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Variation In Health Outcomes: The Role Of Spending On Social Services, Public Health, And Health Care, 2000–09

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ABSTRACT Although spending rates on health care and social services vary substantially across the states, little is known about the possible association between variation in state-level health outcomes and the allocation of state spending between health care and social services. To estimate that association, we used state-level repeated measures multivariable modeling for the period 2000–09, with region and time fixed effects adjusted for total spending and state demographic and economic characteristics and with one- and two-year lags. We found that states with a higher ratio of social to health spending (calculated as the sum of social service spending and public health spending divided by the sum of Medicare spending and Medicaid spending) had significantly better subsequent health outcomes for the following seven measures: adult obesity; asthma; mentally unhealthy days; days with activity limitations; and mortality rates for lung cancer, acute myocardial infarction, and type 2 diabetes. Our study suggests that broadening the debate beyond what should be spent on health care to include what should be invested in health—not only in health care but also in social services and public health—is warranted.

The high cost of health care remains a pressing concern for state policy makers and taxpayers. During the period 1999–2009, health care costs increased faster than inflation,¹ and in many states Medicaid inflation-adjusted spending has had a compound annual growth rate of more than 5 percent since 2000.² Such increased spending may reflect greater insurance coverage and access to health care for the population. Nevertheless, greater investments in health care without equivalent economic and tax revenue growth may result in fewer resources for state-funded social services, such as housing, nutrition, and income support programs—which themselves may influence health outcomes in states.

The potential for social services to be crowded out to some degree by rising health care costs is of particular concern given health policy makers' growing interest in the role of social determinants in influencing the health of individuals and populations. Extensive evidence demonstrates a clear relationship between a variety of social determinants and health outcomes.^{3–6} Poor environmental conditions, low incomes, and inadequate education have consistently been associated with poorer health in a diverse set of populations. Taken together, social, behavioral, and environmental factors are estimated to contribute to more than 70 percent of some types of cancer cases, 80 percent of cases of heart disease, and 90 percent of cases of stroke.^{7,8}

Furthermore, several studies have aimed to

quantify the health gains associated with social service interventions.^{9–13} The provision of housing vouchers,⁹ assistance with covering home energy needs,¹⁰ and availability of supermarkets¹² have been associated with subsequent reductions in extreme obesity,^{9,12} diabetes,⁹ and nutritional risk among children.¹⁰ The availability of prenatal and infant nutritional and income supports have been associated with reduced infant mortality,^{11,14,15} early childhood education can be linked to lower blood pressure in adulthood,¹⁶ and income supports for older adults such as Supplemental Security Income have been associated with reductions in disability.¹⁷

Background

Despite the policy relevance of understanding the relative spending on health care and social services and its association with health outcomes across the states, previous studies have not fully examined this question. International comparisons^{18,19} have demonstrated that when overall spending is adjusted for, countries with higher social services spending relative to health care spending had significantly better health outcomes. Nevertheless, studies assessing the association between social service and health spending and health outcomes within the United States are limited, largely because of the difficulty of obtaining comparable data across states on social services spending.

We found only three relevant studies.^{13,20,21} Two investigated the state-level variation in social and health care spending and all-cause mortality,^{20,21} and the third examined the association between social and health care spending and premature mortality using variation across large US cities.¹³ Each of these studies found a significant association between higher spending on education and lower all-cause mortality, although two of the studies used only a single year of data.^{13,20} Additionally, each study lacked health outcomes other than all-cause mortality, and the spending data used focused largely on education and income support expenditures instead of including a more comprehensive set of services—such as those related to housing, nutrition support, public health, and transportation—that may be associated with health outcomes.

Accordingly, we sought to advance this literature by exploring the association between state-level health outcomes and relative spending on social services and public health and on health care. We hypothesized that states with higher ratios of social to health spending would have better health outcomes in subsequent years. One explanation for such a finding could be that

states with greater illness spend more on health care to address illness, which crowds out spending on social services and reduces the ratio (that is, higher spending on social services and public health services divided by spending on health care services)—thus resulting in an observed association between lower ratios of social to health spending and poorer health. An alternative explanation for this finding is that spending on social services and public health meaningfully addresses social determinants of health and thus improves health outcomes.

We constructed a unique data set of health care spending from the National Health Expenditures data and public health and social service spending data from the Census Bureau by state for the period 2000–09. We gathered health outcome data from the Centers for Disease Control and Prevention (CDC) for prevalent and costly conditions for which consistent data existed for the same period.

