inversely associated with children's dental problems ($r_s$ = -0.51).

residents have greater disease burden. Although spending did not correlate meaningfully with health, certain features of the health care system did correlate highly with health outcomes, notably rates of health insurance coverage and access to affordable care (not having to forego care due to cost). As noted earlier, our data also suggested that health outcomes were better in states with adequate primary care services to manage chronic diseases and prevent hospitalizations for conditions like heart attacks, congestive heart failure, and pneumonia.

Finally, we found that infrastructure spending (e.g., mass transit) correlated with health outcomes (Figure 19). Such data signal the importance of policy decisions regarding the built environment. For example, as noted earlier, people in states with lower rates of overweight and obesity reported more walkable neighborhoods, proximity to parks, and less commuting by motor vehicle. These states with lower obesity rates also spent more per capita on mass transit, and states that spent more on mass transit also had lower death rates from motor vehicle crashes (Figure 19). Other forms of infrastructure spending also seemed important. For example, spending on parks and recreation correlated with health outcomes that benefit from physical activity and green

FIGURE 19.

## WHAT CORRELATES THE MOST WITH OTHER FORMS OF NON-HEALTH SPENDING?




The size of the dot represents the correlation coefficient ($r_s$), or the strength of the relationship. Orange dots indicate an inverse relationship, blue dots indicate variables that travel together.

*Per capita spending on sewers/waste management was inversely correlated with suicide ($r_s$= - 0.52). Positive correlations between HIV infection and suicide and several forms of spending (natural resources, waste management) were considered spurious.

TABLE 2.

## NUMBER OF APPEARANCES IN THE BOTTOM 10

| | | |
|---|---|---|
| 1. | Mississippi | 31 |
| | **(1)** Newborn life expectancy, **(2)** Life expectancy at age 65, **(3)** Years of life lost before age 75, **(4)** All-cause mortality rate, **(5)** Low birth weight, **(6)** Infant mortality, **(7)** Dental problems, **(8)** Childhood overweight, **(9)** Childhood asthma, **(10)** Teen births, **(11)** Chlamydia infection, **(12)** Gonorrhea infections, **(13)** HIV infection, **(14)** Unintentional injury deaths, **(15)** Motor vehicle fatalities, **(16)** Homicide, **(17)** Adult health status, **(18)** Physically unhealthy days, **(19)** Mentally unhealthy days, **(20)** Activity limitations, **(21)** Adult overweight/obesity, **(22)** Diabetes prevalence, **(23)** Diabetes mortality, **(24)** Cardiovascular mortality, **(25)** Stroke prevalence, **(26)** Cerebrovascular mortality, **(27)** Cancer mortality, **(28)** Colorectal cancer prevalence, **(29)** Lower respiratory mortality, **(30)** Renal mortality, **(31)** Influenza/pneumonia mortality | |
| 2. | Alabama | 30 |
| | **(1)** Newborn life expectancy, **(2)** Life expectancy at age 65, **(3)** Years of life lost before age 75, **(4)** All-cause mortality rate, **(5)** Low birth weight, **(6)** Infant mortality, **(7)** Childhood overweight, (8) Childhood asthma, **(9)** Teen births, **(10)** Chlamydia infection, **(11)** Gonorrhea infections, **(12)** Motor vehicle fatalities, **(13)** Homicide, **(14)** Adult health status, **(15)** Physically unhealthy days, **(16)** Mentally unhealthy days, **(17)** Activity limitations , **(18)** Adult overweight/obesity, **(19)** Diabetes prevalence, **(20)** Diabetes mortality, **(21)** Heart disease prevalence, **(22)** Cardiovascular mortality, **(23)** Stroke prevalence, **(24)** Cerebrovascular mortality, **(25)** Cancer mortality, **(26)** Lung cancer prevalence, **(27)** Prostate cancer prevalence, **(28)** Lower respiratory mortality, **(29)** Renal mortality, **(30)** Influenza/pneumonia mortality | |
