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Characteristics of High-poverty Counties with High Well-being

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High-poverty Counties with High Well-Being

TITLE Characteristics of High-poverty Counties with High Well-being

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High-poverty Counties with High Well-Being

Abstract

OBJECTIVE To identify county characteristics associated with high well-being among high-poverty counties.

DESIGN Observational cross-sectional study at the county level to investigate the associations of 29 county characteristics with the odds of a high-poverty county reporting population well-being in the top quintile versus the bottom quintile of well-being in the United States. County characteristics representing key determinants of health were drawn from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps population health model.

SETTING Counties in the United States that are in the highest quartile of poverty rate, defined by percent of persons in poverty.

MAIN OUTCOME MEASURE Gallup-Sharecare Well-being Index, a comprehensive population-level measure of physical, mental and social health. Counties were classified as having a well-being index score in the top or bottom 20% of all counties in the U.S.

RESULTS Among 770 high-poverty counties, 72 were categorized as having high well-being and 311 as having low well-being. The high well-being counties had a mean well-being score of 71.8 with a SD of 2.3, while the low well-being counties had a mean well-being score of 60.2 with a SD of 2.8. Among the 6 domains of well-being, basic access and life evaluation scores differed the most between high- and low-well-being counties. Among 29 county characteristics tested, 6 were independently and significantly associated with high well-being ($p<0.05$). These were: lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of some college education and paradoxically, a higher percentage of heavy drinkers.

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CONCLUSIONS Among 770 high-poverty counties, approximately 9% outperformed expectations, reporting a collective well-being score in the top 20% of all counties in the United States. High-poverty counties reporting high well-being differed from high-poverty counties reporting low well-being in several characteristics.

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Strengths and Limitations of this Study

- In this study of high-poverty counties in the United States, we used a unique and validated measure of population well-being, the Gallup-Sharecare Well-being Index, and 29 county characteristics highlighted by the Robert Wood Johnson Foundation County Health Rankings and Roadmaps model of population health.
- Using these data, this study was the first to identify characteristics associated with high well-being among high-poverty counties.
- As this was a cross-sectional study, we were unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties.
- Our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county level, however, counties are important units for policy action and represent municipalities for which there are a number of key metrics available.

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Introduction

Poverty is negatively associated with physical, mental and social health. [1-14] In particular, studies have linked poverty with higher rates of obesity and greater incidence of coronary artery disease, as well as lower levels of life satisfaction and social capital. [1, 5, 9-12] Though it is essential to decrease rates of poverty in the United States, there is also a need to mitigate its adverse health consequences through policies and programs focused on high-poverty populations. [15]

One approach to understanding how to reduce the consequences of poverty is to study populations with high rates of poverty that report high levels of physical, mental and social health, together defined as high well-being. [16] Well-being includes not only the absence of disease, but also a sense of opportunity, happiness and lack of stress. It reflects the ability to afford food, housing and healthcare, to live in a safe neighborhood, and to work in a trusting, respectful environment. [16-19] As poverty is negatively associated with many aspects of well-being, if high-poverty populations report high well-being, these populations have outperformed expectations. [1-8, 20]

Accordingly, we sought to identify the community characteristics most strongly associated with high well-being among counties with high rates of poverty. We conducted this analysis using county-level estimates of well-being from the Gallup-Sharecare Well-Being Index, a survey that comprehensively evaluates well-being across the nation. [17] We compared the characteristics of high-poverty counties with high and low well-being, relative to the distribution of all counties, using data from the Robert Wood Johnson Foundation (RWJF) County Health Rankings and

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Roadmaps (CHRR), which includes a robust portfolio of factors describing counties in the United States. [17, 21, 22]

Methods

We conducted an observational cross-sectional study of high-poverty counties or county equivalents (in some states, cities, parishes or boroughs) to determine which domains of the Gallup-Sharecare Well-Being Index differed the most between high- and low-well-being counties, and to identify the county characteristics that were most strongly associated with high versus low well-being.

Data Sources and Measures

County-level poverty prevalence was measured by 2010 county-level percent of persons in poverty from the Area Health Resources Files (AHRF) of the Health Resources and Services Administration. These estimates are from the Bureau of Census’ Small Area Income Poverty Estimates (SAIPE) files for 2010 and are constructed from statistical models which include data from federal income tax returns, participation in the Food Stamp program, and the previous census. [23]

Well-being data were obtained from the 2010-2012 Gallup-Sharecare Well-Being Index. [17] The Gallup-Sharecare Well-Being Index has been validated as a measure of population well-being by Gallup, Inc. and prior studies have linked it with life expectancy, employee productivity, health care utilization and spending, and voting patterns.[17, 19, 24-27]

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Data were collected in a national telephone survey of individuals age eighteen and older from all fifty states and the District of Columbia; approximately 1,000 telephone (landline and cell) surveys were conducted each day during the fielding period. [17] Six well-being domains, as well as population demographics, were evaluated with fifty-five survey questions. "Physical health" assesses the burden of chronic disease and recent illness. "Emotional health" measures daily emotions and the presence or absence of depression. "Healthy behaviors" assess the prevalence of smoking, exercising, and eating fruit and vegetables. "Life evaluation" measures life satisfaction and optimism about the future. "Basic access" includes perception of safety and access to housing and health care. "Work environment" assesses job satisfaction, trust and respect in the workplace and, unlike the other domains, it is collected only from the subset of respondents who report being employed. Each domain is represented on a scale of 0 to 100. The composite well-being score is an unweighted mean of all six domains. [17]

In order to describe the demographics of survey respondents and their counties of residence, we used 2013 rural-urban continuum codes from AHRF as well as region of the United States and annual household income of respondents from the Gallup-Sharecare Well-Being Index. Data on county-level characteristics were obtained from the 2014 RWJF CHRR model of population health. [21] In this model, county factors that influence the health of a county are organized into four categories: clinical care, social

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and economic factors, health behaviors, and physical environment. Each factor is represented by 1-4 county characteristics. (Figure 1) Data for four county characteristics: excessive drinking, inadequate social support, tobacco use and violent crime rates, were not comparable across states or missing for many counties. [21, 22] Tobacco use and excessive drinking were replaced with 2011 estimates of mean smoking prevalence and percent heavy drinkers, respectively, from the Institute for Health Metrics and Evaluation (IHME). [28-30] Heavy drinking was defined as the consumption, on average, of more than one drink per day for women or two drinks per day for men in the past 30 days. [29] Inadequate social support was replaced with the number of social associations from the 2015 RWJF CHRR. [31] We were unable to find an alternative data source for violent crime rates, so this variable was excluded. Finally, we included income inequality, measured as a Gini coefficient, in the list of characteristics, because this county characteristic was added to the CHRR in 2015, and because income disparities within a community may affect well-being.[31, 32] These data were also obtained from the 2015 RWJF CHRR. [31] The 29 characteristics used in our study were categorized into tertiles based on each characteristic’s distribution across our sample of high-poverty counties.

Statistical Analysis

We first identified high-poverty counties as those where the percent of persons in poverty was in the top 25% of all counties in the United States. Among these high-

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poverty counties, high-well-being counties were those with a well-being score in the top 20% of all counties in the United States while low-well-being counties were those with a well-being score in the bottom 20% of all counties in the United States. We summarized well-being as well as respondent and county characteristics for these two groups of counties. We also calculated Cohen's D standardized differences for each of the six domain scores to determine which domains differed the most between high- and low-well-being counties.

We used a multi-step procedure to identify which of the 29 community characteristics from the RWJF CHRR model of population health were most strongly associated with high versus low well-being. Since we expected that many county characteristics would be correlated within and across categories, we used an approach similar to that previously utilized in other studies to reduce many related factors to a smaller representative set. [33, 34] First, we estimated a series of bivariate logistic regression models, one for each characteristic in Figure 1. The outcome of each model was whether the county was classified as high versus low well-being. To account for differing precision of the well-being estimates, each county-level observation was weighted by the number of survey respondents. In addition, to account for correlation of observations within each state, we used generalized estimating equations models, and to account for missing values of independent variables, we used multiple imputation.

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[35, 36] For each model, we calculated R^2 as the correlation between predicted and observed values, as well as the C-statistic. [37] From the bivariate results, we retained characteristics significantly associated with the county composite well-being score ($p < 0.05$) and those that explained a meaningful amount of variance in the outcome ($R^2 > 0.05$). Among the characteristics retained, we assessed for multi-collinearity within each category of characteristics using variance decomposition, eliminating the characteristic with smallest variance decomposition component when the singular value was greater than 20. [38] We estimated a model for each category of characteristics including only those characteristics retained from the prior steps. In two final models, we included all variables independently significant ($p < 0.05$) in their respective category models. The first of these models included only these variables; in order to assess any impact of differential respondent income, the second included the percent of respondents in each income category. For each logistic regression model, we report the C-statistic and R^2 as defined above.

Analyses were performed using Stata 15.1 (2018, StataCorp, College Station, TX). The Yale University Institutional Review Board approved this study.

Patient and Public Involvement

No patients or the public were involved in the planning and design of this study.

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Results

Well-being data were available for 3,091 counties in the United States. Among these counties, 770 met our definition of being "high-poverty", with percent of persons in poverty in the top quartile of all counties in the United States.

Among all 3,091 counties, well-being scores ranged from 35.6 to 87.1 (mean 66.5, SD 4.2). When the sample was limited to high-poverty counties, well-being scores ranged from 46.2 to 81.3, with a mean score of 64.3 and standard deviation of 4.3. In comparison, the mean well-being score for all other counties in the United States was 67.2 and the standard deviation was 3.9. (eFigure 1)

Among high-poverty counties, 72 had a composite well-being score in the top 20% of all counties in the United States and were classified as "high-well-being" and 311 had a composite well-being score in the bottom 20% of all counties in the United States and were classified as "low-well-being." High-well-being counties had a mean well-being score of 71.8 with a SD of 2.3, while low-well-being counties had a mean well-being score of 60.2 with a SD of 2.8. (Table 1) The majority of counties in both the high- and low-well-being groups were urban and the distributions of urban and rural counties in these two groups were not significantly different from each other. The majority of both high- and low-well-being counties were located in the South, but typically in different regions within the

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South, with the largest percentage of high-well-being counties located in the South Atlantic region and the largest percentage of low-well-being counties located in the East South Central region. Finally, the incomes of survey respondents were slightly higher in high-well-being counties compared to those in low-well-being counties. (Table 1)

When the six domains of well-being were compared between high- and low-well-being counties, the largest standardized differences were for the basic access and life evaluation domain scores. Compared with domain scores in low well-being counties, basic access and life evaluation domain scores in high well-being counties were 2.56 and 2.51 standard deviations higher, respectively. (Table 2)

In bivariate analyses, among the 29 community characteristics tested, 21 were significantly associated with high versus low well-being ($p<0.05$). (eTable 1) Among these 21 characteristics, 10 explained greater than 5% of the variation in well-being. These characteristics were primary care physicians, mental health providers, preventable hospital stays, some college, injury deaths, smoking, obesity, physical inactivity, heavy drinking, and long commute. These 10 characteristics were retained and used to estimate a model for each category. The health behaviors category model explained the greatest amount of variance (R^2 : 0.24; C-statistic: 0.81) and the physical environment model explained the least amount of variance (R^2 : 0.05; C-statistic: 0.66). (Table 3) Eight

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characteristics were significant in their respective category models with a p-value < 0.05, and these eight characteristics were included in the final combined model. (Table 4)

In the final combined model, six characteristics remained significantly associated ($p < 0.05$) with high versus low well-being: lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of heavy drinkers, and higher percentage of residents with some college education. In the final model, the R^2 value was 0.30 and the C-statistic was 0.83. After adjusting for respondent-level income, three factors remained significantly associated with higher well-being: heavy drinking, smoking, and primary care physician density. In this final adjusted model, the R^2 was 0.34 and the C-statistic was 0.84. (Table 4)

Discussion

In this study of 770 high-poverty counties, approximately 9% achieved high well-being despite economic disadvantage. These counties shared distinctive characteristics, including lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of some college education, and paradoxically a higher percentage of heavy drinkers.

