By J. Mac McCullough and Jonathon P. Leider

Government Spending In Health And Nonhealth Sectors Associated With Improvement In County Health Rankings

DOI: 10.1377/hlthaff.2016.0708
HEALTH AFFAIRS 35,
NO. 11 (2016): 2037–2043

ABSTRACT **There is little evidence to demonstrate the impact on local health outcomes of spending that occurs outside the health care sector. We leveraged novel data from the US Census Bureau to measure the independent impact of a community's health and nonhealth expenditures on a broad measure of overall health—the County Health Rankings—over time. Using lagged longitudinal models that accounted for correlations of health outcomes and expenditures within counties, we found significant positive associations between expenditures and County Health Rankings for seven of the fourteen expenditure categories examined: community health care and public health, public hospitals, fire protection, K–12 education, corrections, libraries, and housing and community development. These areas of social spending have modest but detectable positive associations with population health, whether or not they primarily target health. Achieving improved health outcomes through a culture-of-health ethos should involve the consideration of public expenditures in both health and other social service areas.**

J. Mac McCullough (mccullough@asu.edu) is an assistant professor in the School for the Science of Health Care Delivery, College of Health Solutions, Arizona State University, in Phoenix.

Jonathon P. Leider is a faculty affiliate in the Department of Health Policy and Management at the Johns Hopkins Bloomberg School of Public Health, in Baltimore, Maryland.

A growing body of literature has explored the extent to which governmental expenditures on public health are associated with population health outcomes.[1] A 10 percent increase in local public health spending has been linked with reductions in mortality of 1.1–6.9 percent.[2] A long-term $10 increase in per capita public health spending has been shown to increase the proportion of people reporting that they are in good, very good, or excellent health[3] and to reduce all-cause mortality by 9.1 deaths per 100,000 people.[4]

However, important challenges remain in linking public health expenditures to population health outcomes. Specifically, communities that have good health outcomes may simply have more resources to invest in public health. A few previous studies have explored the contribution of expenditures outside the public health sector to population health outcomes.[5–7] There is widespread acknowledgment that population health outcomes are determined by more than just governmental public health expenditures.[6,8,9] One recent study, addressing this topic at the state level, found that a higher ratio of social services to health spending was associated with better state health outcomes.[6] Another state-level study found that higher overall welfare spending was also associated with better health outcomes.[7] While all of these studies point toward a potential link between nonhealth spending and health outcomes, none of them reported granular enough data to enable policy makers to understand which types of social services and welfare spending might contribute to population health gains.[10]

The Robert Wood Johnson Foundation's Culture of Health Action Framework posits that getting and staying healthy requires addressing the "social and physical spaces and the conditions in which people live, learn, work, and play"

in a community.[8(pS150)] Building a culture of health will therefore require engagement, planning, and investment beyond the traditional focus on the health care sector. Communities and policy makers will need to consider not only the direct impacts of allocating public funds toward, say, a new library or park, but also whether these investments are likely to yield health benefits for the community.[8]

Looking beyond the health sector to improve health outcomes requires addressing a complex web of social determinants that affect almost every aspect of a person's life, including health and well-being.[11] The importance of addressing the social determinants of health has been formalized in a number of national frameworks in the United States, including the Culture of Health Action Framework,[8] Healthy People 2020,[12] and the National Prevention Strategy.[13] Measures of health status and the social determinants of health include social deprivation indices,[14] grades and report cards,[15–17] and rankings.[18,19] These measures have a common goal: motivating awareness and change.

One measure that has had a large impact is the County Health Rankings, a collaboration between the University of Wisconsin and the Robert Wood Johnson Foundation. These rankings have received both accolades and criticism,[20] as well as over 800 mentions in the media, as catalogued by LexisNexis between 2010 and 2016.

While the importance of investing in nonhealth sectors is well understood, there is little evidence demonstrating the extent to which this spending contributes to improved health outcomes at the local level. This information could help guide policy makers' prioritization of expenditures to maximize health promotion and disease prevention within their communities.[8] There exist few data regarding how the relationship between social determinants of health and population health is influenced by public expenditures at the local level. Such information could serve to build an evidence base for benchmarks that have been proposed for spending on those social determinants.[21] This article helps build that evidence base. We used novel data for the period 2010–15 to measure the independent associations between health and nonhealth expenditures and County Health Rankings over time.