| 3. | Louisiana | 29 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Low birth weight, (6) Infant mortality, (7) Dental problems, (8) Childhood overweight, (9) Teen births, (10) Chlamydia infection, (11) Gonorrhea infections, (12) HIV infection, (13) Unintentional injury deaths, (14) Motor vehicle fatalities, (15) Drug overdose deaths, (16) Homicide, (17) Adult health status, (18) Physically unhealthy days, (19) Mentally unhealthy days, (20) Diabetes prevalence, (21) Diabetes mortality, (22) Heart disease prevalence, (23) Cardiovascular mortality, (24) Cerebrovascular mortality, (25) Cancer mortality, (26) Colorectal cancer prevalence, (27) Prostate cancer prevalence, (28) Renal mortality, (29) Alzheimer's mortality | |
| 4. | Kentucky | 25 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Childhood overweight, (6) Childhood asthma, (7) Teen births, (8) Unintentional injury deaths, (9) Drug overdose deaths, (10) Adult health status, (11) Physically unhealthy days, (12) Mentally unhealthy days, (13) Activity limitations, (14) Adult overweight/obesity, (15) Heart disease prevalence, (16) Cardiovascular mortality, (17) Stroke prevalence, (18) Cerebrovascular mortality, (19) Cancer mortality, (20) Lung cancer prevalence, (21) Colorectal cancer prevalence, (22) Lower respiratory mortality, (23) Renal mortality, (24) Influenza/pneumonia mortality, (25) Alzheimer's mortality | |
| 5. | West Virginia | 25 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Low birth weight, (6) Teen births, (7) Unintentional injury deaths, (8) Motor vehicle fatalities, (9) Drug overdose deaths, (10) Adult health status, (11) Physically unhealthy days, (12) Mentally unhealthy days, (13) Activity limitations, (14) Adult overweight/obesity, (15) Diabetes prevalence, (16) Diabetes mortality, (17) Heart disease prevalence, (18) Cardiovascular mortality, (19) Stroke prevalence, (20) Cancer mortality, (21) Lung cancer prevalence, (22) Colorectal cancer prevalence, (23) Lower respiratory mortality, (24) Renal mortality, (25) Influenza/pneumonia mortality | |
| 6. | Arkansas | 23 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Adult health status, (6) Teen births, (7) Chlamydia infection, (8) Gonorrhea infections, (9) Motor vehicle fatalities, (10) Homicide, (11) Adult health status, (12) Mentally unhealthy days, (13) Activity limitations, (14) Adult overweight/obesity, (15) Heart disease prevalence, (16) Cardiovascular mortality, (17) Stroke prevalence, (18) Cerebrovascular mortality, (19) Cancer mortality, (20) Lung cancer prevalence, (21) Lower respiratory mortality, (22) Renal mortality, (23) Influenza/pneumonia mortality | |
| 7. | Oklahoma | 23 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Infant mortality, (6) Teen births, (7) Unintentional injury deaths, (8) Motor vehicle fatalities, (9) Drug overdose deaths, (10) Homicide, (11) Adult health status, (12) Physically unhealthy days, (13) Mentally unhealthy days, (14) Activity limitations, (15) Adult overweight/obesity, (16) Diabetes prevalence, (17) Diabetes mortality, (18) Heart disease prevalence, (19) Cardiovascular mortality, (20) Stroke prevalence, (21) Cerebrovascular mortality, (22) Cancer mortality, (23) Lower respiratory mortality | |
| 8. | Tennessee | 23 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Low birth weight, (6) Infant mortality, (7) Unintentional injury deaths, (8) Drug overdose deaths, (9) Adult health status, (10) Physically unhealthy days, (11) Mentally unhealthy days, (12) Adult overweight/obesity, (13) Diabetes prevalence, (14) Diabetes mortality, (15) Heart disease prevalence, (16) Cardiovascular mortality, (17) Stroke prevalence, (18) Cerebrovascular mortality, (19) Cancer mortality, (20) Lung cancer prevalence, (21) Lower respiratory mortality, (22) Influenza/pneumonia mortality, (23) Alzheimer's mortality | |
| 9. | South Carolina | 16 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75, (3) All-cause mortality rate (4) Low birth weight, (5) Infant mortality, (6) Childhood overweight, (7) Chlamydia infection, (8) Gonorrhea infections, (9) Motor vehicle fatalities, (10) Homicide, (11) Mentally unhealthy days, (12) Adult overweight/obesity, (13) Diabetes prevalence, (14) Stroke prevalence, (15) Cerebrovascular mortality, (16) Alzheimer's mortality | |
| 10. | District of Columbia | 14 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75, (3) Low birth weight, (4) Infant mortality, (5) Adult health status, (6) Childhood overweight, (7) Childhood asthma, (8) Teen births, (9) Chlamydia infection, (10) Gonorrhea infections, (11) HIV infection, (12) Homicide, (13) Cardiovascular mortality, (14) Prostate cancer prevalence | |