Recently, our team identified twelve county characteristics explaining over two-thirds of the variation in well-being across all counties in the United States.[39] As we found in this study,

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characteristics in clinical care and social and economic categories were significantly associated with higher well-being, suggesting that access to high-quality healthcare and affordable education may be especially important to well-being, both in all counties and in this sample of high-poverty counties.

Higher supply of primary care physicians and lower rates of preventable hospital stays were both significantly associated with high well-being. These findings are consistent with prior research showing better health outcomes among populations served by primary care-based health systems. [40, 41] For example, a 2005 study showed that a higher supply of primary care providers at the county level was associated with lower total and heart disease mortality rates, even after controlling for socioeconomic and demographic characteristics. [42] In addition, in our recent study of all counties in the United States, we found a significant negative association between rates of preventable hospital stays and individual-level resident well-being. [39] Lower preventable hospital stays may reflect greater access and quality of care in the outpatient setting, better insurance coverage and stronger partnerships between a hospital and its surrounding community; factors that may be especially important to the well-being of high-poverty populations. [21, 43-47]

We were surprised to find that heavy drinking was associated with higher well-being, given that excessive drinking has previously been linked with multiple adverse health outcomes. [29, 48, 49] It is important to note, however, that excessive drinking is inconsistently defined in the literature. In our study, heavy drinking was defined as greater than 1 drink per day for women and greater than 2 drinks per day for men [30], but others have used higher thresholds. [48, 49] It

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is possible that heavy drinking as defined amongst our sample served as a signal for one or more unmeasured confounders. Additional exploration into this relationship would be required to understand true targets for well-being improvement.

Lower rates of smoking and higher levels of some college education were significantly associated with high well-being. The percentage of some college education includes the percentage of individuals with an associate's, bachelor's, graduate or professional degree, as well as those who completed some post-secondary education but did not attain a degree. [22, 50]

Smoking and post-secondary education were highlighted in a 2016 analysis of the geographic variation in life expectancy among low-income populations. Authors found that life expectancy in low-income areas was negatively correlated with rates of smoking and positively correlated with the fraction of college graduates. [51] There are many reasons why measures of smoking prevalence and post-secondary education may help to explain both variation in life expectancy and variation in well-being among high-poverty populations. Potential harms of smoking include not only adverse health consequences to smokers themselves, but also to those exposed to second-hand smoke, while potential benefits of post-secondary education include access to more employment opportunities, as well as better health outcomes among both educated individuals and their children. [52-56]

Finally, higher rates of physical activity were associated with higher well-being, consistent with prior work linking physical activity with mental and physical health. [57, 58] For example, in a recent report from the Appalachian Regional Commission, RWJF, and the Foundation for a Healthy Kentucky, both physical activity and smoking were shown to explain variation in health

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outcomes amongst Appalachian counties. [59] Our results suggest that efforts to encourage exercise, such as improving neighborhood walkability and allowing for greater access to parks and recreation facilities may be especially impactful in high-poverty counties. [7]

Measures of community safety, family and social support were not significant in our final model. This finding was unexpected, as prior work has suggested that community violence and lower social capital, including trust and cohesion between neighbors, mediate the relationship between poverty and poor health outcomes. [1] We used only one measure of community safety: “injury death rate,” because the other measure “violent crime rates,” was incomparable across counties, and we were unable to find an alternative data source. In addition, though we were able to utilize both “children in single-parent households” and “social associations” to represent family and social support, these measures may not adequately capture aspects of social capital that have the strongest influence on well-being. If other measures of social capital and community violence had been available at the county level, these characteristics may have helped to explain variation in well-being across high-poverty counties.

Although our sample was limited to counties in the highest quartile of poverty, the income of respondents varied, with respondents in high-well-being counties reporting higher incomes than respondents in low-well-being counties. (Table 1) Similarly, we found that the percent of children in poverty, a measure of county-level income, was significantly and negatively associated with well-being. (eTable 1) Therefore, differences in income partly explained differences in well-being across these high-poverty counties. However, although the bivariate association between percent children in poverty and well-being was significant, this variable

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explained less than 5% of variance in well-being. (eTable 1) We found that other county characteristics more fully explained differences in well-being among these high-poverty counties.

Among the six domains of well-being, we found that the “basic access” and “life evaluation” scores were most different between high- and low well-being counties, suggesting that efforts focused on these domains may be especially impactful in high-poverty counties. These domains may be related to the community characteristics we identified in this study. For example, perception of neighborhood safety, a component of the basic access domain, has previously been negatively associated with the prevalence of smoking. [60] Similarly, percentage of college graduates at the county level has been associated with average life satisfaction, a component of the life evaluation domain. [5] Future work should explore the relationships between these community characteristics and each of the well-being domains, as these analyses may provide additional insights into predictors of well-being in the setting of economic disadvantage.

This study has several limitations. First, as this was a cross-sectional study, we are unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties. It is possible that other unmeasured factors explain the relationships we found between these community characteristics and well-being, and which represent the true targets for well-being improvement efforts. For example, the positive association between some college and well-being may reflect other characteristics of high-well-being counties such as access to

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affordable community colleges or state universities, parenting styles and cultural beliefs that promote higher education, or sufficient employment opportunities for individuals with post-secondary education. A mixed methods approach incorporating qualitative analyses may be useful in further exploring the relationships between the characteristics identified in our study and the well-being of high-poverty counties. Second, though the Gallup-Sharecare Well-Being Index is a national survey that uses stratified random sampling, design weights were not available at the county level; however, though this may limit inferences about the well-being of any individual county, it does not affect inferences about associations among counties. Finally, our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county level. However, counties are important units for policy action and represent municipalities for which there are a number of key metrics available.

As poverty is negatively associated with many aspects of well-being, it is essential to reduce the burden of poverty affecting many counties in the United States.[1-8, 13, 14] Though poverty eradication remains an essential priority, our findings suggest that targeting certain county characteristics may mitigate the negative influence of poverty on well-being. Specifically, efforts to improve access to high-quality primary care and affordable post-secondary education, increase taxes on tobacco, reduce barriers to tobacco cessation treatment, and improve neighborhood walkability may be especially impactful among high-poverty populations, an idea worth testing. [7, 42, 47, 54, 55]

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Contributors

All authors contributed to the study concept and design, analysis and interpretation of the data, drafting and revising the manuscript. Dr. Herrin completed all statistical analyses.

Competing interests

During the development of this manuscript, Dr. Arora was supported by RWJF and the Yale Center for Clinical Investigation through Clinical and Translational Science Award (CTSA) Grant No. TL1 TR001864 from the National Center for Advancing Translational Science (NCATS), a component of the National Institutes of Health (NIH). Dr. Spatz receives support from the Centers for Medicare & Medicaid Services to develop and maintain performance

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Patient consent for publication Not required.

Data sharing statement

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If the paper is accepted for publication, we will post a de-identified data set with county well-being data from Gallup-Sharecare on ICSPR Open, a publicly available site. County characteristic data from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps are available from www.countyhealthrankings.org.

References

1. Chen, E. and G.E. Miller, *Socioeconomic status and health: mediating and moderating factors*. Annu Rev Clin Psychol, 2013. **9**: p. 723-49.
2. Bikdeli, B., et al., *Place of residence and outcomes of patients with heart failure: analysis from the telemonitoring to improve heart failure outcomes trial*. Circ Cardiovasc Qual Outcomes, 2014. **7**(5): p. 749-56.
3. Sampson, R.J., *The neighborhood context of well-being*. Perspect Biol Med, 2003. **46**(3 Suppl): p. S53-64.
4. O'Campo, P., et al., *The Neighbourhood Effects on Health and Well-being (NEHW) study*. Health Place, 2015. **31**: p. 65-74.
5. Lawless, N.M. and R.E. Lucas, *Predictors of Regional Well-Being: A County Level Analysis*. Social Indicators Research, 2011. **101**(3): p. 341-357.
6. Ludwig, J., et al., *Neighborhood effects on the long-term well-being of low-income adults*. Science, 2012. **337**(6101): p. 1505-10.
7. Diez Roux, A.V. and C. Mair, *Neighborhoods and health*. Ann N Y Acad Sci, 2010. **1186**: p. 125-45.
8. Robinette, J.W., S.T. Charles, and T.L. Gruenewald, *Neighborhood Socioeconomic Status and Health: A Longitudinal Analysis*. J Community Health, 2017.
9. Levine, J.A., *Poverty and obesity in the U.S. Diabetes*, 2011. **60**(11): p. 2667-8.
10. Sundquist, K., et al., *Neighborhood socioeconomic environment and incidence of coronary heart disease: a follow-up study of 25,319 women and men in Sweden*. Am J Epidemiol, 2004. **159**(7): p. 655-62.
11. Arcaya, M.C., et al., *Research on neighborhood effects on health in the United States: A systematic review of study characteristics*. Social Science & Medicine, 2016. **168**: p. 16-29.
12. Haan, M., G.A. Kaplan, and T. Camacho, *Poverty and health. Prospective evidence from the Alameda County Study*. Am J Epidemiol, 1987. **125**(6): p. 989-98.
13. Egen, O., et al., *Health and Social Conditions of the Poorest Versus Wealthiest Counties in the United States*. Am J Public Health, 2017. **107**(1): p. 130-135.
14. Galea, S. and R. Vaughan, *A Public Health of Consequence: Review of the January 2017 Issue of AJPH*. Am J Public Health, 2017. **107**(1): p. 17-18.
15. McGinnis, J.M., *Income, Life Expectancy, and Community Health: Underscoring the Opportunity*. Jama, 2016. **315**(16): p. 1709-10.

High-poverty Counties with High Well-Being

16. *Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference*. 1946, New York: 19–22 June 1946, and entered into force on 7 April 1948.