Study Data And Methods

DATA We used two major sources of data: public expenditure data from the Census Bureau and County Health Rankings data.

Our public expenditure data came from the Census Bureau's census of governments, which includes expenditure data from all of the approximately 87,000 local governments in the United States.[22] Data are available every five years (the most recent releases were in 2007 and 2012). To obtain annual estimates, we conducted linear nearest-neighbor interpolation by year for each governmental entity and expenditure category (for more details on how the estimates were generated, see the online Appendix).[23] We then aggregated expenditures for all governmental entities within a county according to spending categories defined by the Census Bureau.[22] We analyzed fourteen health and social service expenditure categories that have been used in similar previous work[6] or were specifically identified in the Culture of Health Action Framework[8] (for technical definitions of the expenditure categories, see Appendix Exhibit A1).[23]

Our population health data came from County Health Rankings and Roadmaps. Given the broad range of avenues through which nonhealth public spending could conceivably affect population health, we sought a broad measure of population health status. The County Health Rankings are a well-known and widely used measure of the overall health of a population.[24] Moreover, the rankings are sometimes treated as an outcome themselves, as articles in the media frequently report on a county's ranking instead of, for example, the county's underlying all-cause mortality rates.[24,25] There may thus be intrinsic value in examining the ranking itself.

Normally produced at the state level, the County Health Rankings compile a range of county-level data to rank counties based on both health outcomes (length of life and quality of life, each of which account for 50 percent of these outcomes) and health factors (social determinants and other factors related to the physical and social environment within a county).[19,20,25] For this study, we used a special-use version of the 2010–15 County Health Rankings from the University of Wisconsin's Population Health Institute, in which counties were ranked both nationally and by state in terms of health outcomes for the period 2012–15 and in terms of health factors for the period 2010–13. Each county's health outcomes ranking was the primary outcome of interest, and its health factors ranking was a predictor of interest.

ANALYTIC APPROACH We performed univariate and bivariate analyses to explore associations between public expenditures and county-level health factors and outcomes. Bivariate analyses used county health rankings at both the national and state levels. We explored the fourteen expenditure categories as per capita dollar amounts and as percentages of total public expenditures within a county. We tested for significant differ-

ences in spending using Kruskal-Wallis tests and analysis of variation tests.

We used lagged random-intercept multivariate longitudinal models to regress a county's national health outcomes ranking (the primary outcome of interest) on the county's mean per capita expenditures and year-specific deviation from its county-specific mean in each of the fourteen categories from the four previous years and its health factors ranking for the two previous years, controlling for population and state-level clustering (for more details on model and variable lag specifications, see the Appendix).[23]

Multivariate analyses used county health rankings at the national level. To account for potential nonlinearities in the spending-to-health outcomes relationships, the square of per capita spending for each category was also included in the model. In addition to the primary outcome of interest, we used multivariable models to explore the association between spending and each of the five health outcomes measures used to construct the rankings: years of potential life lost, adults in poor or fair health, number of poor physical health days, proportion of births that are low birthweight, and number of poor mental health days.

The models included data for 2,500 counties in 2012, 2,459 in 2013, 2,351 in 2014, and 2,403 in 2015, for a total sample size of 9,713 county-year observations. Estimates were unreliable for states with especially small numbers of counties, so the states with fewer than ten counties in the data set were excluded (Connecticut, Delaware, Hawaii, and Rhode Island; we also excluded the District of Columbia). We performed post estimations to calculate the regression-adjusted effects of increases of $10 in per capita expenditures and of 10 percent increases in expenditures for significant variables. Data coding and analyses were performed using Stata, version 13.1.

LIMITATIONS Our study had several limitations. First, while our longitudinal design allowed us to examine the impacts of changes in spending over time, we could not prove causality. Public expenditures are determined not randomly but by community resources, events, priorities, and other characteristics.[26] For example, in some states where funding for public health is determined formulaically, areas with low health status receive proportionately more funding than other areas. Thus, public health spending and health outcomes may be endogenous,[27] and the relationships observed between the two should be viewed as associative instead of causal.