## NUMBER OF APPEARANCES IN THE TOP 10

| | | |
|---|---|---|
| 1. | Utah | 21 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Infant mortality, (4) Childhood overweight, (5) Childhood asthma, (6) Chlamydia infection, (7) Gonorrhea infections, (8) Homicide, (9) Adult health status, (10) Physically unhealthy days, (11) Mentally unhealthy days, (12) Adult overweight/obesity, (13) Diabetes prevalence, (14) Heart disease prevalence, (15) Stroke prevalence, (16) Cancer mortality, (17) Lung cancer prevalence, (18) Colorectal cancer prevalence, (19) breast cancer prevalence, (20) Prostate cancer prevalence, (21) Lower respiratory mortality | |
| 2. | Massachusetts | 21 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75, (3) All-cause mortality rate, (4) Infant mortality, (5) Adult health status, (6) Dental problems, (7) Teen births , (8) Chlamydia infection, (9) Gonorrhea infections, (10) Unintentional injury deaths, (11) Motor vehicle fatalities, (12) Suicide, (13) Homicide, (14) Adult health status, (15) Activity limitations, (16) Adult overweight/obesity, (17) Diabetes mortality, (18) Cardiovascular mortality, (19) Stroke prevalence, (20) Cerebrovascular mortality, (21) Lower respiratory mortality | |
| 3. | Hawaii | 20 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Unintentional injury deaths, (6) Motor vehicle fatalities, (7) Drug overdose deaths, (8) Homicide, (9) Physically unhealthy days, (10) Mentally unhealthy days, (11) Activity limitations, (12) Adult overweight/obesity, (13) Diabetes mortality, (14) Heart disease prevalence, (15) Cardiovascular mortality, (16) Cancer mortality, (17) Lung cancer prevalence, (18) Prostate cancer prevalence, (19) Lower respiratory mortality, (20) Alzheimer's mortality | |
| 4. | Connecticut | 20 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Dental problems, (6) Teen births , (7) Motor vehicle fatalities, (8) Suicide, (9) Adult health status, (10) Physically unhealthy days, (11) Activity limitations, (12) Adult overweight/obesity, (13) Diabetes mortality, (14) Heart disease prevalence, (15) Stroke prevalence, (16) Cerebrovascular mortality, (17) Cancer mortality, (18) Lower respiratory mortality, (19) Influenza/pneumonia mortality, (20) Alzheimer's mortality | |
| 5. | Vermont | 20 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75 (3) Low birth weight, (4) Infant mortality, (5) Adult health status, (6) Dental problems, (7) Childhood overweight, (8) Teen births, (9) Chlamydia infection, (10) Gonorrhea infections, (11) HIV infection, (12) Adult health status, (13) Physically unhealthy days, (14) Adult overweight/obesity, (15) Diabetes prevalence, (16) Diabetes mortality, (17) Stroke prevalence, (18) Cerebrovascular mortality, (19) Renal mortality, (20) Influenza/pneumonia mortality | |
| 6. | Minnesota | 20 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Low birth weight, (6) Infant mortality, (7) Dental problems, (8) Teen births, (9) Chlamydia infection, (10) Motor vehicle fatalities, (11) Drug overdose deaths, (12) Homicide, (13) Adult health status, (14) Physically unhealthy days, (15) Mentally unhealthy days, (16) Activity limitations, (17) Diabetes prevalence, (18) Cardiovascular mortality, (19) Stroke prevalence, (20) Influenza/pneumonia mortality | |
| 7. | California | 16 |
| | (1) Newborn life expectancy, (2) Life expectancy at age 65, (3) Years of life lost before age 75, (4) All-cause mortality rate, (5) Low birth weight, (6) Infant mortality, (7) Unintentional injury deaths, (8) Suicide, (9) Heart disease prevalence, (10) Cancer mortality, (11) Lung cancer prevalence, (12) Colorectal cancer prevalence, (13) breast cancer prevalence, (14) Prostate cancer prevalence, (15) Lower respiratory mortality, (16) Renal mortality | |
| 8. | Colorado | 16 |
| | (1) Life expectancy at age 65, (2) All-cause mortality rate, (3) Childhood overweight, (4) Adult overweight/obesity, (5) Diabetes prevalence, (6) Diabetes mortality, (7) Heart disease prevalence, (8) Cardiovascular mortality, (9) Stroke prevalence, (10) Cancer mortality, (11) Lung cancer prevalence, (12) Colorectal cancer prevalence, (13) breast cancer prevalence, (14) Prostate cancer prevalence, (15) Renal mortality, (16) Influenza/pneumonia mortality | |
| 9. | New Hampshire | 15 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75, (3) Infant mortality, (4) Adult health status, (5) Dental problems, (6) Childhood overweight, (7) Teen births, (8) Chlamydia infection, (9) Gonorrhea infections, (10) HIV infection, (11) Homicide, (12) Adult health status, (13) Cardiovascular mortality, (14) Stroke prevalence, (15) Cerebrovascular mortality | |
| 10. | New Jersey | 15 |
| | (1) Newborn life expectancy, (2) Years of life lost before age 75, (3) All-cause mortality rate, (4) Infant mortality, (5) Dental problems, (6) Childhood overweight, (7) Teen births, (8) Chlamydia infection, (9) Unintentional injury deaths, (10) Motor vehicle fatalities, (11) Suicide, (12) Activity limitations, (13) Lower respiratory mortality, (14) Influenza/pneumonia mortality, (15) Alzheimer's mortality | |

space. Per capita spending on natural resources (including regulation of industries) correlated with lower asthma rates.[p]

Figure 19 presents correlations between spending and seemingly unrelated health outcomes, such as spending on housing and death rates from motor vehicle crashes. We suspect they are acting as markers of states with the resources and political inclination to make greater investments in infrastructure and social programs, including those not measured here that could influence the diseases listed in the table.

## THE GEOGRAPHY OF HEALTH

The determinants of health—health behaviors, the environment, socioeconomic conditions, health systems, and public policies—may help explain the geographic footprint of states with the best and worst outcomes. The forthcoming supplements to this report include U.S. maps and listings of the Top 10 and Bottom 10 states for 39 health conditions. Table 2 lists the states that ranked most often in the Top 10 or Bottom 10 (and the conditions to which those rankings apply). The scope of this project did not permit a complete analysis of the historical and contextual factors that might explain the patterns we observed by region, nor the backstory behind "outlier" states, where rankings for specific health conditions deviated from regional norms and might suggest successful strategies and polices for other states to consider. The following interesting examples emerged from these data, but further research is necessary to understand causal factors and policy decisions that might explain the results:

### The Pacific and Pacific Coast

Hawaii was designated by America's Health Rankings as the nation's healthiest state,[24] and in our study ranked in the highest quintile (Top 10) for 20 health outcomes (Table 2). Noteworthy exceptions to this favorable trend included its high rates of childhood asthma and it high death rates from influenza and pneumonia. Further research should explore explanatory factors. For example, the high asthma prevalence in Hawaii may relate to high sulfur dioxide emissions from the Kilauea Volcano, which generate an acidic haze called "vog."[121]

California also ranked highly for many outcomes (Table 2) but ranked 51st for the low proportion of children described in good or excellent health; it also ranked poorly (47th) for children's dental health and had intermediate rankings for asthma, childhood overweight/obesity, and teen births. These results could reflect inaccuracies in these measures (e.g., such as relying on parental report to assess children's health status), or they may reflect real problems with children's health, perhaps because of the challenging socioeconomic conditions facing California's

p. Bear in mind that such states also have other characteristics (e.g., more walkable neighborhoods and built environments, fewer primary care shortage areas) that may contribute to these associations.