As our primary analysis, we explored the relationship between the ratio of social to health spending and subsequent health outcomes, after adjusting for total spending. We did not estimate the effects of the ratio's components in the same model, since they are part of the same construct (state-level public spending) and highly correlated, and doing so would have resulted in multicollinearity. However, we did test the contribution of each component separately, adjusted for time and region fixed effects, state-level repeated measures, logged gross domestic product (GDP), and total spending as a percentage of GDP. Findings may inform efforts among policy makers, clinicians, and researchers to leverage social services and health care spending more effectively to improve population health.

Study Data And Methods

STUDY DESIGN AND SAMPLE We conducted a retrospective longitudinal study of the fifty states and the District of Columbia for the period 2000–09 (giving us 510 state-year observations). This decade was the most recent ten-year period for which consistent data were available on health care, public health, and social services spending across states. As mentioned above, we used a unique data set that we created from existing data on the targeted health outcomes as well as on spending on health care services, public health services, and social services.

The study was deemed exempt from review by the Institutional Review Board at the Yale University School of Medicine because we used publicly available deidentified data.

DATA AND MEASURES

► **DEPENDENT VARIABLES:** Our dependent

variables were eight measures of state-level health outcomes that were selected as prevalent and costly conditions for which consistent data were available for the study period. These health outcomes included the percentages of adults in the state who were obese (body mass index of 30 kg/m² or more), had asthma, reported fourteen or more days in the past thirty days as mentally unhealthy, or reported fourteen or more days in the past thirty days with activity limitations—all of which we measured using data from the Behavioral Risk Factor Surveillance System for the study period. Our other health outcomes were as follows: state-level mortality rates per 100,000 population for acute myocardial infarction, lung cancer, and type 2 diabetes (measured using data from the CDC)²² and post-neonatal mortality rates (measured in three-year intervals using data from the National Center for Health Statistics).²³

► **INDEPENDENT VARIABLE:** Our independent variable of interest for each state and year was the spending on social services and public health relative to the spending on health care in each state. This independent variable was used to measure spending on services that address social determinants of health that have been shown to be associated with health outcomes (for example, nutrition, housing, and income support) relative to spending on services that address the medical determinants of health (such as health care).⁵

In models that adjusted for total absolute spending as a percentage of GDP, relative spending was measured by the ratio of social to health spending (calculated as the sum of social services spending and public health spending divided by the sum of Medicare spending and Medicaid spending for beneficiaries residing in the state). We included public health spending in the numerator because, like social services spending, most public health spending focuses primarily on addressing social and environmental determinants of health for the population, as opposed to medical care delivered to individuals.

We included social services for which there is literature suggesting that they have a positive effect on recipients' health.⁵ These services included primary, secondary, and higher education; income supports, such as cash assistance, general relief for low-income or needs-tested beneficiaries of public welfare programs, and Supplemental Nutritional Assistance Program funding; transportation, such as spending on sidewalks, highways, and mass transit systems; environment, such as sanitation and recreational programming and the conservation of natural resources; public safety, including law enforcement and fire protection but excluding correc-

The allocation of state-level spending on social services and public health and on health care, may be key to understanding population health outcomes.

tions; and housing, such as aid for public or private housing and community development.

Data on social services spending were obtained from the Census Bureau's 2014 Annual Survey of State and Local Government Finances, the Social Security Administration, the Administration for Children and Families, and the Department of Agriculture for the period 2000–09. Public health spending, obtained from the Census Bureau, included expenditures for public health department activities and federally defined health activities and programs (for example, disease surveillance; the Special Supplemental Nutrition Program for Women, Infants, and Children; health-related inspections; community health care programs; the regulation of air and water quality; and animal control).

The ratio of social to health spending was calculated with the following two denominators: publicly funded health care spending (Medicare plus Medicaid) and all public and private health care spending in the states. We used the publicly funded health care services denominator in our analyses because we had data only on publicly funded social services and public health services to calculate the numerator.