17. Gallup-Healthways, *Gallup-Healthways Well-Being Index: Methodology Report for Indexes*. 2009: Available at <http://www.gallup.com/poll/195539/gallup-healthways-index-methodology-report-indexes.aspx>.

18. Kobau, R., et al., *Mental, social, and physical well-being in New Hampshire, Oregon, and Washington, 2010 Behavioral Risk Factor Surveillance System: implications for public health research and practice related to Healthy People 2020 foundation health measures on well-being*. Population Health Metrics, 2013. **11**: p. 19-19.

19. Arora, A., et al., *Population Well-Being Measures Help Explain Geographic Disparities In Life Expectancy At The County Level*. Health Aff (Millwood), 2016. **35**(11): p. 2075-2082.

20. Chen, E. and G.E. Miller, "Shift-and-Persist" Strategies: Why Low Socioeconomic Status Isn't Always Bad for Health. *Perspect Psychol Sci*, 2012. **7**(2): p. 135-58.

21. Institute, U.o.W.P.H. *County Health Rankings 2014*. Available from: www.countyhealthrankings.org.

22. Remington, P.L., B.B. Catlin, and K.P. Gennuso, *The County Health Rankings: rationale and methods*. Population Health Metrics, 2015. **13**(1): p. 1-12.

23. *Area Health Resources Files 2013-2014*. U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Workforce: Rockville, MD.

24. Sears, L.E., et al., *Overall well-being as a predictor of health care, productivity, and retention outcomes in a large employer*. *Popul Health Manag*, 2013. **16**(6): p. 397-405.

25. Gandy, W.M., et al., *Well-being and employee health-how employees' well-being scores interact with demographic factors to influence risk of hospitalization or an emergency room visit*. *Popul Health Manag*, 2014. **17**(1): p. 13-20.

26. Herrin, J., et al., *Population well-being and electoral shifts*. *PLoS One*, 2018. **13**(3): p. e0193401.

27. Riley, C., et al., *Association of the overall well-being of a population with health care spending for people 65 years of age or older*. *JAMA Network Open*, 2018. **1**(5): p. e182136.

28. (IHME), I.o.H.M.a.E., *United States Smoking Prevalence by County 1996-2012*. 2014, Institute for Health Metrics and Evaluation (IHME): Seattle, United States.

29. Dwyer-Lindgren, L., et al., *Drinking Patterns in US Counties From 2002 to 2012*. *American journal of public health*, 2015. **105**(6): p. 1120-1127.

30. *Institute for Health Metrics and Evaluation (IHME). United States Alcohol Use Prevalence by County 2002-2012*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2015.

31. Institute, U.o.W.P.H. *County Health Rankings 2015*. Available from: www.countyhealthrankings.org.

32. Institute, U.o.W.P.H., *2015 County Health Rankings Key Findings Report*. 2015.

33. Bradley, E.H., et al., *Hospital strategies for reducing risk-standardized mortality rates in acute myocardial infarction*. *Ann Intern Med*, 2012. **156**(9): p. 618-26.

34. Herrin, J., et al., *Community factors and hospital readmission rates*. *Health Serv Res*, 2015. **50**(1): p. 20-39.

35. Hardin, J. and J. Hilbe, *Generalized Estimating Equations*. 2003, London: Chapman and Hall.

High-poverty Counties with High Well-Being

36. Little, R. and D. Rubin, *Statistical analysis with missing data*. 2nd ed. 2002, New York: Wiley.
37. Efron, B., *Regression and ANOVA with Zero-One Data: Measures of Residual Variation*. Journal of the American Statistical Association, 1978. **73**(361): p. 113-121.
38. Belsley DA, K.E., Welsch RE, *Regression diagnostics*. 1980, New York, New York: J. Wiley & Sons.
39. Roy, B., et al., *Identifying county characteristics associated with resident well-being: A population based study*. PLoS One, 2018. **13**(5): p. e0196720.
40. Phillips, R.L., Jr. and B. Starfield, *Why does a U.S. primary care physician workforce crisis matter?* Am Fam Physician, 2004. **70**(3): p. 440, 442, 445-6.
41. Goodman, D.C. and K. Grumbach, *Does having more physicians lead to better health system performance?* Jama, 2008. **299**(3): p. 335-7.
42. Starfield, B., et al., *The effects of specialist supply on populations' health: assessing the evidence*. Health Aff (Millwood), 2005. **Suppl Web Exclusives**: p. W5-97-w5-107.
43. Billings, J., et al., *Impact of socioeconomic status on hospital use in New York City*. Health Aff (Millwood), 1993. **12**(1): p. 162-73.
44. Erickson, D. and N. Andrews, *Partnerships among community development, public health, and health care could improve the well-being of low-income people*. Health Aff (Millwood), 2011. **30**(11): p. 2056-63.
45. Antonisse L, G.R., Rudowitz R, Artiga S *The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review*. 2017.
46. Pappas, G., et al., *Potentially avoidable hospitalizations: inequalities in rates between US socioeconomic groups*. American Journal of Public Health, 1997. **87**(5): p. 811-816.
47. Parchman, M.L. and S.D. Culler, *Preventable hospitalizations in primary care shortage areas. An analysis of vulnerable Medicare beneficiaries*. Arch Fam Med, 1999. **8**(6): p. 487-91.
48. Rehm, J., et al., *The relation between different dimensions of alcohol consumption and burden of disease: an overview*. Addiction (Abingdon, England), 2010. **105**(5): p. 817-843.
49. Rehm, J., et al., *The relationship between different dimensions of alcohol use and the burden of disease-an update*. Addiction (Abingdon, England), 2017. **112**(6): p. 968-1001.
50. *County Health Rankings & Roadmaps*. [cited 2017 February 25]; Available from: <http://www.countyhealthrankings.org/our-approach>.
51. Chetty, R., et al., *The Association Between Income and Life Expectancy in the United States, 2001-2014*. Jama, 2016.
52. Olshansky, S.J., et al., *Differences in life expectancy due to race and educational differences are widening, and many may not catch up*. Health Aff (Millwood), 2012. **31**(8): p. 1803-13.
53. Egerter S, B.P., Sadegh-Nobari T, Grossman-Kahn R, Dekker M. Education Matters for Health. Princeton, NJ: RWJF Commission to Build a Healthier America; 2009. Issue Brief 6.
54. Hout, M., *Social and Economic Returns to College Education in the United States*. Annual Review of Sociology, 2012. **38**(1): p. 379-400.
55. Ekpu, V.U. and A.K. Brown, *The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence*. Tobacco Use Insights, 2015. **8**: p. 1-35.
56. U.S. Department of Health and Human Services. *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*. Atlanta, G.U.S.D.

High-poverty Counties with High Well-Being

57. Harris, M.A., *The relationship between physical inactivity and mental wellbeing: Findings from a gamification-based community-wide physical activity intervention*. Health psychology open, 2018. **5**(1): p. 2055102917753853-2055102917753853.

58. Penedo, F.J. and J.R. Dahn, *Exercise and well-being: a review of mental and physical health benefits associated with physical activity*. Curr Opin Psychiatry, 2005. **18**(2): p. 189-93.

59. G. Mark Holmes, N.M.L., William Holding, Randy Randolph, Jonathan Rodgers, Pam Silberman, Lisa Villamil, Thomas A. Arcury, Kelly Ivey, Daniel Goolsby, Ashli Keyser, and J&J Editorial, *Identifying Bright Spots in Appalachian Health: Statistical Analysis*. 2018, Appalachian Regional Commission; PDA, Inc.; Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill.

60. Mayne, S.L., et al., *Cross-sectional and longitudinal associations of neighbourhood social environment and smoking behaviour: the multiethnic study of atherosclerosis*. J Epidemiol Community Health, 2017. **71**(4): p. 396-403.

Tables and figures:

Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF County Health Rankings and Roadmaps (CHRR). All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinkers (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)

Table 1. Geography and demographics of all high poverty counties, and of high-poverty counties with high and low well-being

Variable	Value	All high poverty counties	Low well-being counties	High well-being counties	P-value
N		770 (100)	311 (100)	72 (100)	
Urban/rural status	Urban	595 (77.3)	215 (69.1)	44 (61.1)	0.190
N (%)	Rural	175 (22.7)	96 (30.9)	28 (38.9)	
Region of the United States	New England	1 (0.1)	0 (0.0)	0 (0.0)	<0.001
N (%)	Mid Atlantic	5 (0.6)	0 (0.0)	0 (0.0)	
	East North Central	36 (4.7)	11 (3.5)	3 (4.2)	
	West North Central	49 (6.4)	22 (7.1)	13 (18.1)	
	South Atlantic	216 (28.1)	86 (27.7)	23 (31.9)	
	East South Central	201 (26.1)	110 (35.4)	7 (9.7)	
	West South Central	183 (23.8)	65 (20.9)	14 (19.4)	
	Mountain Pacific	50 (6.5)	13 (4.2)	9 (12.5)	
		29 (3.8)	4 (1.3)	3 (4.2)	
Income of respondents	% >120 k	5.8 (3.6)	4.9 (3.4)	6.3 (5.3)	0.005
Mean (SD)	% 60k-120k	14.7 (5.7)	12.7 (5.1)	18.2 (7.8)	<0.001
	% 36k-60k	18.6 (6.1)	18.4 (6.4)	19.6 (8.0)	0.185
	% 12k-36k	29.6 (7.3)	31.6 (7.2)	25.7 (8.7)	<0.001
	% <12k	12.6 (6.0)	14.1 (6.0)	9.7 (6.0)	<0.001

High-poverty Counties with High Well-Being

Well-being score Mean (SD)		64.3 (4.3)	60.2 (2.8)	71.8 (2.3)	<0.001
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Table 2. Standardized differences in domain scores when comparing high and low well-being counties among all high-poverty counties (all significant at $p < 0.001$)

Domain	Standardized difference (95% confidence interval)
Basic Access	2.56 (2.25, 2.87)
Life evaluation	2.51 (2.20, 2.82)
Physical Health	2.46 (2.15, 2.77)
Emotional Health	1.71 (1.43, 1.99)
Healthy Behaviors	1.51 (1.23, 1.78)
Work Environment	1.25 (0.97, 1.52)

Table 3. Category-specific models: Odds ratios describe odds of a county having high versus low well-being

Health Behaviors				
R2: 0.243	C: 0.812	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Percent smoking	Tertile 1	Ref		<0.001
	Tertile 2	0.03	(0.01, 0.10)	
	Tertile 3	0.02	(0.01, 0.06)	
Adult obesity	Tertile 1	Ref		0.241
	Tertile 2	0.71	(0.35, 1.43)	
	Tertile 3	0.31	(0.08, 1.21)	
Percent heavy drinkers	Tertile 1	Ref		<0.001
	Tertile 2	7.23	(2.20, 23.83)	
	Tertile 3	10.54	(3.36, 33.06)	