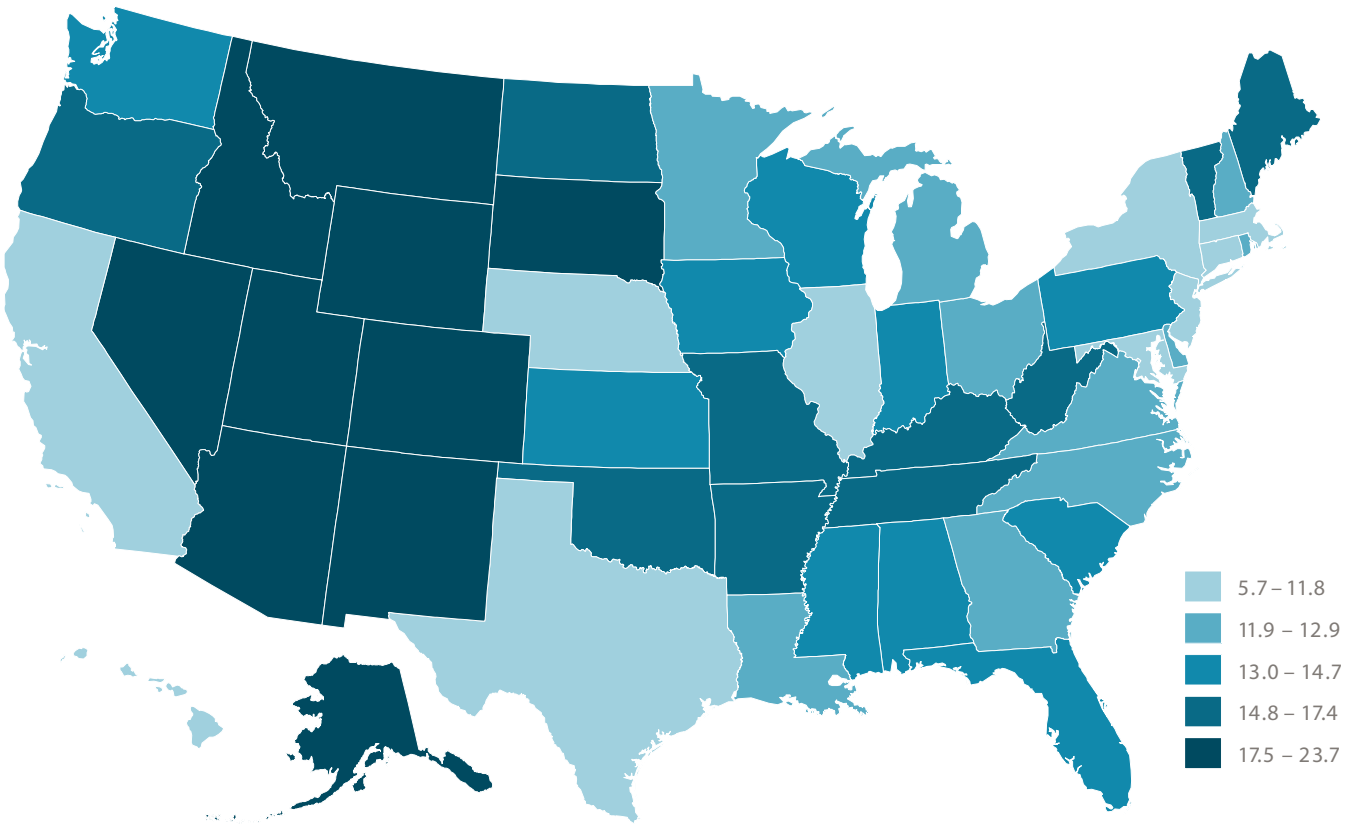
youth. *Kids Count*, the annual report on child wellbeing produced by the Annie E. Casey Foundation, ranked California 36th on child wellbeing (47th on Economic Wellbeing and 35th and 41st, respectively, on Education and Family and Community).[q] *Kids Count* noted that California had the highest percentage of children living in families not headed by a high school graduate and in households struggling with housing costs.[35] In 1970, California was in the top quintile for preschool enrollment but fell from the top 10 in subsequent decades. By 1980-1990, California had entered the highest quintile for violent crimes.[32]

q. *Kids Count* gave California a higher ranking on child health (11th) but did so based on birth weight, children with health insurance, child/adolescent mortality, and teen substance abuse.

## The Mountain States

Mountain states like Utah and Colorado often ranked in the Top 10 for health statistics, but this region dominated the Bottom 10 for suicide rates (Figure 20). The Bottom 10 states for motor vehicle fatalities included Montana and North Dakota, where 47 percent of motor vehicle fatalities involved alcohol, more than twice that of Utah (20.2 percent).[122] The Mountain states generally lack primary seat belt laws and allow higher speed limits and helmetless riding of motorcycles—all of which increase the risk of motor vehicle deaths.[98,102] The Mountain states also have

FIGURE 20.
### SUICIDE MORTALITY (PER 100,000) BY STATE (2013)



among the nation's highest rates of firearm ownership.[124] Easy access to rifles and other weapons may affect suicide rates, especially for individuals predisposed to impulsive self-harm. Montana, the state with the highest suicide rate in our study, also had the nation's highest rate of household firearm ownership (62.6 percent) in 2004 (the last year for which state-level firearm ownership data are available); conversely, New Jersey, the state with the lowest suicide rate, had the lowest firearm ownership rate (11.4 percent).[124] Gun laws are a politically volatile issue,[125] but research shows that states that regulate access to handguns have lower suicide rates.[126] And the converse also appears to be true—one year after South Dakota repealed a mandatory waiting period for handgun purchases, suicide rates increased by 7.6 percent (compared with 3.3 percent nationwide).[127]

Economic conditions might also explain health patterns in certain Mountain states. For example, Nevada ranked highly for many outcomes but appeared in the Bottom 10 for children's health status (50th, second only to California), childhood dental problems (48th), fatal drug overdoses (43rd), lower respiratory disease mortality (43rd), and physically unhealthy days (42nd). Nevada experienced heavy job losses and economic setbacks after the Great Recession, the pace of education reforms slowed, fewer young people were in school or working, and crime rates grew. By 2010 Nevada had received the lowest score on an index of economic opportunity.[32] Further research is needed to determine how these socioeconomic trends might explain Nevada's health statistics.