► **COVARIATES:** We sought to adjust for factors related to demographic characteristics, economics, and the availability of health care resources that might confound the association between state spending and health. Demographic factors for 2000–09 included the percentages of the state population ages sixty-five and older, white, female, ages twenty-five and older with a high school diploma, and residents of urban areas (all of this information was obtained from the Census Bureau) and geographic region (obtained from the Bureau of Economic Analysis). Economic factors for 2000–09 included unemploy-

Our findings suggest broadening the debate beyond health care spending to include investments in social services and public health.

ment rate (obtained from the Department of Labor), mean housing price (obtained from the Federal Housing Finance Agency), percentage of children living in single-parent households (obtained from Kids Count),²⁴ and state-level logged GDP per capita (obtained from the Bureau of Economic Analysis).

We created a political affiliation variable to indicate states in which the governor and the majority of both state legislatures were Democrats or Republicans, and states where neither party had control of both executive and legislative branches. Last, we obtained data on health care resources (hospital beds, primary care providers, and dentists per 100,000 population) from the American Hospital Association, American Medical Association, and American Dental Association.

DATA ANALYSIS We used standard descriptive statistics and graphs to characterize state-level variation in health outcomes, in the ratio of social to health spending, and in the component parts of the ratio. We summarized selected health outcome data and ratio data into quintiles and produced US maps using the most recent year of the study period, 2009 (see the online Appendix).²⁵

To understand the component parts of the ratio by state, we created a graph with social and public health spending as a percentage of GDP on the *y* axis and health care spending as a percentage of GDP on the *x* axis. Because the components are highly correlated and capture the same construct (state spending on services), we could not fit models that simultaneously tested their independent associations with health outcomes. However, we did test the contribution of each component separately using one- and two-year lagged spending variables, adjusted for time and region fixed effects, state-level repeated measures, logged GDP per capita, and

total spending as a percentage of GDP. In general, we reported spending as a percentage of each state's GDP to account for cost and price differences across states.

To estimate associations between the ratio of social to health spending and each of the eight health outcomes, we fitted separate multivariable linear regression models for each health outcome as a function of the ratio of social to health spending in the state, using annual data for 2000–09 with spending variables lagged one and two years. We adjusted these models for the log of the state GDP per capita, total spending (summing the components of the ratio) as a percentage of state GDP, time and region fixed effects,^{26,27} and state-level repeated measures when serial correlation was significant based on the Wooldridge test.^{28,29}

We fitted each model with candidate covariates, including the percentage of the population living in urban settings, percentage white, unemployment rate, percentage of children living in single-parent households, and number of primary care physicians and hospitals per 100,000 population. We excluded several other variables that were found to be multicollinear³⁰ with the spending ratio, the state GDP, or the density of primary care physicians. We removed the variable for political affiliation because it was non-significant in all models, and we tested the final models for multicollinearity assumptions with the variance inflation factor.³¹

We estimated robust standard errors using Huber-White sandwich estimators.^{32,33} We chose not to use state fixed effects because with only ten years of data and modest variation within states over time, there were statistical power limitations. For all models, we imputed missing data using an iterative Markov chain Monte Carlo method with fifty imputations per variable.³⁴ We reported regression coefficients for a change of one standard deviation (which was equivalent to 20 percent of the median value of the ratio of social to health spending with Medicare and Medicaid spending in the denominator and to 10 percent of the median value of the ratio with total health care spending in the denominator).

In a secondary analysis we reestimated the primary models using the ratio of social to health spending with total health care spending (instead of only publicly funded spending through Medicare and Medicaid) in the ratio's denominator. All statistical analyses were performed with Stata, version 12.

LIMITATIONS Our findings should be interpreted in light of several limitations. First, our data were state-level observational data and thus should be interpreted as reflecting statistical association, not causation. Nonetheless, we used

strong statistical methods to estimate the association between spending and health outcomes, and we demonstrated the association between spending in one year and health outcomes one and two years later at the state level. The lags were used to address concerns about reverse causality; with only ten years of data, we could not examine longer lag times because of statistical power considerations. We also adjusted for a range of potentially confounding variables, state-level repeated measures, and region and time fixed effects. Moreover, we interpreted the results as pertaining to the state-level outcomes, recognizing that our findings could not be extrapolated to individual-level experiences.

Second, the data were somewhat dated, and, as noted above, statistical power was limited by our having only ten years of data. As a robustness check, we replaced region fixed effects with state fixed effects. Although statistical significance was lost on several estimates when we did this, the magnitude and direction of the effects did not change substantially—which suggested power limitations.

Third, we restricted the analysis to public spending on social services, public health, and health care services, since comprehensive state-level data on private spending on social services and public health were not readily available. Despite these limitations, the data we used were the most extensive contemporary and historical data we could locate that were consistently measured across all states. In addition, this study substantially extends previous work in this area, much of which has been conducted with only one year of data.