High-poverty Counties with High Well-Being

Physical inactivity	Tertile 1 Tertile 2 Tertile 3	Ref 0.26 0.65	(0.12, 0.56) (0.16, 2.69)	0.002
Clinical Care				
R2: 0.177	C: 0.775	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Primary care physicians	Tertile 1 Tertile 2 Tertile 3	Ref 1.12 4.58	(0.28, 4.44) (1.79, 11.77)	<0.001
Mental health providers	Tertile 1 Tertile 2 Tertile 3	Ref 1.93 3.97	(0.61, 6.07) (1.14, 13.80)	0.096
Preventable hosp. stays	Tertile 1 Tertile 2 Tertile 3	Ref 0.18 0.03	(0.06, 0.56) (0.01, 0.13)	<0.001
Social and Economic Factors				
R2: 0.163	C: 0.765	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Some College	Tertile 1 Tertile 2 Tertile 3	Ref 1.36 16.55	(0.41, 4.50) (5.16, 53.05)	<0.001
Injury deaths	Tertile 1 Tertile 2 Tertile 3	Ref 0.24 0.06	(0.05, 1.11) (0.02, 0.13)	<0.001
Physical Environment				
R2: 0.050	C: 0.663	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Long commute-driving alone	Tertile 1 Tertile 2 Tertile 3	Ref 0.34 0.06	(0.07, 1.56) (0.02, 0.14)	<0.001

High-poverty Counties with High Well-Being

Physical Inactivity	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.28 0.88 3.14	(0.10, 0.80) (0.28, 2.75) (0.96, 10.23)	0.042	Ref 0.41 1.08 2.64	(0.14, 1.22) (0.35, 3.36) (0.95, 7.35)	0.120
Primary Care Physicians	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.53 3.11 5.83	(0.11, 2.53) (1.53, 6.32) (1.49, 22.87)	<0.001	Ref 0.51 2.05 4.06	(0.12, 2.19) (1.05, 4.00) (1.03, 16.05)	0.021
Preventable hospital stays	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.35 0.30 0.86	(0.10, 1.15) (0.10, 0.90) (0.21, 3.56)	0.046	Ref 0.52 0.42 0.81	(0.15, 1.81) (0.14, 1.32) (0.20, 3.23)	0.282
Some college	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.94 2.72 2.91	(0.12, 7.05) (0.40, 18.42) (1.45, 5.82)	0.007	Ref 0.63 1.61 2.54	(0.09, 4.51) (0.24, 10.89) (0.98, 6.59)	0.157
Injury deaths	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.44 0.31 0.69	(0.16, 1.22) (0.11, 0.86) (0.24, 2.00)	0.067	Ref 0.64 0.44 0.68	(0.24, 1.69) (0.18, 1.06) (0.22, 2.13)	0.164
Long commute	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 1.34 2.35 1.75	(0.56, 3.20) (0.64, 8.56) (0.59, 5.17)	0.433	Ref 0.93 1.53 1.65	(0.33, 2.58) (0.36, 6.43) (0.42, 6.53)	0.773

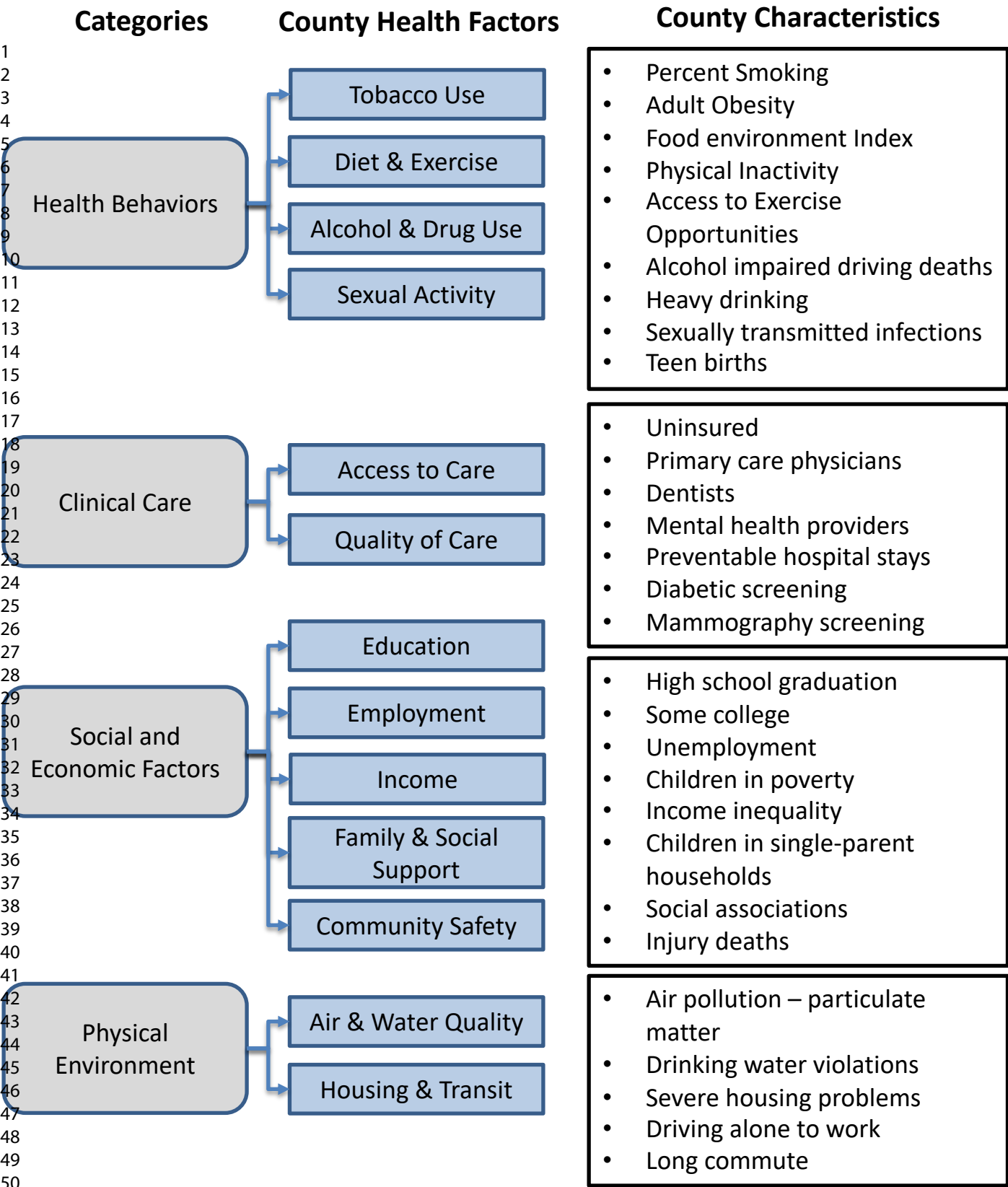
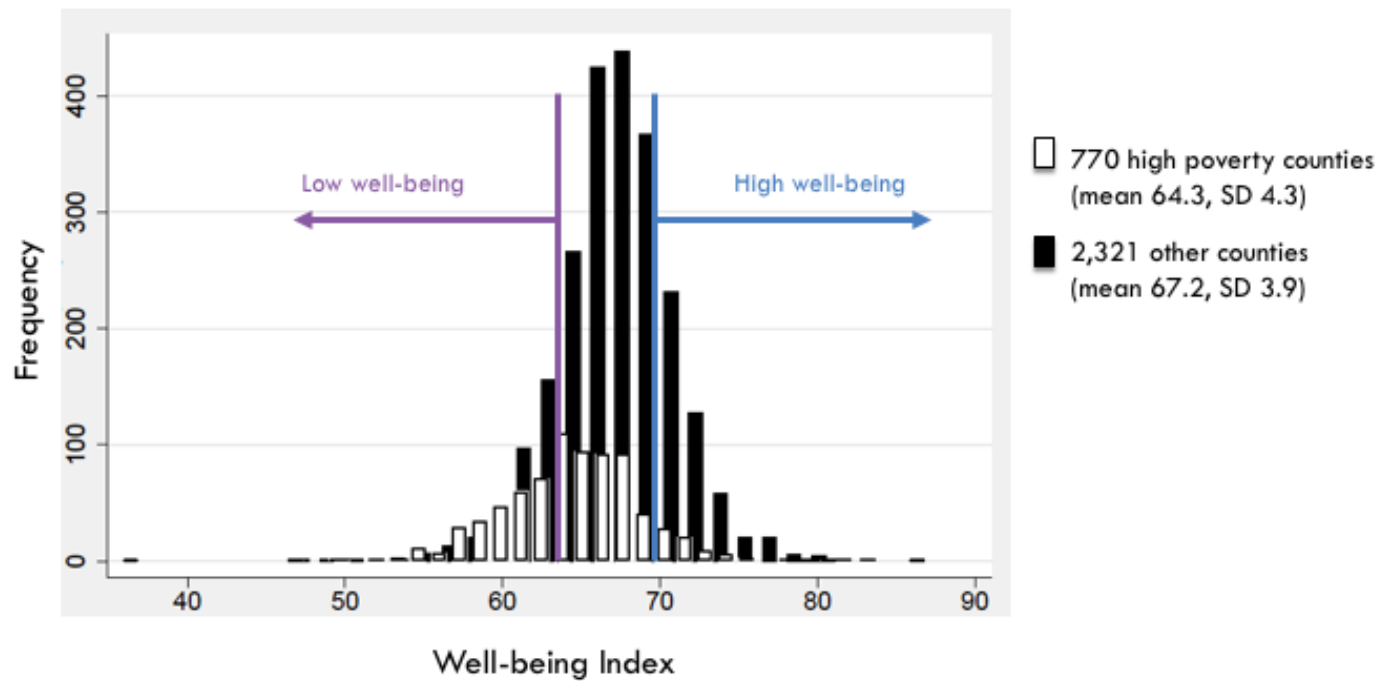


Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF CHRR. All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinking (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)



Supplementary Figure 1. Distribution of well-being among high poverty counties and all other counties in the United States

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Supplementary Table 1: Bivariate Associations of 29 Community Factors