However, a strength of our analysis lies in its broad, multisector representation of public spending categories. We are unaware of formulas used to determine nonhealth expenditures (such as for libraries or fire protection) that are based on health outcomes. In addition, we controlled for a county's health factors and its average total spending levels in our models. These considerations strengthen our confidence that the associations we observed were not spurious.

Second, as mentioned above, lags were used for both expenditure and health factor variables. Some data used to construct the rankings data were pooled to improve reliability and span multiple years. Thus, there is the potential for correlation across years. We partially accounted for this potential correlation within county measures across years through the use of variables centered on county means. As additional County Health Rankings data become available, refined testing for this potential issue may become possible.

Third, our study was constrained by the availability of outcome data, which meant that we could examine only those impacts for which data were available over four years of the national rankings. However, the time between when an investment is made and when its impacts occur might vary by sector, and impacts might last beyond four years. For example, Timothy Brown found that the full impact on mortality rates of additional public health spending was still being realized ten years following the investment.[4] However, approximately 80 percent of the benefits were realized within the first four years. Therefore, our study might understate the bene-

EXHIBIT 1

County per capita expenditures for health and social services areas, 2012

	County expenditures ($)		
Expenditure category	**Median**	**Mean**	**SD**
Community health care and public health	60.12	96.44	115.19
Public hospitals	—[a]	343.64	725.91
Parks and recreation	45.35	65.02	25.91
Natural resources	10.81	33.12	60.00
Waste management	51.60	60.93	48.47
Sewerage	89.99	114.46	93.62
Fire protection	66.81	80.98	62.14
Protective inspections	4.24	7.24	9.83
Public welfare	13.54	92.97	149.43
K–12 education	1,613.41	1,712.58	512.27
Corrections	51.72	65.20	66.14
Libraries	21.55	27.50	25.45
Transportation	189.73	243.25	193.46
Housing and community development	42.74	66.36	80.91

SOURCE Authors' analysis of data for 2007–12 from the Census Bureau's census of governments and for 2012–15 from County Health Rankings and Roadmaps. **NOTE** SD is standard deviation. [a]Only 37 percent of the counties in the data set had any public hospital expenditures in 2012, so median expenditure for this category is $0.00.

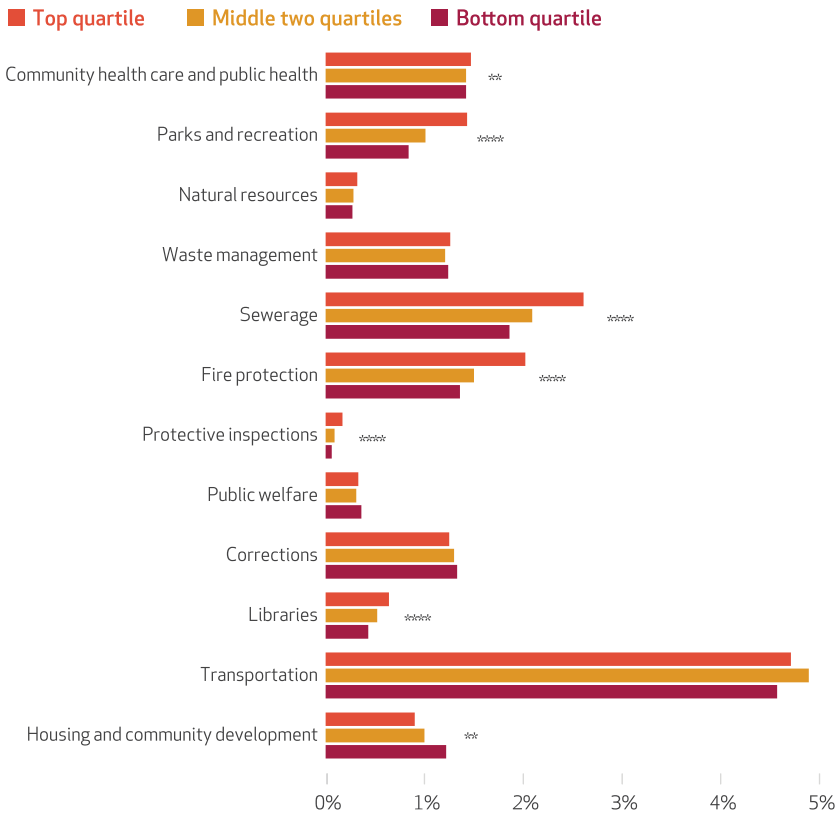
fits of additional expenditures, especially for sectors with longer cumulative lags between investment and population health impacts.