## The Midwest

Our data were noteworthy for the favorable health status of the West North Central region, including Minnesota and adjacent states. North Dakota, a state that experienced an economic boom and now has the nation's largest proportion of residents living in prosperous zip codes,[97] ranked in the Top 10 or second quintile for 22 health outcomes. Studies show that upward economic mobility is greatest in the Great Plains.[66] Conversely, Rust Belt states facing economic losses in the manufacturing sector had poorer health outcomes. For example, Michigan, a state affected by setbacks in the automobile industry, stood out among Midwestern states for its poor heart health—it ranked 43rd in the prevalence of overweight and obesity, 45th in the prevalence of angina and coronary artery disease, and 42nd in cardiovascular mortality. In the period of 1970–2010, Michigan experienced "sharply increasing income inequality and unemployment coupled with the greatest increase in poverty and steepest decline in income of any state."[32]

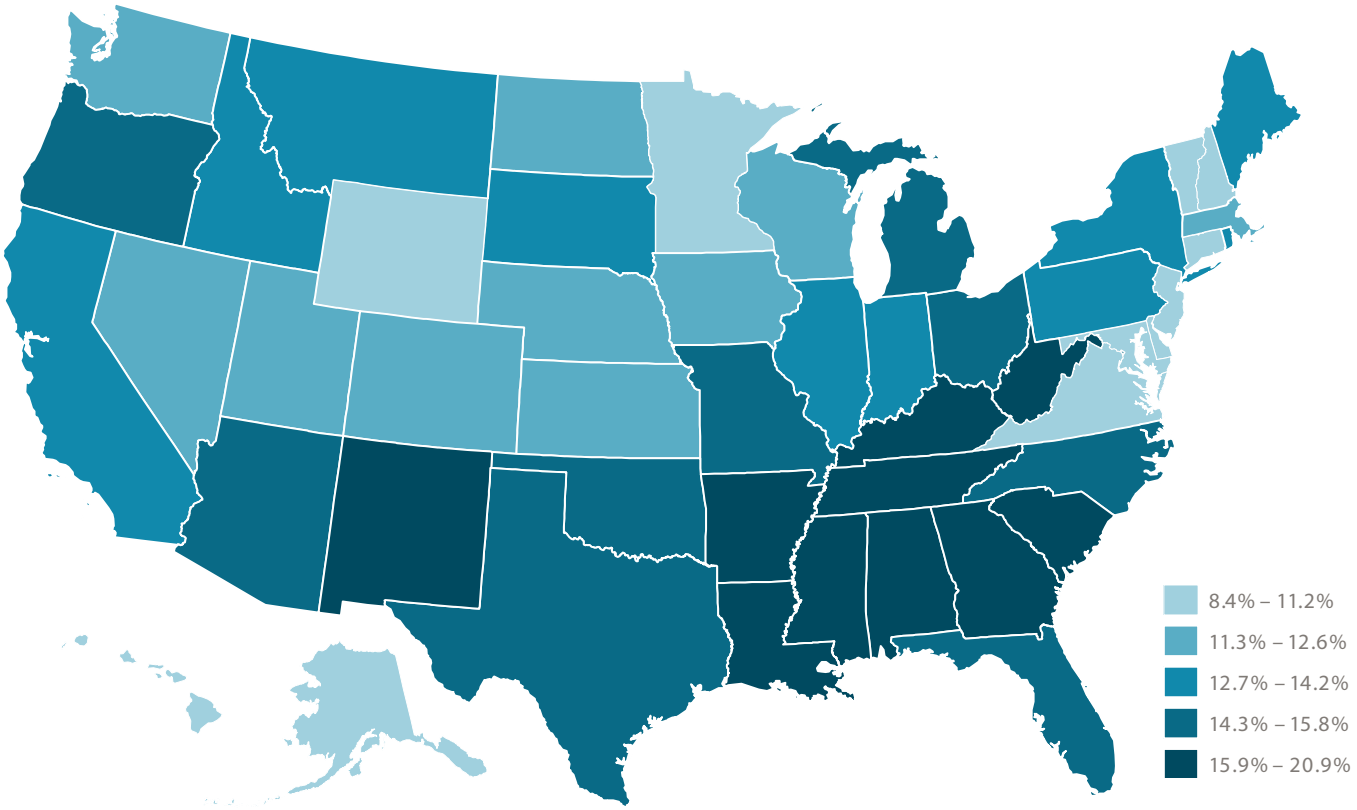
## New England

New England states dominated the Top 10 with superior health statistics (Table 2), a pattern that could be easily attributed to the region's high socioeconomic status. For example, New Hampshire has been the top-scoring state for economic opportunity since 1990.[32] However, noteworthy departures from this trend could be instructive. For example, we found that fatal drug overdoses were more common in Massachusetts than elsewhere in New England. Vermont had a higher death rate from Alzheimer's disease than other New England states. Understanding the reason for these contrasts could provide important clues to causal factors.