Category: Health Behaviors	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	GHD: % Smoking				n (%)	<0.001	0.2229	0.792
		T1 [12.68-25.67]	256 (33.2)	42 (13.5)	46 (63.9)			
		T2 [25.68-28.46]	257 (33.4)	106 (34.1)	17 (23.6)			
		T3 [28.47-39.50]	255 (33.1)	163 (52.4)	9 (12.5)			
		Missing	2 (0.3)	0 (0.0)	0 (0.0)			
	GHD: % Heavy drinkers					<0.001	0.0684	0.679
		T1 [2.40-5.90]	258 (33.5)	142 (45.7)	13 (18.1)			
		T2 [6.00-7.50]	269 (34.9)	103 (33.1)	25 (34.7)			
		T3 [7.60-21.40]	241 (31.3)	66 (21.2)	34 (47.2)			
		Missing	2(0.3)	0 (0.0)	0 (0.0)			
	RWJ: Adult obesity					<0.001	0.0664	0.678
		T1 [0.18-0.32]	265 (34.4)	82 (26.4)	40 (55.6)			
		T2 [0.32-0.35]	255 (33.1)	106 (34.1)	21 (29.2)			
		T3 [0.35-0.48]	250 (32.5)	123 (39.5)	11 (15.3)			
	RWJ: Food environment index					0.016	0.0059	0.553
		T1 [0.00-6.06]	257 (33.4)	102 (32.8)	27 (37.5)			
		T2 [6.06-7.04]	257 (33.4)	87 (28.0)	24 (33.3)			
		T3 [7.04-8.77]	256 (33.2)	122 (39.2)	21 (29.2)			
	RWJ: Physical inactivity					<0.001	0.1036	0.711
		T1 [0.14-0.29]	257 (33.4)	61 (19.6)	40 (55.6)			
		T2 [0.29-0.33]	262 (34.0)	113 (36.3)	20 (27.8)			
		T3 [0.34-0.44]	251 (32.6)	137 (44.1)	12 (16.7)			
	RWJ: Access to exercise opportunities					<0.001	0.0126	0.558
		T1 [0.00-0.29]	255 (33.1)	121 (38.9)	25 (34.7)			
		T2 [0.29-0.52]	254 (33.0)	111 (35.7)	18 (25.0)			
		T3 [0.53-1.00]	254 (33.0)	78 (25.1)	27 (37.5)			
		Missing	7 (0.9)	1 (0.3)	2 (2.8)			
	RWJ: Alcohol-impaired driving deaths					0.415	0.0069	0.552
		T1 [0.00-0.25]	267 (34.7)	113 (36.3)	30 (41.7)			

		T2 [0.25-0.36]	246 (31.9)	92 (29.6)	13 (18.1)			
		T3 [0.36-1.00]	255 (33.1)	106 (34.1)	28 (38.9)			
		Missing	2 (0.3)	0 (0.0)	1 (1.4)			
	RWJ: Sexually transmitted infections					0.006	0.0103	0.564
		T1 [43.00-323.60]	252 (32.7)	136 (43.7)	20 (27.8)			
		T2 [324.40-619.00]	252 (32.7)	96 (30.9)	27 (37.5)			
		T3 [619.70-2701.60]	252 (32.7)	74 (23.8)	20 (27.8)			
		Missing	14 (1.8)	5 (1.6)	5 (6.9)			
	RWJ: Teen births					<0.001	0.0347	0.627
		T1 [4.62-54.95]	256 (33.2)	88 (28.3)	37 (51.4)			
		T2 [55.01-69.16]	255 (33.1)	101 (32.5)	14 (19.4)			
		T3 [69.20-130.43]	255 (33.1)	122 (39.2)	20 (27.8)			
		Missing	4 (0.5)	0 (0.0)	1 (1.4)			
Category: Clinical Care			All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P value	R2	C-stat
	RWJ: Uninsured					0.888	0.0063	0.465
		T1 [0.06-0.19]	257 (33.4)	114 (36.7)	25 (34.7)			
		T2 [0.19-0.23]	257 (33.4)	105 (33.8)	15 (20.8)			
		T3 [0.23-0.39]	256 (33.2)	92 (29.6)	32 (44.4)			
	RWJ: Primary care physicians					<0.001	0.0576	0.667
		T1 [0.00-33.53]	244 (31.7)	131 (42.1)	16 (22.2)			
		T2 [33.56-52.14]	244 (31.7)	99 (31.8)	14 (19.4)			
		T3 [52.44-268.90]	243 (31.6)	65 (20.9)	32 (44.4)			
		Missing	39 (5.1)	16 (5.1)	10 (13.9)			
	RWJ: Dentists					<0.001	0.0153	0.564
		T1 [0.00-20.83]	246 (31.9)	120 (38.6)	24 (33.3)			
		T2 [20.83-34.53]	245 (31.8)	109 (35.0)	21 (29.2)			
		T3 [34.53-166.08]	245 (31.8)	61 (19.6)	24 (33.3)			
		Missing	34 (4.4)	21 (6.8)	3 (4.2)			
	RWJ: Mental health providers					<0.001	0.0612	0.666
		T1 [0.00-26.55]	219 (28.4)	103 (33.1)	12 (16.7)			
		T2 [26.56-76.03]	219 (28.4)	97 (31.2)	11 (15.3)			

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		T3 [76.77-1387.78]	218 (28.3)	57 (18.3)	28 (38.9)			
		Missing	114 (14.8)	54 (17.4)	21 (29.2)			
	RWJ: Preventable hospital stays					<0.001	0.1191	0.734
		T1 [27.44-75.59]	246 (31.9)	50 (16.1)	34 (47.2)			
		T2 [75.66-101.23]	245 (31.8)	98 (31.5)	20 (27.8)			
		T3 [101.45-280.58]	245 (31.8)	149 (47.9)	10 (13.9)			
		Missing	34 (4.4)	14 (4.5)	8 (11.1)			
	RWJ: Diabetic screening					0.384	0.0075	0.521
		T1 [0.18-0.81]	256 (33.2)	114 (36.7)	24 (33.3)			
		T2 [0.81-0.85]	256 (33.2)	101 (32.5)	15 (20.8)			
		T3 [0.85-0.94]	254 (33.0)	95 (30.5)	31 (43.1)			
		Missing	4 (0.5)	1 (0.3)	2 (2.8)			
	RWJ: Mammography screening					<0.001	0.0493	0.624
		T1 [0.26-0.53]	252 (32.7)	134 (43.1)	22 (30.6)			
		T2 [0.53-0.60]	251 (32.6)	96 (30.9)	12 (16.7)			
		T3 [0.60-0.80]	251 (32.6)	75 (24.1)	35 (48.6)			
		Missing	16 (2.1)	6 (1.9)	3 (4.2)			
Category: Social and Economic Factors			All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P value	R2	C-stat
	RWJ: High school graduation					0.515	0.0011	0.507
		T1 [0.29-0.73]	232 (30.1)	86 (27.7)	17 (23.6)			
		T2 [0.73-0.82]	239 (31.0)	105 (33.8)	15 (20.8)			
		T3 [0.83-1.00]	224 (29.1)	94 (30.2)	16 (22.2)			
		Missing	75 (9.7)	26 (8.4)	24 (33.3)			
	RWJ: Some college					<0.001	0.1156	0.704
		T1 [0.19-0.41]	257 (33.4)	142 (45.7)	15 (20.8)			
		T2 [0.41-0.49]	257 (33.4)	116 (37.3)	18 (25.0)			
		T3 [0.49-0.88]	256 (33.2)	53 (17.0)	39 (54.2)			
	RWJ: Unemployment					<0.001	0.0494	0.656
		T1 [0.03-0.08]	257 (33.4)	83 (26.7)	38 (52.8)			
		T2 [0.08-0.11]	257 (33.4)	101 (32.5)	20 (27.8)			
		T3 [0.11-0.28]	256 (33.2)	127 (40.8)	14 (19.4)			
	RWJ: Children in poverty					<0.001	0.0327	0.612

		T1 [0.12-0.32]	258 (33.5)	74 (23.8)	32 (44.4)			
		T2 [0.32-0.38]	259 (33.6)	109 (35.0)	20 (27.8)			
		T3 [0.38-0.60]	253 (32.9)	128 (41.2)	20 (27.8)			
	RWJ: Children in single-parent households					0.040	0.0007	0.518
		T1 [0.11-0.35]	257 (33.4)	114 (36.7)	29 (40.3)			
		T2 [0.35-0.44]	257 (33.4)	97 (31.2)	23 (31.9)			
		T3 [0.44-0.79]	256 (33.2)	100 (32.2)	20 (27.8)			
	RWJ: Social associations					0.216	0.0004	0.529
		Q1 [0.00-9.64]	257 (33.4)	120 (38.6)	20 (27.8)			
		Q2 [9.66-13.14]	257 (33.4)	102 (32.8)	22 (30.6)			
		Q3 [13.15-33.50]	256 (33.2)	89 (28.6)	30 (41.7)			
	RWJ: Injury deaths					<0.001	0.0754	0.683
		T1 [28.00-75.10]	245 (31.8)	60 (19.3)	32 (44.4)			
		T2 [75.30-96.30]	246 (31.9)	97 (31.2)	15 (20.8)			
		T3 [96.50-251.90]	244 (31.7)	143 (46.0)	14 (19.4)			
		Missing	35 (4.5)	11 (3.5)	11 (15.3)			
	RWJ: GINI coefficient					0.128	0.0035	0.513
		T1 [37.80-44.90]	261 (33.9)	105 (33.8)	19 (26.4)			
		T2 [45.00-47.10]	257 (33.4)	106 (34.1)	22 (30.6)			
		T3 [47.20-58.60]	252 (32.7)	100 (32.2)	31 (43.1)			
Category: Physical Environment		Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: Air pollution - particulate matter					0.004	0.0031	0.567
		T1 [7.21-11.37]	255 (33.1)	76 (24.4)	30 (41.7)			
		T2 [11.38-12.72]	260 (33.8)	107 (34.4)	23 (31.9)			
		T3 [12.73-14.50]	250 (32.5)	126 (40.5)	18 (25.0)			
		Missing	5 (0.6)	2 (0.6)	1 (1.4)			
	RWJ: Drinking water violations					0.076	0.0045	0.553
		T1 [0.00-0.00]	311 (40.4)	142 (45.7)	30 (41.7)			
		T2 [0.00-0.09]	190 (24.7)	60 (19.3)	18 (25.0)			
		T3 [0.09-1.00]	250 (32.5)	105 (33.8)	19 (26.4)			
		Missing	19 (2.5)	4 (1.3)	5 (6.9)			
	RWJ: Severe housing problems					<0.001	0.0392	0.608

		T1 [0.05-0.14]	257 (33.4)	134 (43.1)	23 (31.9)			
		T2 [0.14-0.17]	257 (33.4)	106 (34.1)	16 (22.2)			
		T3 [0.17-0.69]	256 (33.2)	71 (22.8)	33 (45.8)			
	RWJ: Driving alone to work					<0.001	0.0477	0.647
		T1 [0.04-0.78]	257 (33.4)	96 (30.9)	41 (56.9)			
		T2 [0.78-0.82]	257 (33.4)	94 (30.2)	17 (23.6)			
		T3 [0.82-0.91]	256 (33.2)	121 (38.9)	14 (19.4)			
	RWJ: Long commute - driving alone					<0.001	0.0589	0.663
		T1 [0.00-0.24]	259 (33.6)	74 (23.8)	38 (52.8)			
		T2 [0.24-0.35]	256 (33.2)	109 (35.0)	19 (26.4)			
		T3 [0.35-0.66]	255 (33.1)	128 (41.2)	15 (20.8)			

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	7-8
		(d) If applicable, describe analytical methods taking account of sampling strategy	9
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10

		(b) Indicate number of participants with missing data for each variable of interest	Supplementary table 1
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(b) Report category boundaries when continuous variables were categorized	10
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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High-poverty Counties with High Well-Being

TITLE Identifying Characteristics of High-poverty Counties with High Well-being: An Observational Cross-Sectional Study

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High-poverty Counties with High Well-Being

Abstract

OBJECTIVE To identify county characteristics associated with high versus low well-being among high-poverty counties.