Fourth, we tested for potential nonlinearities in the relationship between a county's overall ranking and its score on the underlying z-score used to create the ranking. We found little evidence to suggest that this was an issue, with the exception of the extreme tails of the distribution. Thus, our estimates might not be generalizable to the most or least healthy counties, although the direction of the relationship appears to hold.

Finally, our data set did not include spending by private actors. Such spending could supplement or replace public expenditures in some instances and represents an important area for research and the collection of additional data. Nevertheless, there is a need to understand and justify the sizable public investments in health and nonhealth sectors made each year by local governments. Given the importance of both public and private spending in fostering a culture of health, further exploration of the potential relationship between public and private spending on health is warranted.

EXHIBIT 2

Median county budget allocations for relevant expenditure categories, by county health factors ranking, 2012



SOURCE Authors' analysis of data for 2007–12 from the Census Bureau's census of governments and for 2012–15 from County Health Rankings and Roadmaps. **NOTES** Expenditures on elementary education are not shown because of scale issues. The amounts allocated to K–12 education were 40.8 percent of total expenditures for counties in the top quartile of the ranking, 42.9 percent for counties in the middle two quartiles, and 43.9 percent for counties in the bottom quartile. Expenditures for public hospitals are not shown because the median value was 0 percent (only approximately one-third of counties had any expenditures in this category). Significance levels shown if at least one category (top quartile, middle two quartiles, and bottom quartile) is significantly different than the others. $^{**}p < 0.05$ $^{****}p < 0.001$

Study Results

By far the largest of the health and social services spending categories examined was K–12 education, with median per capita spending of $1,613 in 2012 (Exhibit 1). The category of community health care and public health had median spending of $60.12—less than 3 percent of the total spending examined in this analysis.

Our analyses revealed several ways in which county-level public expenditures and county-level population health status were related. Median per capita expenditures on the fourteen categories analyzed were not significantly different for counties in the healthiest three quartiles of health outcomes ($3,064) than for counties in the bottom quartile ($3,083; $p = 0.30$) (data not shown). But median per capita expenditures were significantly higher for counties in the top three quartiles of health factors rankings ($3,081) than for counties in the bottom quartile ($3,032; $p = 0.04$). Compared to counties in the bottom three quartiles of health factors rankings, counties in the top quartile tended to allocate a larger proportion of their annual budgets to community health care and public health, parks and recreation, sewerage, fire protection, protective inspections, libraries, and housing and community development (Exhibit 2).

Multivariate longitudinal models found several significant associations between health outcomes and per capita expenditures (for full regression outputs, see Appendix Exhibit A3).[23] Multivariable models indicated that changes in the expenditure categories shown in Exhibit 3 were independently associated with changes in health outcome rankings at the county level. The size of the improvement varied but was modest in all cases.

While increased spending in each of the seven categories shown in Exhibit 3 was associated with improvements in national county health rankings, there were negative associations for the square of per capita spending in the categories of fire protection, K–12 education, and corrections (full regression results are shown in Appendix Exhibit A5).[23] This means that there may be a nonlinear relationship between increased spending in these three categories and improved rankings, with decreasing returns for large changes in spending in these categories.