## The South

States in Appalachia and along the Gulf Coast, including nearby West South Central states such as Arkansas and Oklahoma, dominated the Bottom 10 (Table 2). These states, struggling with weak economies and the loss of once-vibrant industries (e.g., cotton, tobacco, coal mining), have high rates of unemployment, poverty, food insecurity, and poor housing,[128] especially in Central Appalachia and the Mississippi Delta (Figure 21). Upward

FIGURE 21.
**POVERTY RATE BY STATE (2012)**



mobility is lowest in the Southeast,[66] where there is greater income inequality and spatial inequality (e.g., the gap between metropolitan and rural distress).[97] Less than 10 percent of the population of Mississippi and West Virginia live in a prosperous zip code. Educational opportunities are more limited: in the Gulf Coast states of Louisiana, Mississippi, and Alabama, the percentage of public schools that were racially segregated[r] in 2012 was 22.1 percent, 23.3 percent, and 24.1 percent, respectively (compared to 1.4 percent in Hawaii).[129]

These socioeconomic difficulties could explain the region's higher rates of smoking, obesity, and physical inactivity—behaviors that are linked with socioeconomic status—as well as high rates of opioid abuse in states like West Virginia and Kentucky.[130] However, the role of public policy in the region must also be considered. Southern legislatures have set lower tobacco tax rates than elsewhere in the country and tend to have less progressive policies to promote health and prevent injuries. For example, as of 2014, six of the seven states with no bans on indoor smoking (seven of the nine states with no bans on workplace smoking as of 2011) were in the South and West South Central regions.[131,132] Southern governors have generally resisted the expansion of Medicaid eligibility under the Affordable Care Act.[133] Weak economies and political resistance also limit state spending on social services, income support, or education.[129]

Outlier patterns in the South raise intriguing questions about success stories. For example, we found that Georgia had distinctly lower death rates from injuries, lower prevalence of angina and coronary heart disease, and fewer people reporting activity limitations than did nearby Alabama and Mississippi and most other Southern states. West Virginia and Kentucky had among the lowest rates of chlamydia and gonorrhea in the nation. It is unclear whether these differences are an artifact of weaker systems for surveillance and reporting of infectious diseases or a success story in preventing sexually transmitted infections. Further research is needed to understand the policy history and epidemiological context behind these patterns.

## District of Columbia

The nation's capital stood out from the states, not only because it is a city, with a smaller population and geographic footprint, but also because our data tell a story of two cities. Some of the data describe a city in poor health: the District of Columbia ranked in the Bottom 10 for life expectancy, premature mortality, sexually transmitted infections, and poor children's health; its rates of infant mortality and asthma were higher than those of any state. But other data describe

r. Defined as a school where more than 90 percent of students were the same race and the students' racial composition differed significantly (more than 5 percentage points) from that of the overall public school student population in the county.

a city in good health: the District of Columbia had the lowest rates of motor vehicle fatalities and suicides. It also ranked in the Top 10 for adult health status; for low rates of adult overweight and obesity, angina, and coronary heart disease; and for low death rates from strokes, lower respiratory disease, and renal disease.

The "apples and oranges" problem of comparing a city with 50 states may explain part of these findings, but the health advantages may not all be artefactual. For example, a study of the 50 largest U.S. cities ranked Washington, D.C. first in "community and environmental factors" that promote fitness. Among these cities, it ranked above the 90th percentile in land area devoted to parks; park proximity to residents; per capita spending on parks; use of public transportation; and the density of farmers' markets, recreational centers, swimming pools, and tennis courts.[134]

# Going Forward

## THE RESEARCH AGENDA

Despite its length, this report serves only as a conversation starter. Its "deep dive" into the data reached only a shallow depth: more granular data analysis and systematic policy research are needed to understand how the health of the states varies, what factors are responsible, and which policies can best close the gap. Three overarching research priorities emerge from our analysis:

### 1. Understanding how health in the United States varies by geography

**Obtaining more current data:** We examined the most current data that were available at the time our analysis began. Our findings should be updated and tested with the most recent data available.

**Obtaining data on more indicators:** Some state-level indicators were not

examined in this analysis, including data on additional health outcomes and determinants of health that may be important to understanding geographic disparities. We also identified a number of data sources that are available for major cities and metropolitan areas.[s]

**Examining geography at multiple levels:** By design, this project focused on the health of the states, but health is influenced by conditions and decisions at multiple geographic levels. For example, health is affected by federal policy and by regional trends, such as market forces affecting states that have historically relied on agriculture, manufacturing, or coal mining industries. Health is also affected at smaller geographic levels, including the conditions that exist in counties, cities, zip codes, census tracts, and census block groups. Some data and some policy matters are unique to geography. Statistics on the prevalence of health behaviors often exist for states but not always for communities. Policies under the authority of city councils, county supervisors, and school boards differ from those under the purview of governors and state legislatures. A true understanding of geographic disparities requires a multilevel analysis that accounts for these differences.

## 2. Understanding what factors are responsible for geographic health disparities

**Moving from correlations to multivariate analyses:** Our analysis relied on Spearman rank order correlation coefficients and bivariate relationships (see *Supplement 1: Spotlight on methods*), an approach that necessarily glossed over the complex interactions and confounding relationships that exist between the factors we examined. We are eager to subject our data to multivariate modeling and alternative statistical computing methods, which were beyond the scope of this initial project but are an essential next step to determine which associations observed in our analysis remain significant when examined together. Our study began by calculating the correlation between 386 indicators and 56 health outcomes, creating a matrix of 21,616 cells. A "big data" opportunity exists in modeling the interrelationships in large data sets like ours, especially if they are expanded to include many more years and multiple geographic levels. New machine learning tools can help identify important patterns in such data. For example, using a data mining procedure (random forest analysis), Basu and Siddiqi reported that three factors—the teen birth rate, Native

s. Examples include data on golf courses, park units, recreation centers, and other resources for physical activity from The Trust for Public Land. Other efforts, such as the 100 Million Healthy Lives initiative, are amassing large data sets for local indicators.