DESIGN Observational cross-sectional study at the county level to investigate the associations of 29 county characteristics with the odds of a high-poverty county reporting population well-being in the top quintile versus the bottom quintile of well-being in the United States. County characteristics representing key determinants of health were drawn from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps population health model.

SETTING Counties in the United States that are in the highest quartile of poverty rate.

MAIN OUTCOME MEASURE Gallup-Sharecare Well-being Index, a comprehensive population-level measure of physical, mental and social health. Counties were classified as having a well-being index score in the top or bottom 20% of all counties in the U.S.

RESULTS Among 770 high-poverty counties, 72 were categorized as having high well-being and 311 as having low well-being. The high well-being counties had a mean well-being score of 71.8 with a SD of 2.3, while the low well-being counties had a mean well-being score of 60.2 with a SD of 2.8. Among the 6 domains of well-being, basic access, which includes access to housing and healthcare, and life evaluation, which includes life satisfaction and optimism, differed the most between high- and low-well-being counties. Among 29 county characteristics tested, 6 were independently and significantly associated with high well-being ($p<0.05$). These were: lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of some college education and higher percentage of heavy drinkers.

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CONCLUSIONS Among 770 high-poverty counties, approximately 9% outperformed expectations, reporting a collective well-being score in the top 20% of all counties in the United States. High-poverty counties reporting high well-being differed from high-poverty counties reporting low well-being in several characteristics.

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High-poverty Counties with High Well-Being

Strengths and Limitations of this Study

- In this study of high-poverty counties in the United States, we used a unique and validated measure of population well-being, the Gallup-Sharecare Well-being Index.
- We described high-poverty counties with high and low well-being using 29 characteristics from the Robert Wood Johnson Foundation (RWJF) County Health Rankings and Roadmaps, a well-established model of population health.
- Using these data, this study was the first to identify characteristics associated with high well-being among high-poverty counties.
- As this was a cross-sectional study, we were unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties.
- Our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county level.

High-poverty Counties with High Well-Being

Introduction

Poverty is negatively associated with physical, mental and social health. [1-14] In particular, studies have linked poverty with higher rates of obesity and greater incidence of coronary artery disease, as well as lower levels of life satisfaction and social capital. [1, 5, 9-12] Though it is essential to decrease rates of poverty in the United States, there is also a need to mitigate its adverse health consequences through policies and programs focused on high-poverty populations. [15]

One approach to understanding how to reduce the consequences of poverty is to study populations with high rates of poverty that report high levels of physical, mental and social health, together defined as high well-being. [16] Well-being includes not only the absence of disease, but also a sense of opportunity, happiness and lack of stress. It reflects the ability to afford food, housing and healthcare, to live in a safe neighborhood, and to work in a trusting, respectful environment. [16-19] As poverty is negatively associated with many aspects of well-being, if high-poverty populations report high well-being, these populations have outperformed expectations. [1-8, 20] By exploring the characteristics of high-poverty populations with high well-being and comparing them to high-poverty populations with low well-being, we may identify potential targets for well-being improvement efforts.

Accordingly, we sought to identify the community characteristics most strongly associated with high versus low well-being among counties with high rates of poverty. We conducted this analysis using county-level estimates of well-being from the Gallup-Sharecare Well-Being Index, a survey that comprehensively evaluates well-being across the nation. [17] We compared

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the characteristics of high-poverty counties with high and low well-being, relative to the distribution of all counties, using data from the Robert Wood Johnson Foundation (RWJF) County Health Rankings and Roadmaps (CHRR), which includes a robust portfolio of factors describing counties in the United States. [17, 21, 22]

Methods

We conducted an observational cross-sectional study of high-poverty counties or county equivalents (in some states, cities, parishes or boroughs) to determine which domains of the Gallup-Sharecare Well-Being Index differed the most between high- and low-well-being counties, and to identify the county characteristics that were most strongly associated with high versus low well-being.

Data Sources and Measures

County-level poverty prevalence was measured by 2010 county-level percent of persons in poverty from the Area Health Resources Files (AHRF) of the Health Resources and Services Administration. These estimates are from the Bureau of Census’ Small Area Income Poverty Estimates (SAIPE) files for 2010 and are constructed from statistical models which include data from federal income tax returns, participation in the Food Stamp program, and the previous census. [23]

Well-being data were obtained from the 2010-2012 Gallup-Sharecare Well-Being Index. [17]
The Gallup-Sharecare Well-Being Index has been validated as a measure of population

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well-being by Gallup, Inc. and prior studies have linked it with life expectancy, employee productivity, health care utilization and spending, and voting patterns.[17, 19, 24-27]

Data were collected in a national telephone survey of individuals age eighteen and older from all fifty states and the District of Columbia; approximately 1,000 telephone (landline and cell) surveys were conducted each day during the fielding period. [17] Six well-being domains, as well as population demographics, were evaluated with fifty-five survey questions. "Physical health" assesses the burden of chronic disease and recent illness. "Emotional health" measures daily emotions and the presence or absence of depression. "Healthy behaviors" assess the prevalence of smoking, exercising, and eating fruit and vegetables. "Life evaluation" measures life satisfaction and optimism about the future. "Basic access" includes perception of safety and access to housing and health care. "Work environment" assesses job satisfaction, trust and respect in the workplace and, unlike the other domains, it is collected only from the subset of respondents who report being employed. Each domain is represented on a scale of 0 to 100. The composite well-being score is an unweighted mean of all six domains. [17]

In order to describe the demographics of survey respondents and their counties of residence, we used 2013 rural-urban continuum codes from AHRF as well as region of the United States and annual household income of respondents from the Gallup-Sharecare Well-Being Index. Data on county-level characteristics were obtained from the

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2014 RWJF CHRR model of population health. [21] In this model, county factors that influence the health of a county are organized into four categories: clinical care, social and economic factors, health behaviors, and physical environment. Each factor is represented by 1-4 county characteristics. (Figure 1) Data for four county characteristics: excessive drinking, inadequate social support, tobacco use and violent crime rates, were not comparable across states or missing for many counties. [21, 22] Tobacco use and excessive drinking were replaced with 2011 estimates of mean smoking prevalence and percent heavy drinkers, respectively, from the Institute for Health Metrics and Evaluation (IHME). [28-30] Heavy drinking was defined as the consumption, on average, of more than one drink per day for women or two drinks per day for men in the past 30 days. [29] Inadequate social support was replaced with the number of social associations from the 2015 RWJF CHRR. [31] We were unable to find an alternative data source for violent crime rates, so this variable was excluded. Finally, we included income inequality, measured as a Gini coefficient, in the list of characteristics, because this county characteristic was added to the CHRR in 2015, and because income disparities within a community may affect well-being.[31, 32] These data were also obtained from the 2015 RWJF CHRR. [31] The 29 characteristics used in our study were categorized into tertiles based on each characteristic's distribution across our sample of high-poverty counties.

Statistical Analysis

High-poverty Counties with High Well-Being

We first identified high-poverty counties as those where the percent of persons in poverty was in the top 25% of all counties in the United States. Among these high-poverty counties, high-well-being counties were those with a well-being score in the top 20% of all counties in the United States while low-well-being counties were those with a well-being score in the bottom 20% of all counties in the United States. We summarized well-being as well as respondent and county characteristics for these two groups of counties. We also calculated Cohen's D standardized differences for each of the six domain scores to determine which domains differed the most between high- and low-well-being counties.

We used a multi-step procedure to identify which of the 29 community characteristics from the RWJF CHRR model of population health were most strongly associated with high versus low well-being. Since we expected that many county characteristics would be correlated within and across categories, we used an approach similar to that previously utilized in other studies to reduce many related factors to a smaller representative set. [33, 34] First, we estimated a series of bivariate logistic regression models, one for each characteristic in Figure 1. The outcome of each model was whether the county was classified as high versus low well-being. To account for differing precision of the well-being estimates, each county-level observation was weighted by the number of survey respondents. In addition, to account for correlation of

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observations within each state, we used generalized estimating equations models, and to account for missing values of independent variables, we used multiple imputation. [35, 36] For each model, we calculated R^2 as the squared correlation between predicted and observed values, as well as the C-statistic. [37] From the bivariate results, we retained characteristics significantly associated with the county composite well-being score ($p<0.05$) and those that explained a meaningful amount of variance in the outcome ($R^2>0.05$). Among the characteristics retained, we assessed for multicollinearity within each category of characteristics using variance decomposition, eliminating the characteristic with smallest variance decomposition component when the singular value was greater than 20. [38] We estimated a model for each category of characteristics including only those characteristics retained from the prior steps. In two final models, we included all variables independently significant ($p<0.05$) in their respective category models. The first of these models included only these variables; in order to assess any impact of differential respondent income, the second included the percent of respondents in each income category. For each logistic regression model, we report the C-statistic and R^2 as defined above.

Analyses were performed using Stata 15.1 (2018, StataCorp, College Station, TX). The Yale University Institutional Review Board approved this study.

Patient and Public Involvement

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No patients or the public were involved in the planning and design of this study.

Results

Well-being data were available for 3,091 counties in the United States. Among these counties, 770 met our definition of being “high-poverty”, with percent of persons in poverty in the top quartile of all counties in the United States.

Among all 3,091 counties, well-being scores ranged from 35.6 to 87.1 (mean 66.5, SD 4.2). When the sample was limited to high-poverty counties, well-being scores ranged from 46.2 to 81.3, with a mean score of 64.3 and standard deviation of 4.3. In comparison, the mean well-being score for all other counties in the United States was 67.2 and the standard deviation was 3.9. (Supplementary file, figure 1)

Among high-poverty counties, 72 had a composite well-being score in the top 20% of all counties in the United States and were classified as “high-well-being” and 311 had a composite well-being score in the bottom 20% of all counties in the United States and were classified as “low-well-being.” High-well-being counties had a mean well-being score of 71.8 with a SD of 2.3, while low-well-being counties had a mean well-being score of 60.2 with a SD of 2.8. (Table 1) The majority of counties in both the high- and low-well-being groups were urban and the distributions of urban and rural counties in these two groups were not significantly different from each other. The majority of both high- and low-well-

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being counties were located in the South, but typically in different regions within the South, with the largest percentage of high-well-being counties located in the South Atlantic region and the largest percentage of low-well-being counties located in the East South Central region. (Table 1; Figure 2; Supplementary file, table 1) Finally, the incomes of survey respondents were slightly higher in high-well-being counties compared to those in low-well-being counties and a joint test of differences in all income groups was significant ($p<0.001$). (Table 1)

When the six domains of well-being were compared between high- and low-well-being counties, the largest standardized differences were for the basic access and life evaluation domain scores. Compared with domain scores in low well-being counties, basic access and life evaluation domain scores in high well-being counties were 2.56 and 2.51 standard deviations higher, respectively. (Table 2)

In bivariate analyses, among the 29 community characteristics tested, 21 were significantly associated with high versus low well-being ($p<0.05$). (Supplementary file, table 2) Among these 21 characteristics, 10 explained greater than 5% of the variation in well-being. These characteristics were primary care physicians, mental health providers, preventable hospital stays, some college, injury deaths, smoking, obesity, physical inactivity, heavy drinking, and long commute. These 10 characteristics were retained and

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used to estimate a model for each category. The health behaviors category model explained the greatest amount of variance (R^2 : 0.24; C-statistic: 0.81) and the physical environment model explained the least amount of variance (R^2 : 0.05; C-statistic: 0.66). (Table 3) Eight characteristics were significant in their respective category models with a p -value<0.05, and these eight characteristics were included in the final combined model. (Table 4)

In the final combined model, six characteristics remained significantly associated (p <0.05) with high versus low well-being: lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of heavy drinkers, and higher percentage of residents with some college education. In the final model, the R^2 value was 0.30 and the C-statistic was 0.83. After adjusting for respondent-level income, three factors remained significantly associated with higher well-being: heavy drinking, smoking, and primary care physician density. In this final adjusted model, the R^2 was 0.34 and the C-statistic was 0.84. (Table 4)

Discussion

In this study of 770 high-poverty counties, approximately 9% achieved high well-being despite economic disadvantage. These counties shared distinctive characteristics, including lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of

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smoking, lower physical inactivity, higher percentage of some college education, and paradoxically a higher percentage of heavy drinkers.