Models that explored the association between a 10 percent change in per capita expenditures and subsequent changes in underlying health outcome measures revealed associations between certain spending categories and health outcome measures. However, no single spending category was significantly associated with all five health outcome measures. For example, additional spending on libraries was associated with significant improvements in only two of the measures: the number of adults in fair or poor health and the proportion of births that were low birthweight. Notably, additional spending for some of these categories was associated with population health declines (for a full table of findings, see Appendix Exhibit A4; for full regression outputs, see Appendix Exhibit A5).[23]

Discussion

There is an increasing recognition of the importance of social determinants of health as drivers of health outcomes.[8,12,13] Yet there is limited evidence regarding the interplay among social services spending, social determinants of health, and population health outcomes at the local level.[5,6] Our study examined the relationships between county-level spending on social services, county-level health factors, and county-level health outcomes.

Notable patterns emerged for counties when we examined governmental spending across quartiles of health outcomes and health factors rankings. Overall, jurisdictions with higher health outcome rankings devote larger proportions of their expenditures to community health care and public health, parks and recreation, sewerage, fire protection, and libraries, compared to jurisdictions with lower health outcome rankings. Counties that invest less in community health care and public health, social services, and other areas relevant to the Culture of Health Action Framework tend to fare worse in terms of their health factors. Given that health factors have been referred to as the health outcomes of the future,[24] this gap may represent a source of future health disparities, as the longer-term impacts of these differential investments are felt in subsequent years.

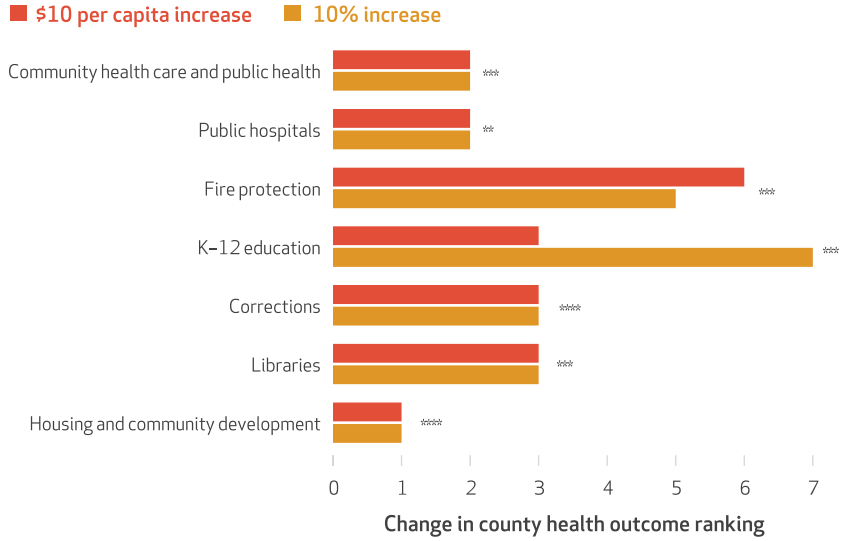
We also found evidence of an association between social services spending and subsequent population health outcomes, even after we controlled for each county's health factors (social determinants and other factors related to the physical and social environment within a county). Our findings suggest that changes in health outcome rankings could not be traced directly back to a single health outcome measure. We found evidence of a wide range of associations between changes in social services spending and changes in a number of health outcome measures. At the most general level, the size of the association was relatively modest, and no single expenditure category was associated with meaningfully larger gains than other categories were.

One critical recommendation based on this finding is that policy makers and program advocates should carefully consider the possible impacts if spending increases in one area are offset by spending decreases in other areas. In some cases, additional spending in nonhealth areas—such as libraries—may yield a population health dividend in addition to the direct effects in the nonhealth areas.[28] Yet our models showed decreasing returns on additional spending across several social services categories, which means that there may be some level of spending after which additional spending may yield fewer additional benefits from a health outcomes perspective.