American population, and proportion of children who were uninsured—could identify the 14 U.S. counties with the highest premature death rates.[135]

**Studying longitudinal trends and cohort effects:** Our analysis relied on cross-sectional data (from the most current, but often not the same, year) to draw correlations, but every variable we examined is dynamic in nature and changes over time, sometimes dramatically. The demographics, socioeconomic conditions, physical and social environment, and policy and spending landscape are moving targets—and their effects on each other and on health outcomes often lag over a period of years. Differences across states must take account of migration patterns and the proportion of state residents who come from other states or countries. For example, we found that Florida often had better health statistics than other Southern states but the majority of Florida's population was born outside the South.[136]

**Understanding geographic patterns:** Another clue to causality is the geographic fingerprint of health disparities, such as the patterns discussed earlier. The concentration of injury deaths in the Mountain states holds clues about potential causes that may apply across the nation. Conversely, the Mountain and West North Central states dominated the Top 10 for their low asthma rates, perhaps suggesting lower exposure to allergens. Uncovering causal factors or links to policy decisions can be helpful nationwide.

**Studying outliers:** Geographic patterns can point to causes, but departures from geographic patterns can be equally instructive. Outliers that break from the pattern stand out visually on the heat maps (Figures 2–3). What can we learn from these exceptions? For example, the six states that ranked most often in the Top 10 (Table 2)—Utah, Massachusetts, Hawaii, Connecticut, Vermont, and Minnesota—ranked poorly on certain health outcomes. Why did New Jersey rank in the Top 10 for low infant mortality rates, low rates of overweight, good dental health, and low rates of teen birth—appearing in the Bottom 10 only for high rates of HIV infection—while the adjacent states of New York and Pennsylvania appeared in the Bottom 10 four and seven times, respectively? Low birth weight is less common in states that report low rates of overweight and obesity. Why did Iowa rank in the Top 10 for birth weight but ranked 39$^{th}$ on overweight and obesity? Off-diagonal studies of outliers, "bright

spots" analyses, and other forms of counterfactual research can provide new insights about causal pathways.

### 3. Understanding which policies can best close the gap

**Learning from the successes of states and communities:** The study of outliers may uncover success stories, such as policies or strategies responsible for improved health outcomes, and cautionary tales about factors that compromised health outcomes. The policy research agenda should include a closer probe of specific states, first to confirm our findings and then to dig deeper by examining compilations of state laws[137] and investigating the backstory that underlies health trends. For example, Mississippi, a state that often has unfavorable health statistics, achieved the highest vaccination rate for school-aged children through a strong public health program that removed loopholes in its mandatory vaccination law.[138]

**Using simulation modeling to predict the outcomes of policy options:** Computational modeling and machine learning techniques could prove useful in understanding these complex interrelationships. Tools such as agent-based modeling and predictive analytics can marshal quantitative data to forecast which policy levers are most likely to improve health outcomes.[139]

**Conducting health impact assessments of potential policies:** The National Research Council defines health impact assessment as "a tool that can help decision-makers identify the public-health consequences of proposals that potentially affect health."[179] See the Health Impact Project for examples.

## THE POLICY AGENDA

Policies and action steps to improve the health of the states can be informed by further research but should not wait for it. Our work, and that of others before us, makes a compelling case for action despite the limitations of the data and methods and the many unanswered questions that linger. The evidence for the U.S. health

> ***"job creation, economic development, transportation, the environment, and education are integral to improving health"***

disadvantage is too strong and consistent for policymakers to ignore. Publishing the results of this analysis will not benefit the public unless coupled with action.

As noted earlier, our data reaffirm that health behaviors—notably physical inactivity and smoking—correlate highly with health outcomes, but we also found that social and economic factors (e.g., poverty) often correlated just as strongly ($r_s$ as high as 0.87) and with a larger number of conditions (36 versus 15). Conditions in the physical and social environment (e.g., motor vehicle commuting, childhood trauma) correlated with 25 conditions, with coefficients as high as 0.78.

***"Reducing income inequality and enhancing the financial wellbeing of Americans have the potential to boost the economy while also improving the health of employees, increasing workforce productivity, and lowering health care costs"***

This means that states with poor health outcomes cannot make meaningful progress without investments, at the state and local level, to create stronger economic conditions and healthier environments. Exhortations for the public to be more active will have modest impact unless accompanied by investments in public transportation and urban planning that discourage driving, create green space, and promote walking and cycling.[25]

The data we report about employment, education, and concentrated poverty remind policymakers that matters seemingly unrelated to health and medicine—such as job creation, economic development, transportation, the environment, and education—are integral to improving the health of the states (and controlling the costs of health care). Important health gains can be achieved by improving education—especially early childhood education—and by raising household incomes.[68, 118, 140–145] Specific policies have health implications. For example, decisions about the minimum wage can affect infant birth weight,[146] premature mortality,[147] and other health outcomes. This means that the local economy is important to health, especially in distressed communities. The health of distressed communities is tied to economic empowerment to reverse the long-term consequences of disinvestment; provide better education and employment

opportunities; reduce crime; and attract supermarkets, doctors' offices, and child care.