Fourth, we were unable to identify all social services spending that passed directly from the federal government to individuals without being administered by the states. These federal expenditures, however, were unlikely to vary greatly per person across states and thus should not substantially bias our findings.

Fifth, because spending and health data were linked to state residence, we were unable to address the issue of crossing state borders to receive services. Recent research suggests, however, that such border crossing for Medicaid benefits is modest.³⁵ Furthermore, we did not have data on nonprofit spending on social services and public health, which can vary by state³⁶ and hence could have affected the results.

Last, while the study suggests a new avenue for research on policy-level determinants of a broad range of health outcomes, it was not designed to identify specific programs, particular social services, or public health actions to which the positive effects could be attributed.

Study Results

STATE-LEVEL VARIATION IN SPENDING AND OUTCOMES States varied greatly in terms of spending and all eight outcomes. The average ratio of social to health spending in 2000–09 was 3.09, and the median was 3.02 (Exhibit 1). Thus, in the average state, for every \$1 of Medicare and Medicaid spending, an additional \$3 was spent on social services and public health. The mean share of state GDP devoted to health care spending was 14.1 percent, while 12.2 percent was devoted to social services spending (Exhibit 2).

Although the ratio of social to health spending was relatively stable over time within any single state (data not shown), there was variation in the ratio and its components across the states in 2009, the most current year for which data were available (Exhibit 3). Exhibits 5–8 in the Appendix²⁵ characterize states by quintiles of the ratio and health outcomes.

ASSOCIATIONS BETWEEN SPENDING AND HEALTH OUTCOMES In fully adjusted multivariate models, states with higher one-year lagged ratios of social to health spending had significantly better health outcomes in seven of the eight health measures (model 1 in Exhibit 4). Specifically, compared to states with lower lagged ratios, states with higher lagged ratios had lower percentages of adults who were obese; had asthma; reported fourteen or more mentally unhealthy days or fourteen or more days of activity limitations in the past thirty days; and had lower mortality rates for lung cancer, acute myocardial infarction, and type 2 diabetes. Results were similar for the two-year lagged models, although the association with obesity became nonsignificant ($p = 0.084$) (Exhibit 9 in the Appendix).²⁵

In the secondary analysis, in which we used total health care spending for the ratio denominator, results were largely consistent with the primary analysis. Higher ratios of social to health spending were associated with significantly better outcomes for six of the eight health measures for both the one-year lagged model (model 2 in Exhibit 4) and the two-year lagged models (Exhibit 9 in the Appendix).²⁵

Although we could not enter both social services and public health spending and health care spending in a single model to estimate their independent effects because of multicollinearity, we did examine the association of one-year lagged social services and public health spending (the numerator of the ratio) and then of the one-year lagged health services spending (the denominator) in separate models with all eight health outcomes. Increased social services and public health spending as a percentage of state GDP was associated with better outcomes for all eight health measures, with the association

EXHIBIT 1**Distribution of health outcomes and spending across the fifty states and the District of Columbia, 2000–09**

	Mean	SD	IQR
HEALTH OUTCOMES			
Percent of adults who:			
Were obese (body mass index ≥ 30)	23.8	3.7	21.2, 26.1
Had asthma	8.1	1.1	7.3, 8.9
Reported 14+ days of past 30 days as mentally unhealthy days	9.9	1.8	8.8, 10.8
Reported 14+ days of past 30 days with activity limitations	6.4	1.5	5.4, 7.0
Mortality rate for:			
Acute myocardial infarction (per 100,000 population)	53.9	20.7	38.4, 66.5
Lung cancer (per 100,000 population)	55.2	12.5	48.8, 64.1
Type 2 diabetes (per 100,000 population)	5.7	2.3	4.0, 7.1
Postneonatal infants (per 100,000 births) ^a	238.2	65.9	194.4, 279.1
SPENDING MEASURES			
Annual social services and public health spending ^b (% of GDP)	15.23	2.73	13.56, 16.98
Annual Medicare and Medicaid spending (% of GDP)	4.96	1.49	3.92, 5.94
Social-to-health spending ratio ^c	3.09	0.59	2.60, 3.39
Annual total health care spending (both public and private; % of GDP)	14.10	2.80	12.28, 15.80
Social-to-health-spending ratio ^d	1.06	0.10	0.98, 1.11