Recently, our team identified twelve county characteristics explaining over two-thirds of the variation in well-being across all counties in the United States.[39] As we found in this study, characteristics in clinical care and social and economic categories were significantly associated with higher well-being, suggesting that access to high-quality healthcare and affordable education may be especially important to well-being, both in all counties and in this sample of high-poverty counties.

Higher supply of primary care physicians and lower rates of preventable hospital stays were both significantly associated with high versus low well-being. These findings are consistent with prior research showing better health outcomes among populations served by primary care-based health systems. [40, 41] For example, a 2005 study showed that a higher supply of primary care providers at the county level was associated with lower total and heart disease mortality rates, even after controlling for socioeconomic and demographic characteristics. [42] In addition, in our recent study of all counties in the United States, we found a significant negative association between rates of preventable hospital stays and individual-level resident well-being. [39] Lower preventable hospital stays may reflect greater access and quality of care in the outpatient setting, better insurance coverage and stronger partnerships between a hospital and its surrounding community; factors that may be especially important to the well-being of high-poverty populations. [21, 43-47]

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We were surprised to find that heavy drinking was associated with high versus low well-being, given that excessive drinking has previously been linked with multiple adverse health outcomes. [29, 48, 49] It is important to note, however, that excessive drinking is inconsistently defined in the literature. In our study, heavy drinking was defined as greater than 1 drink per day for women and greater than 2 drinks per day for men [30], but others have used higher thresholds. [48, 49] It is possible that heavy drinking as defined amongst our sample served as a signal for one or more unmeasured confounders. Additional exploration into this relationship would be required to understand true targets for well-being improvement.

Lower rates of smoking and higher levels of some college education were significantly associated with high versus low well-being. The percentage of some college education includes the percentage of individuals with an associate's, bachelor's, graduate or professional degree, as well as those who completed some post-secondary education but did not attain a degree. [22, 50] Smoking and post-secondary education were highlighted in a 2016 analysis of the geographic variation in life expectancy among low-income populations. Authors found that life expectancy in low-income areas was negatively correlated with rates of smoking and positively correlated with the fraction of college graduates. [51] There are many reasons why measures of smoking prevalence and post-secondary education may help to explain both variation in life expectancy and variation in well-being among high-poverty populations. Potential harms of smoking include not only adverse health consequences to smokers themselves, but also to those exposed to second-hand smoke, while potential benefits of post-secondary education include access to more

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employment opportunities, as well as better health outcomes among both educated individuals and their children. [52-56]

Finally, higher rates of physical activity were associated with high versus low well-being, consistent with prior work linking physical activity with mental and physical health. [57, 58] For example, in a recent report from the Appalachian Regional Commission, RWJF, and the Foundation for a Healthy Kentucky, both physical activity and smoking were shown to explain variation in health outcomes amongst Appalachian counties. [59] Our results suggest that efforts to encourage exercise, such as improving neighborhood walkability and allowing for greater access to parks and recreation facilities may be especially impactful in high-poverty counties. [7]

Measures of community safety, family and social support were not significant in our final model. This finding was unexpected, as prior work has suggested that community violence and lower social capital, including trust and cohesion between neighbors, mediate the relationship between poverty and poor health outcomes. [1] We used only one measure of community safety: “injury death rate,” because the other measure “violent crime rates,” was incomparable across counties, and we were unable to find an alternative data source. In addition, though we were able to utilize both “children in single-parent households” and “social associations” to represent family and social support, these measures may not adequately capture aspects of social capital that have the strongest influence on well-being. If other measures of social capital and community violence had been available at the county level, these characteristics may have helped to explain variation in well-being across high-poverty counties.

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Although our sample was limited to counties in the highest quartile of poverty, the income of respondents varied, with respondents in high-well-being counties reporting higher incomes than respondents in low-well-being counties. (Table 1) Similarly, we found that the percent of children in poverty, a measure of county-level income, was significantly and negatively associated with well-being. (Supplementary file, table 2) Therefore, differences in income partly explained differences in well-being across these high-poverty counties. However, although the bivariate association between percent children in poverty and well-being was significant, this variable explained less than 5% of variance in well-being. (Supplementary file, table 2) We found that other county characteristics more fully explained differences in well-being among these high-poverty counties. Similarly, even after controlling for differences in individual income, three factors remained significantly associated with high versus low well-being: heavy drinking, smoking, and primary care physician density, confirming that individual income does not fully account for variation in well-being among high-poverty counties. The associations of physical inactivity, preventable hospital stays, and some college with well-being became insignificant, suggesting that income may be the underlying confounder in the relationships of these factors with well-being.

Among the six domains of well-being, we found that the “basic access” and “life evaluation” scores were most different between high- and low well-being counties, suggesting that efforts focused on these domains may be especially impactful in high-poverty counties. These domains may be related to the community characteristics we identified in this study. For example, perception of neighborhood safety, a component of the basic access domain, has

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previously been negatively associated with the prevalence of smoking. [60] Similarly, percentage of college graduates at the county level has been associated with average life satisfaction, a component of the life evaluation domain. [5] Future work should explore the relationships between these community characteristics and each of the well-being domains, as these analyses may provide additional insights into predictors of well-being in the setting of economic disadvantage.

This study has several limitations. First, as this was a cross-sectional study, we are unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties. It is possible that other unmeasured factors explain the relationships we found between these community characteristics and well-being, and which represent the true targets for well-being improvement efforts. For example, the positive association between some college and well-being may reflect other characteristics of high-well-being counties such as access to affordable community colleges or state universities, parenting styles and cultural beliefs that promote higher education, or sufficient employment opportunities for individuals with post-secondary education. A mixed methods approach incorporating qualitative analyses may be useful in further exploring the relationships between the characteristics identified in our study and the well-being of high-poverty counties. Second, though the Gallup-Sharecare Well-Being Index is a national survey that uses stratified random sampling, design weights were not available at the county level; however, though this may limit inferences about the well-being of any individual county, it does not affect inferences about associations among counties. Finally, our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county

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level. However, counties are important units for policy action and represent municipalities for which there are a number of key metrics available.

As poverty is negatively associated with many aspects of well-being, it is essential to reduce the burden of poverty affecting many counties in the United States.[1-8, 13, 14] Though poverty eradication remains an essential priority, our findings suggest that targeting certain county characteristics may mitigate the negative influence of poverty on well-being. Specifically, efforts to improve access to high-quality primary care and affordable post-secondary education, increase taxes on tobacco, reduce barriers to tobacco cessation treatment, and improve neighborhood walkability may be especially impactful among high-poverty populations, an idea worth testing. [7, 42, 47, 54, 55]

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Contributors

AA, ES, JH, CR, BR, ER, KK and HK contributed to the study concept and design, analysis and interpretation of the data, drafting and revising the manuscript. JH completed all statistical analyses.

Competing interests

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Patient consent for publication Not required.

Data sharing statement

If the paper is accepted for publication, we will post a de-identified data set with county well-being data from Gallup-Sharecare on ICSPR Open, a publicly available site. County characteristic data from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps are available from www.countyhealthrankings.org.

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References

1. Chen, E. and G.E. Miller, *Socioeconomic status and health: mediating and moderating factors*. Annu Rev Clin Psychol, 2013. **9**: p. 723-49.

2. Bikdeli, B., et al., *Place of residence and outcomes of patients with heart failure: analysis from the telemonitoring to improve heart failure outcomes trial*. Circ Cardiovasc Qual Outcomes, 2014. **7**(5): p. 749-56.

3. Sampson, R.J., *The neighborhood context of well-being*. Perspect Biol Med, 2003. **46**(3 Suppl): p. S53-64.

4. O'Campo, P., et al., *The Neighbourhood Effects on Health and Well-being (NEHW) study*. Health Place, 2015. **31**: p. 65-74.

5. Lawless, N.M. and R.E. Lucas, *Predictors of Regional Well-Being: A County Level Analysis*. Social Indicators Research, 2011. **101**(3): p. 341-357.

6. Ludwig, J., et al., *Neighborhood effects on the long-term well-being of low-income adults*. Science, 2012. **337**(6101): p. 1505-10.

7. Diez Roux, A.V. and C. Mair, *Neighborhoods and health*. Ann N Y Acad Sci, 2010. **1186**: p. 125-45.

8. Robinette, J.W., S.T. Charles, and T.L. Gruenewald, *Neighborhood Socioeconomic Status and Health: A Longitudinal Analysis*. J Community Health, 2017.

9. Levine, J.A., *Poverty and obesity in the U.S.* Diabetes, 2011. **60**(11): p. 2667-8.

10. Sundquist, K., et al., *Neighborhood socioeconomic environment and incidence of coronary heart disease: a follow-up study of 25,319 women and men in Sweden*. Am J Epidemiol, 2004. **159**(7): p. 655-62.

11. Arcaya, M.C., et al., *Research on neighborhood effects on health in the United States: A systematic review of study characteristics*. Social Science & Medicine, 2016. **168**: p. 16-29.

12. Haan, M., G.A. Kaplan, and T. Camacho, *Poverty and health. Prospective evidence from the Alameda County Study*. Am J Epidemiol, 1987. **125**(6): p. 989-98.

13. Egen, O., et al., *Health and Social Conditions of the Poorest Versus Wealthiest Counties in the United States*. Am J Public Health, 2017. **107**(1): p. 130-135.

14. Galea, S. and R. Vaughan, *A Public Health of Consequence: Review of the January 2017 Issue of AJPH*. Am J Public Health, 2017. **107**(1): p. 17-18.