Future research to determine optimal levels for each expenditure type may be beneficial and could help inform potential benchmarking efforts.[21] One practical consideration here is that stakeholders advocating for the optimizing of population health outcomes would be well advised to take a holistic view of how public spend-

EXHIBIT 3

Estimated lagged effects on county health outcomes rankings for 2012–15 of increases in spending on social services from 2008 to 2012



SOURCE Authors' analysis of data for 2007–12 from the Census Bureau's census of governments and for 2012–15 from County Health Rankings and Roadmaps. **NOTES** The exhibit shows regression effects adjusted for a county's health factors, population, state, and mean levels of expenditures. Changes correspond to position changes in the rankings during the study period. Lagged effects for the remaining categories in Exhibit 1 are not shown because they were not significant (alpha = 0.05). Significance refers to the relationship between changes in county social services and subsequent changes in county health outcome rankings. Significance outcomes were the same in each category for both per capita increases and percent increases. $^{**}p < 0.05$ $^{***}p < 0.01$ $^{****}p < 0.001$

ing affects population health outcomes. Together, our findings underscore the need to use a multisector approach in efforts to advance health outcomes within a community.

It is worth noting that counties may not always be the locus of local investment decision making. While the expenditure data used in this analysis can be matched to cities, municipalities, and other areas, finding reliable annual health outcomes data at these local levels remains challenging.[29] The results of local initiatives to track expenditures against measurable health outcomes may help policy makers within counties tailor these findings to their jurisdictions.

Conclusion

This article presents novel local-level data on a range of specific categories of public spending in relation to population health outcomes. Previous work has explored the association between spending on a range of social services categories and health outcomes at the state level.[6,7] However, our data allowed us to conduct a granular examination of the relationship between spending and health outcomes while also accounting for variation in local policies, programs, and priorities.

We found evidence that investments in community health care and public health, public hospitals, fire protection, K–12 education, corrections, libraries, and housing and community development were associated with improved health outcomes, as indicated by improvements in County Health Rankings. Many of these factors were also associated with gains in the underlying health outcome measures that make up the County Health Rankings. These areas of social services expenditures have detectable, significant, and positive associations with population health, whether or not they primarily target health.

Our findings provide policy makers with evidence that investments beyond the health sectors may yield health dividends.

Counties with limited means may have the opportunity to improve their population's health (and their own ranking) by adjusting their spending on social services. Our study provides evidence that spending in health and nonhealth sectors is associated with improved county health outcomes within a modest time frame. Yet the least healthy communities are currently underinvesting in some of these areas, relative to other communities. Attempting to improve population health outcomes through a culture-of-health ethos should involve considering public expenditures in both health and nonhealth sectors. Our findings provide policy makers with evidence that investments beyond the health sectors may yield health dividends. ■

This study was supported by a grant from County Health Rankings and Roadmaps, a collaboration of the University of Wisconsin Population Health Institute and the Robert Wood Johnson Foundation. Funders did not have editorial review or approval of this work. The views expressed are those of the authors and do not necessarily reflect the views of County Health Rankings and Roadmaps or the Robert Wood Johnson Foundation. J. Mac McCullough has received funding from the Maricopa County Department of Public Health. That agency played no role in this study.