SOURCE Authors' analysis of data for 2000–09 from the following sources: (1) Behavioral Risk Factor Surveillance System. (2) Centers for Disease Control and Prevention. WONDER online databases (Note 22 in text). (3) National Center for Health Statistics. Health Data Interactive (Note 23 in text). **NOTES** SD is standard deviation. GDP is gross domestic product. ^aPostneonatal death rates were measured in three-year intervals. ^bSome social services spending data were missing for 2000, 2001, and 2003. They were imputed for the statistical analysis. ^cThe social-to-health spending ratio was calculated as follows for each state: (social services spending plus public health spending)/(Medicare spending plus Medicaid spending). The median for the ratio was 3.02. ^dThe social-to-health-spending ratio was calculated as follows for each state: (social services plus public health spending)/(total health care spending). The median for the ratio was 1.04.

reaching significance for three of the eight measures (mentally unhealthy days, days with physical limitations, and lung cancer mortality; $p < 0.01$). In contrast, increased health care spending as a percentage of GDP was associated with worse health outcomes for all eight health measures, and the association reached significance for five of the eight measures (obesity rates, asthma rates, mentally unhealthy days, days with physical limitations, and lung cancer mortality; $p < 0.05$; data not shown).

Discussion

We found that in the period 2000–09, states with higher ratios of social to health spending had better health outcomes one and two years later, compared to states with lower ratios. The effect of the ratio was significant for seven of the eight health outcomes we assessed, even after we adjusted for region; year; state-level repeated measures; state-level GDP per capita; total spending as a percentage of GDP; and sociodemographic, economic, and health care resources factors. We could not establish causality with these observational data. However, the persistent pattern across a range of health outcomes is notable.

One interpretation of our findings could be that people who have poorer health require more medical care spending, which results in a lower ratio of social to health spending that is associ-

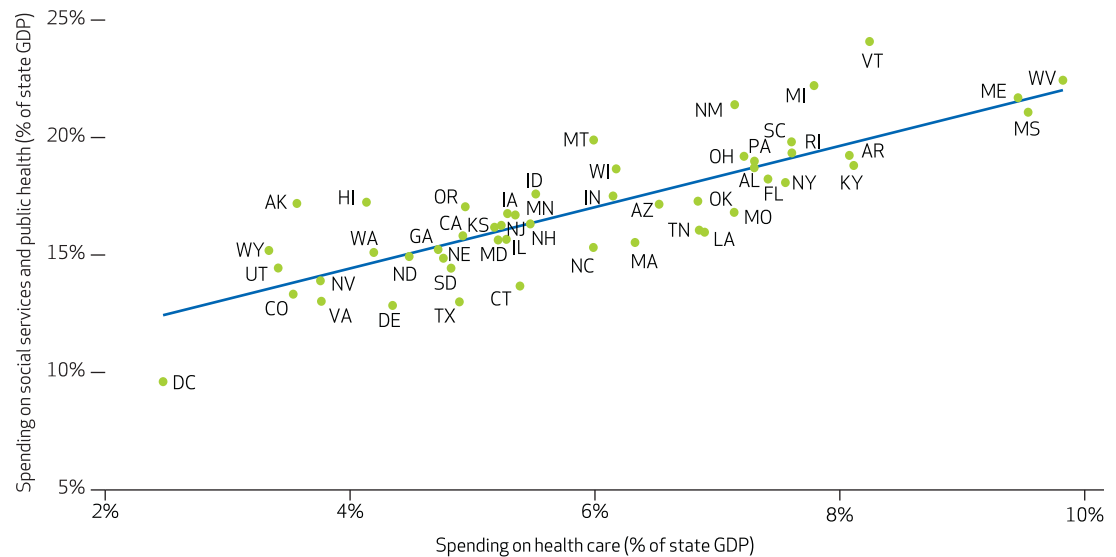
EXHIBIT 2**Annual state-level spending as a percentage of state GDP, 2002 and 2004–09**

Spending category	Mean (%)	SD	IQR
Medicaid ^a	2.2	0.8	1.74, 2.66
Medicare ^a	2.7	0.9	2.12, 3.17
Total health care ^a (including private spending and excluding public health)	14.1	2.8	12.28, 15.80
Public health ^b	3.6	0.8	1.99, 3.03
Total social services ^{b,c}	12.2	2.4	11.36, 13.93
Education ^b	5.3	1.0	4.66, 5.96
Income support ^{b,e}	4.0	1.5	3.76, 5.09
Transportation ^b	0.9	0.3	0.78, 1.10
Environment ^b	0.8	0.2	0.65, 0.90
Public safety ^b (excluding corrections)	0.8	0.2	0.66, 0.85
Housing ^b	0.3	0.2	0.18, 0.30