Reversing the harmful effects of racial segregation requires the dismantling of conditions that isolate minorities and impede their participation in the larger economy, beginning with education. Inspired by the success of the Harlem Children's Zone, the Federal government's Promise Neighborhoods program is working to improve the education of students in distressed neighborhoods.[148] Sustaining such governmental programs is difficult, given fiscal and political realities. The weak economies and tight budgets in some regions make such support even more difficult. In Mississippi—the state that ranked most often in the Bottom 10 in our study—income assistance has declined by more than 7 percent over the past two decades.[33]

Whether or not governments are prepared to act, employers, investors, health care systems, and communities are increasingly interested in the social determinants of health and in social impact investments in education, job training, affordable housing, and local economic development.[149–151] The business case is compelling. Prominent economists, including the chair of the Federal Reserve,[152] have warned that income inequality is curbing economic growth. By one analysis, eliminating racial disparities in income would boost the U.S. gross domestic product by 14 percent ($2.1 trillion per year).[153] Reducing income inequality and enhancing the financial wellbeing of Americans have the potential to boost the economy while also improving the health of employees, increasing workforce productivity,[154] and lowering health care costs. Whether or not governments are prepared to act, employers, investors, health care systems, and communities are increasingly interested in the social determinants of health and in social impact investments in education, job training, affordable housing, and local economic development.[149–151] The business case is compelling. Prominent economists, including the chair of the Federal Reserve,[152] have warned that income inequality is curbing economic growth. By one analysis, eliminating racial disparities in income would boost the U.S. gross domestic product by 14 percent ($2.1 trillion per year).[153] Reducing income inequality and enhancing the financial wellbeing of Americans have the potential to boost the economy while also improving the health of employees, increasing workforce

productivity, and lowering health care costs.[133,154] Policymakers, employers, and investors who are looking for specific, actionable plans can find "take action" resources that identify effective programs and monetize the value of these investments.[155–161] Collective impact initiatives—in which stakeholders in a community collaborate across sectors to share data, resources, and strategies to achieve explicit health goals—are becoming more common across the country.[150] Cross-sector collaborations of this sort are also being pursued on a national scale.[162,163]

The health of Americans is deeply interconnected with the pressing social issues of our time, such as income inequality, racism, violence, and the decline in civic engagement.[164] Our data suggest that the health of states is directly connected to the social fabric of our communities. Movements and policies to enhance social capital—to promote trust, engagement, and supportive relationships among neighbors and increase the agency and voice of marginalized populations—are not only a civic priority but are essential to public health.[62, 165–169] Our data hint at the possibility that these efforts to strengthen social ties may even be more important to health than sidewalks and supermarkets.

The message that community and social wellbeing matter greatly to health is consistent with the *Culture of Health* movement launched by the Robert Wood Johnson Foundation and with other efforts to think about the "upstream" drivers of health and wellbeing. For example, the *Culture of Health* model identifies civic engagement, a sense of community, mindsets and expectations, and investment in collaboration as important drivers of health outcomes.[5] This project lends some empirical support to these efforts by demonstrating, through our data, that health is correlated with the quality of the social environment.

Opioid addiction has emerged as an acute public health crisis during the years this project was completed. Policymakers are rightly focused on improving physician prescribing practices and broadening access to substance abuse and addiction treatment services, but the socioeconomic conditions discussed throughout this and the supplemental reports deserve as much attention. People living amid these stressful conditions rely on coping mechanisms and sometimes turn to smoking, alcohol, or drugs—and increasingly those drugs are heroin or painkillers. Not acting to address

persistent poverty and economic stresses on the middle class may neglect an important root cause for the acute rise in addiction.

Although all age groups are our concern, the literature points to early childhood as a critical priority for action. Efforts to create a more nurturing environment for infants and young children, early childhood education, and other "cradle to career" interventions are important to the health of children and adults and beneficial to society.[68, 118, 170, 171] Our work adds to a large body of research about the immediate and long-term consequences of childhood exposure to trauma.[68] As others have reported,[67, 68] we found high correlations between ACEs and rates of pediatric morbidity, as well as the risk of adult diseases, such as heart disease and strokes.[t] Victims of discrimination and violence live with a form of post-traumatic stress disorder, underscoring the importance not only of trauma-informed care, but also trauma-informed policies and community building.[172, 173]

In addition, our data signal the need to support youth of all ages, especially teens. Adolescence is a period when unhealthy behaviors are often first adopted, when mental illness often first appears, and when teens experiment with risky behaviors or react to stresses in ways that increase their risk of injury, unplanned pregnancy, and untimely death. We found strong correlations between the conditions faced by teens and the health of the states in which they live, including their rankings for the diseases of late life. Programs to help teens cope with stress, graduate from high school, find employment, and afford college are important on many fronts. Helping states where children face the greatest risks will, in sheer numbers,

***"Sharpening our focus on broadening social and economic opportunity, enhancing the environments in which we live, and setting new priorities for public policies and spending that optimize those conditions are our best hope for improving health"***

t. As noted earlier, the biological effects of trauma affect the growing child in ways that can last a lifetime, and the field of epigenetics suggests the effects can be transmitted genetically across generations.

have the biggest impact on the nation's future because those states tend to have the largest youth populations.[174]

We found little evidence that spending more on health care services would be associated with better health outcomes. Our data do support the need for improving access to health insurance coverage, making health care more affordable, and expanding primary care services so that chronic diseases like diabetes and heart disease can be properly managed without the need for frequent hospitalizations. Adequate care requires investments in training programs and other policies to address the nation's shortages in primary care and mental health providers. By one estimate, eliminating the current shortage in primary care providers would require the addition of nearly 7,000 rural physicians and nearly 13,500 inner-city physicians.[175]

As stated at the outset of this report, Americans live shorter lives and experience poorer health than their peers in other high-income countries,[1] but that cross-national health disadvantage is exceeded by the wider gaps in life expectancy and other health outcomes that exist domestically within our country—from region to region, across state lines, and within our communities. Sharpening our focus on broadening social and economic opportunity, enhancing the environments in which we live, and setting new priorities for public policies and spending that optimize those conditions are our best hope for improving health. They are also essential to the economic vitality and social stability of our communities.
States have an important role to play in this endeavor.

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