NOTES

1 Singh SR. Public health spending and population health: a systematic review. Am J Prev Med. 2014;47(5):634–40.
2 Mays GP, Smith SA. Evidence links increases in public health spending to declines in preventable deaths. Health Aff (Millwood). 2011;30(8):1585–93.
3 Brown TT, Martinez-Gutierrez MS, Navab B. The impact of changes in county public health expenditures on general health in the population. Health Econ Policy Law. 2014;9(3):251–69.
4 Brown TT. How effective are public health departments at preventing mortality? Econ Hum Bio. 2014;13:34–45.
5 Bradley EH, Elkins BR, Herrin J, Elbel B. Health and social services expenditures: associations with health outcomes. BMJ Qual Saf. 2011;20(10):826–31.
6 Bradley EH, Canavan M, Rogan E, Talbert-Slagle K, Ndumele C, Taylor L, et al. Variation in health outcomes: the role of spending on social services, public health, and health care, 2000–09. Health Aff (Millwood). 2016;35(5):760–8.
7 Kim A-S, Jennings ET Jr. Effects of U.S. states' social welfare systems on population health. Policy Stud J. 2009;37(4):745–67.
8 Plough AL. Building a culture of health: a critical role for public health services and systems research. Am J Public Health. 2015;105(Suppl 2):S150–2.
9 McCullough JM, Leider JP, Riley WJ. Local fiscal allocation for public health departments. Am J Prev Med. 2015;49(6):921–9.
10 Woolf S, Aron L. The U.S. health disadvantage and the role of spending. Health Affairs Blog [blog on the Internet]. 2016 Jun 1 [cited 2016 Sep 14]. Available from: http://healthaffairs.org/blog/2016/06/01/the-u-s-health-disadvantage-and-the-role-of-spending/
11 Marmot M. Social determinants of health inequalities. Lancet. 2005;365(9464):1099–104.
12 Koh HKA. A 2020 vision for healthy people. N Engl J Med. 2010;362(18):1653–6.
13 National Prevention Council. National Prevention Strategy: America's plan for better health and wellness [Internet]. Rockville (MD): Office of the Surgeon General; 2011 Jun [cited 2016 Sep 14]. Available from: http://www.surgeongeneral.gov/priorities/prevention/strategy/report.pdf
14 Singh GK. Area deprivation and widening inequalities in US mortality, 1969–1998. Am J Public Health. 2003;93(7):1137–43.
15 Roubal AM, Catlin BB, Timberlake K. University of Wisconsin Population Health Institute. Health of Wisconsin report card—2013 [Internet]. Madison (WI): The Institute; 2013 [cited 2016 June 2]; Available from: http://uwphi.pophealth.wisc.edu/programs/match/healthiest-state/report-card/2013/
16 Norton S, Delay D. Health and equity in New Hampshire: 2013 report card [Internet]. Concord (NH): New Hampshire Center for Public Policy; 2013 Jan [cited 2016 Sep 14]. Available from: http://www.nhpolicy.org/UploadedFiles/Reports/HealthEquity2013.pdf
17 Barbot O. Baltimore City health disparities report card 2013 [Internet]. Baltimore (MD): Baltimore City Health Department; 2014 Apr [cited 2016 June 1]. Available from: http://health.baltimorecity.gov/sites/default/files/Health%20Disparities%20Report%20Card%20FINAL%2024-Apr-14.pdf
18 United Health Foundation. America's Health Rankings: annual report 2015 [Internet]. Minnetonka (MN): The Foundation; 2015 Dec [cited 2016 Sep 14]; Available from: http://assets.americashealthrankings.org/app/uploads/2015ahr_annual-v1.pdf
19 County Health Rankings and Roadmaps [home page on the Internet]. Madison (WI): County Health Rankings; c 2016 [cited 2016 Sep 14]. Available from: http://www.countyhealthrankings.org/
20 Rohan AM, Booske BC, Remington PL. Using the Wisconsin County Health Rankings to catalyze community health improvement. J Public Health Manag Pract. 2009;15(1):24–32.
21 Kindig D. From health determinant benchmarks to health investment benchmarks. Prev Chronic Dis. 2015;12:E41.
22 Bureau of the Census. Government finance and employment classification manual [Internet]. Washington (DC): The Bureau; 2006 Oct [cited 2016 Sep 14]. Available from: http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf
23 To access the Appendix, click on the Appendix link in the box to the right of the article online.
24 Remington PL, Catlin BB, Gennuso KP. The County Health Rankings: rationale and methods. Popul Health Metr. 2015;13:11.
25 Peppard PE, Kindig DA, Dranger E, Jovaag A, Remington PL. Ranking community health status to stimulate discussion of local public health issues: the Wisconsin County Health Rankings. Am J Public Health. 2008;98(2):209–12.
26 Mays GP, Smith SA. Geographic variation in public health spending: correlates and consequences. Health Serv Res. 2009;44(5 Pt 2):1796–817.
27 Marton J, Sung J, Honore P. Does more public health spending buy better health? Health Serv Res Manag Epidemiol. 2015;2.
28 McCullough J, Zimmerman FJ, Fielding JE, Teutsch SM. A health dividend for America: the opportunity cost of excess medical expenditures. Am J Prev Med. 2012;43(6):650–4.
29 Casper T, Kindig DA. Are community-level financial data adequate to assess population health investments? Prev Chronic Dis. 2012;9:E136.