SOURCE Authors' analysis of data from the sources in the exhibit footnotes. **NOTES** "State" includes the District of Columbia. Imputed data for 2000, 2001, and 2003 that were used for the statistical analysis were excluded. GDP is gross domestic product. SD is standard deviation. IQR is interquartile range. ^aCMS.gov. Health expenditures by state of residence, 1991–2009 [Internet]. Baltimore (MD): Centers for Medicare and Medicaid Services; [last modified 2014 Sep 2; cited 2016 Mar 10]. Available from: <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsStateHealthAccountsResidence.html>. ^bCensus Bureau. State and local government finance: historical data [Internet]. Washington (DC): Census Bureau; [last revised 2015 Oct 2; cited 2016 Mar 10]. Available from: http://www.census.gov/govs/local/historical_data.html. ^cDepartment of Agriculture. Supplemental Nutrition Assistance Program (SNAP) data system [Internet]. Washington (DC): USDA; [last updated 2013 Jun 18; cited 2016 Mar 10]. Available from: [http://www.ers.usda.gov/data-products/supplemental-nutrition-assistance-program-\(snap\)-data-system/documentation.aspx](http://www.ers.usda.gov/data-products/supplemental-nutrition-assistance-program-(snap)-data-system/documentation.aspx). ^dDepartment of Health and Human Services. Administration for Children and Families archives: TANF financial data [Internet]. Washington (DC): HHS; [last updated 2013 Dec 5; cited 2016 Mar 10]. Available from: <http://archive.acf.hhs.gov/programs/ofs/data/index.html>. ^eSocial Security Administration. Program statistics and data files by title [Internet]. Baltimore (MD): SSA; [cited 2016 Mar 10]. Available from: http://www.ssa.gov/policy/data_title.html.

EXHIBIT 3

Spending on social services and public health and on health care (Medicare and Medicaid) as percentages of state GDP, 2009



SOURCE Authors' analysis of data from Exhibits 1 and 2. **NOTES** States (the fifty states and the District of Columbia) above the line have greater-than-average ratios of social to health spending; states below the line have lower-than-average ratios. GDP is gross domestic product.

EXHIBIT 4

Adjusted associations between the ratio of social to health spending with a one-year lag and health outcomes across the fifty states and the District of Columbia, 2000–09

Health outcome	Model 1 ^a		Model 2 ^b	
	Estimated coefficient ^c	p value	Estimated coefficient ^c	p value
PERCENT OF ADULTS WHO:				
Were obese (body mass index ≥ 30)	−0.33	0.014	−0.16	0.101
Had asthma	−0.11	0.041	−0.12	0.012
Reported 14+ days in past 30 days as mentally unhealthy days	−0.43	0.007	−0.24	0.035
Reported 14+ days in past 30 days with activity limitations	−0.37	<0.001	−0.25	0.002
MORTALITY RATE FOR:				
Acute myocardial infarction (per 100,000 population)	−4.02	0.032	−0.64	0.649
Lung cancer (per 100,000 population)	−2.72	0.001	−2.35	0.002
Type 2 diabetes (per 100,000 population)	−0.45	0.004	−0.51	<0.001
Postneonatal infants ^d (per 100,000 live births)	−4.15	0.325	−6.56	0.037

SOURCE Authors' analysis of data from Exhibits 1 and 2. **NOTES** Both models adjusted for the log of state-level gross domestic product (GDP) per capita, time and region fixed effects, total spending as a percentage of GDP (social services, public health, Medicare, and Medicaid in model 1; social services, public health, and total health spending in model 2), and significant covariates among the following candidate independent variables: percentage of the population white; percentage of adults ages twenty-five and older with a high school diploma; percentage of the population living in an urban area; unemployment rate; percentage of children living in single-parent households; primary care providers per 100,000 population; and hospital beds per 100,000 population, for all models other than the obesity model. State-level repeated measures modeling was used for mental health, postneonatal mortality, and acute myocardial infarction mortality because of serial correlation (see Notes 27 and 28 in text). ^aEffect of one-year lagged social-to-health spending ratio (denominator: Medicare and Medicaid spending). ^bEffect of one-year lagged social-to-health spending ratio (denominator: total health care spending). ^cCoefficients estimate the change in the health outcome associated with a one standard deviation change in relevant social-to-health spending ratio, which is about 20 percent of the median value of the ratio in model 1 and 10 percent of the median value of the ratio in model 2. ^dPostneonatal death rates were measured in three-year intervals.

ated with poorer health outcomes. This may in part be accurate. However, it does not explain the observation that the ratio was also associated with health outcomes one and two years later. Furthermore, we also found a positive association between social services spending and better health outcomes.

The magnitude of the effects, when extended across the US population, was substantial. For instance, a 20 percent change in the median ratio of social to health spending was associated with a –0.33-percentage-point change in the percentage of adults with obesity in the subsequent year. With seventy-eight million obese adults nationwide in 2009,³⁷ the effect of such a change would be 85,000 fewer adults with obesity. Given the evidence that adults with obesity incur approximately \$2,700 more in average annual health care expenses than adults who are not obese,³⁸ this is a sizable effect.

Similarly, higher ratios of social to health spending were associated with a –0.43-percentage-point change in the percentage of adults reporting fourteen or more mentally unhealthy days in the past thirty days. Given that approximately twenty-three million adults nationwide had mental health issues in 2009,³⁹ the effect size is equivalent to 989,000 fewer adults with mental health issues per year.

The importance of nonmedical investments illustrated in this analysis is consistent with the findings of research that has highlighted the social determinants of health,^{3–6} the recent emphasis on “health in all policies,”⁶ and the positive impacts on health outcomes of interventions that coordinate medical and social services.^{6,40–43} Accountable care organizations and

more recent efforts by the Centers for Medicare and Medicaid Services to create accountable health communities reward providers based on health improvements. These efforts could spur experimentation with interventions that address housing, nutrition, transportation, legal, and other social services that may improve patients’ health outcomes.

To support innovative health policies, research that includes spending and outcomes for investments in both health care and social services is critical. This study, consistent with our previous international work,^{18,19} underscores the fact that the allocation of state-level spending on social services and public health and on health care, not just the total spending, may be key to understanding population health outcomes.

Conclusion

We found that the ratio of social to health spending was significantly associated with a range of health outcomes at the state level. Our results suggest that adequate investment in social services and public health, not just investment in health care, may be key to understanding variations in health outcomes across the states. Although it may be tempting to interpret this finding as a demand for the reallocation of state monies from health care to social services and public health, it is important to reiterate that we have reported statistical associations and could not infer causality. Nevertheless, our findings suggest broadening the debate beyond health care spending to include investments in social services and public health. ■

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Errata

2015-0965 DE RIGNE P. 521 In the third paragraph of the “Study Data And Methods” section, a measure of obesity was incorrect. The measure should be body mass index greater than 30 kg/m², not thirty pounds overweight. The article has been corrected online.

2015-0972 BERK ET AL. P. 735 In Exhibit 2, the legend was incorrect. The three cohorts are ages 18–22, ages 23–26, and ages 27–30. The exhibit has been corrected in the article online.

BRADLEY ET AL. 2015-0814 P. 766 The label for California in Exhibit 3 was inadvertently omitted. The exhibit has been corrected online.

2015-1103 ZHOU ET AL. P. 829 The y axis label in Exhibit 4 was erroneously labeled as “Millions spent on opioid pain relievers,” with dollar signs by each label. The correct label is “Total MMEs prescribed,” with no dollar signs. The exhibit has been corrected online.

2015-1379 NEWMAN P. 925 The legend

in Exhibit 4 contained a typographical error. The final set of bars should have been labeled 1.8 < price ratio, not 0.8 < price ratio. The article has been corrected online.

2015-1653 BARRY ET AL. P. 1009 In the opening paragraph, Rep. Patrick Kennedy’s state was incorrect. He is a Democrat from Rhode Island, not Massachusetts. The article has been corrected online.

2016-0017 SWANSON ET AL. PP. 1070, 1071, 1072 First, a formatting error and omitted data in Exhibit 2 resulted in an interpretation error in the text. A new row, “Baker Act without criminal disqualification,” with the numbers 21,343 and 26.12, should be added below the row beginning “Involuntary examination,” not in boldface. A note “b” should be added to the two boldface rows; the note states: “Includes criminal disqualification.” In the text, paragraph with the subheading beginning “Prevalence And Patterns,” the figure 34 percent should be 26 percent.

Second, a labeling error occurred in Exhibit 3. In the bar labeled “Gun suicide (N = 50),” the light green segment should be 54%, and the dark green segment should be 18%. A related error in the text, in the second paragraph below the subheading beginning “Disqualification From,” the figure “one-third” should be “three-quarters,” and the figure 18 percent should be 54 percent.

Finally, in Exhibit 4, the second pair of bars should be labeled “Not gun-prohibited (all)” instead of “No involuntary intervention.”

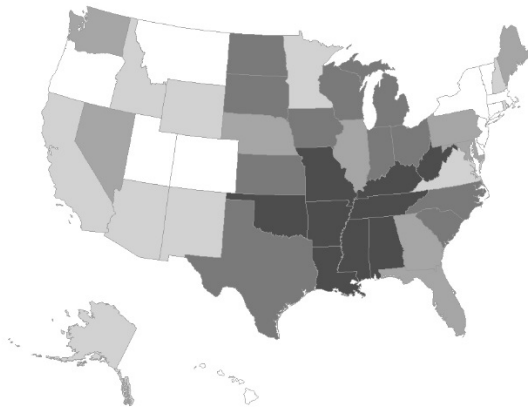
The authors regret these errors, which do not affect the article’s conclusions. The article has been corrected online.

2016-0442 DATAGRAPHIC P. 957 The errors in Swanson et al. as described above resulted in the need to correct a portion of the graphic labeled “Guns and mental health in Florida.” As in the article’s version of Exhibit 2 labeled “Gun suicide (N = 50),” the light green segment should be 54%, and the dark green segment should be 18%. The Data-Graphic has been corrected online.

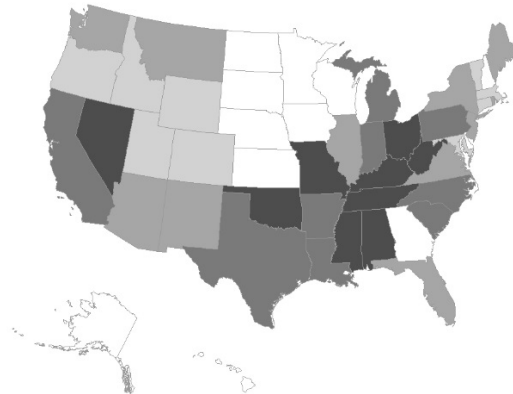
From Appendices

Exhibits: U.S. maps of health outcomes and social-to-health spending ratio quintiles, 2009

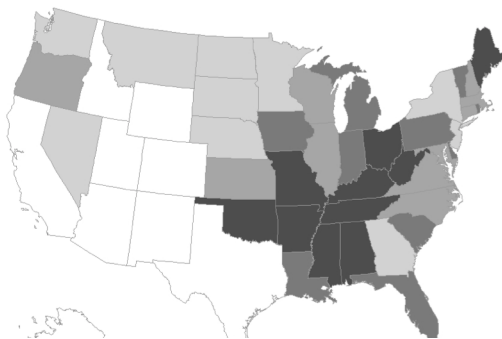
Percent of adult population that is obese^a



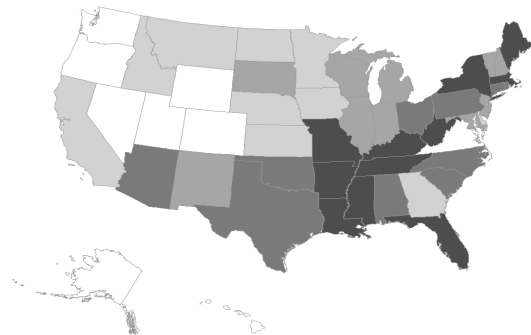
Percent of adults who reported 14 or more days in the last 30 days as mentally unhealthy days^a



Lung cancer mortality rate per 100,000 population^a



Social-to-health spending ratio^b



Sources: Authors' analysis of data from Exhibits 1 and 2

Notes:

^a For the first three Exhibits, dark gray indicates highest quintile (i.e., poorest health outcomes) and white indicates lowest quintile (i.e., best health outcomes).

^b For the last Exhibit, dark gray indicates lowest social-to-health spending ratio; white indicates highest social-to-health ratio (calculated with Medicare plus Medicaid as the denominator).