15. McGinnis, J.M., *Income, Life Expectancy, and Community Health: Underscoring the Opportunity*. Jama, 2016. **315**(16): p. 1709-10.

16. *Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference*. 1946, New York: 19–22 June 1946, and entered into force on 7 April 1948.

High-poverty Counties with High Well-Being

17. Gallup-Healthways, *Gallup-Healthways Well-Being Index: Methodology Report for Indexes*. 2009: Available at <http://www.gallup.com/poll/195539/gallup-healthways-index-methodology-report-indexes.aspx>.
18. Kobau, R., et al., *Mental, social, and physical well-being in New Hampshire, Oregon, and Washington, 2010 Behavioral Risk Factor Surveillance System: implications for public health research and practice related to Healthy People 2020 foundation health measures on well-being*. Population Health Metrics, 2013. **11**: p. 19-19.
19. Arora, A., et al., *Population Well-Being Measures Help Explain Geographic Disparities In Life Expectancy At The County Level*. Health Aff (Millwood), 2016. **35**(11): p. 2075-2082.
20. Chen, E. and G.E. Miller, "Shift-and-Persist" Strategies: Why Low Socioeconomic Status Isn't Always Bad for Health. *Perspect Psychol Sci*, 2012. **7**(2): p. 135-58.
21. Institute, U.o.W.P.H. *County Health Rankings 2014*. Available from: www.countyhealthrankings.org.
22. Remington, P.L., B.B. Catlin, and K.P. Gennuso, *The County Health Rankings: rationale and methods*. Population Health Metrics, 2015. **13**(1): p. 1-12.
23. *Area Health Resources Files 2013-2014*. U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Workforce: Rockville, MD.
24. Sears, L.E., et al., *Overall well-being as a predictor of health care, productivity, and retention outcomes in a large employer*. *Popul Health Manag*, 2013. **16**(6): p. 397-405.
25. Gandy, W.M., et al., *Well-being and employee health-how employees' well-being scores interact with demographic factors to influence risk of hospitalization or an emergency room visit*. *Popul Health Manag*, 2014. **17**(1): p. 13-20.
26. Herrin, J., et al., *Population well-being and electoral shifts*. *PLoS One*, 2018. **13**(3): p. e0193401.
27. Riley, C., et al., *Association of the overall well-being of a population with health care spending for people 65 years of age or older*. *JAMA Network Open*, 2018. **1**(5): p. e182136.
28. (IHME), I.o.H.M.a.E., *United States Smoking Prevalence by County 1996-2012*. 2014, Institute for Health Metrics and Evaluation (IHME): Seattle, United States.
29. Dwyer-Lindgren, L., et al., *Drinking Patterns in US Counties From 2002 to 2012*. *American journal of public health*, 2015. **105**(6): p. 1120-1127.
30. *Institute for Health Metrics and Evaluation (IHME). United States Alcohol Use Prevalence by County 2002-2012*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2015.
31. Institute, U.o.W.P.H. *County Health Rankings 2015*. Available from: www.countyhealthrankings.org.
32. Institute, U.o.W.P.H., *2015 County Health Rankings Key Findings Report*. 2015.
33. Bradley, E.H., et al., *Hospital strategies for reducing risk-standardized mortality rates in acute myocardial infarction*. *Ann Intern Med*, 2012. **156**(9): p. 618-26.
34. Herrin, J., et al., *Community factors and hospital readmission rates*. *Health Serv Res*, 2015. **50**(1): p. 20-39.
35. Hardin, J. and J. Hilbe, *Generalized Estimating Equations*. 2003, London: Chapman and Hall.
36. Little, R. and D. Rubin, *Statistical analysis with missing data*. 2nd ed. 2002, New York: Wiley.

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37. Efron, B., *Regression and ANOVA with Zero-One Data: Measures of Residual Variation*. Journal of the American Statistical Association, 1978. **73**(361): p. 113-121.

38. Belsley DA, K.E., Welsch RE, *Regression diagnostics*. 1980, New York, New York: J. Wiley & Sons.

39. Roy, B., et al., *Identifying county characteristics associated with resident well-being: A population based study*. PLoS One, 2018. **13**(5): p. e0196720.

40. Phillips, R.L., Jr. and B. Starfield, *Why does a U.S. primary care physician workforce crisis matter?* Am Fam Physician, 2004. **70**(3): p. 440, 442, 445-6.

41. Goodman, D.C. and K. Grumbach, *Does having more physicians lead to better health system performance?* Jama, 2008. **299**(3): p. 335-7.

42. Starfield, B., et al., *The effects of specialist supply on populations' health: assessing the evidence*. Health Aff (Millwood), 2005. **Suppl Web Exclusives**: p. W5-97-w5-107.

43. Billings, J., et al., *Impact of socioeconomic status on hospital use in New York City*. Health Aff (Millwood), 1993. **12**(1): p. 162-73.

44. Erickson, D. and N. Andrews, *Partnerships among community development, public health, and health care could improve the well-being of low-income people*. Health Aff (Millwood), 2011. **30**(11): p. 2056-63.

45. Antonisse L, G.R., Rudowitz R, Artiga S *The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review*. 2017.

46. Pappas, G., et al., *Potentially avoidable hospitalizations: inequalities in rates between US socioeconomic groups*. American Journal of Public Health, 1997. **87**(5): p. 811-816.

47. Parchman, M.L. and S.D. Culler, *Preventable hospitalizations in primary care shortage areas. An analysis of vulnerable Medicare beneficiaries*. Arch Fam Med, 1999. **8**(6): p. 487-91.

48. Rehm, J., et al., *The relation between different dimensions of alcohol consumption and burden of disease: an overview*. Addiction (Abingdon, England), 2010. **105**(5): p. 817-843.

49. Rehm, J., et al., *The relationship between different dimensions of alcohol use and the burden of disease-an update*. Addiction (Abingdon, England), 2017. **112**(6): p. 968-1001.

50. *County Health Rankings & Roadmaps*. [cited 2017 February 25]; Available from: <http://www.countyhealthrankings.org/our-approach>.

51. Chetty, R., et al., *The Association Between Income and Life Expectancy in the United States, 2001-2014*. Jama, 2016.

52. Olshansky, S.J., et al., *Differences in life expectancy due to race and educational differences are widening, and many may not catch up*. Health Aff (Millwood), 2012. **31**(8): p. 1803-13.

53. Egerter S, B.P., Sadegh-Nobari T, Grossman-Kahn R, Dekker M. Education Matters for Health. Princeton, NJ: RWJF Commission to Build a Healthier America; 2009. Issue Brief 6.

54. Hout, M., *Social and Economic Returns to College Education in the United States*. Annual Review of Sociology, 2012. **38**(1): p. 379-400.

55. Ekpu, V.U. and A.K. Brown, *The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence*. Tobacco Use Insights, 2015. **8**: p. 1-35.

56. U.S. Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General. Atlanta, G.U.S.D.

57. Harris, M.A., *The relationship between physical inactivity and mental wellbeing: Findings from a gamification-based community-wide physical activity intervention*. Health psychology open, 2018. **5**(1): p. 2055102917753853-2055102917753853.

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58. Penedo, F.J. and J.R. Dahn, *Exercise and well-being: a review of mental and physical health benefits associated with physical activity*. Curr Opin Psychiatry, 2005. **18**(2): p. 189-93.
59. G. Mark Holmes, N.M.L., William Holding, Randy Randolph, Jonathan Rodgers, Pam Silberman, Lisa Villamil, Thomas A. Arcury, Kelly Ivey, Daniel Goolsby, Ashli Keyser, and J&J Editorial, *Identifying Bright Spots in Appalachian Health: Statistical Analysis*. 2018, Appalachian Regional Commission; PDA, Inc.; Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill.
60. Mayne, S.L., et al., *Cross-sectional and longitudinal associations of neighbourhood social environment and smoking behaviour: the multiethnic study of atherosclerosis*. J Epidemiol Community Health, 2017. **71**(4): p. 396-403.

Tables and figures:

Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF County Health Rankings and Roadmaps (CHRR). All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinkers (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)

Figure 2. Map of high poverty counties with high and low well-being. Source: Gallup-Sharecare Well-Being Index

Table 1. Geography and demographics of all high poverty counties, and of high-poverty counties with high and low well-being

Variable	Value	All high poverty counties	Low well-being counties	High well-being counties	P-value
N		770 (100)	311 (100)	72 (100)	
Urban/rural status	Urban	595 (77.3)	215 (69.1)	44 (61.1)	0.190
N (%)	Rural	175 (22.7)	96 (30.9)	28 (38.9)	
Region of the United States	New England	1 (0.1)	0 (0.0)	0 (0.0)	<0.001
N (%)	Mid Atlantic	5 (0.6)	0 (0.0)	0 (0.0)	
	East North Central	36 (4.7)	11 (3.5)	3 (4.2)	
	West North Central	49 (6.4)	22 (7.1)	13 (18.1)	
	South Atlantic	216 (28.1)	86 (27.7)	23 (31.9)	
	East South Central	201 (26.1)	110 (35.4)	7 (9.7)	
	West South Central	183 (23.8)	65 (20.9)	14 (19.4)	
	Mountain	50 (6.5)	13 (4.2)	9 (12.5)	
	Pacific	29 (3.8)	4 (1.3)	3 (4.2)	

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Income of respondents Mean (SD)	% >120 k	5.8 (3.6)	4.9 (3.4)	6.3 (5.3)	0.005
	% 60k-120k	14.7 (5.7)	12.7 (5.1)	18.2 (7.8)	<0.001
	% 36k-60k	18.6 (6.1)	18.4 (6.4)	19.6 (8.0)	0.185
	% 12k-36k	29.6 (7.3)	31.6 (7.2)	25.7 (8.7)	<0.001
	% <12k	12.6 (6.0)	14.1 (6.0)	9.7 (6.0)	<0.001
	% Unknown	18.7 (6.8)	18.2 (6.1)	20.5 (13.0)	0.031
Well-being score Mean (SD)		64.3 (4.3)	60.2 (2.8)	71.8 (2.3)	<0.001

Table 2. Standardized differences in domain scores when comparing high and low well-being counties among all high-poverty counties (all significant at $p<0.001$)

Domain	Standardized difference (95% confidence interval)
Basic Access	2.56 (2.25, 2.87)
Life evaluation	2.51 (2.20, 2.82)
Physical Health	2.46 (2.15, 2.77)
Emotional Health	1.71 (1.43, 1.99)
Healthy Behaviors	1.51 (1.23, 1.78)
Work Environment	1.25 (0.97, 1.52)

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Table 3. Category-specific models: Odds ratios describe odds of a county having high versus low well-being

Health Behaviors				
R²: 0.243	C: 0.812	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Percent smoking	Tertile 1	Ref		<0.001
	Tertile 2	0.03	(0.01, 0.10)	
	Tertile 3	0.02	(0.01, 0.06)	
Adult obesity	Tertile 1	Ref		0.241
	Tertile 2	0.71	(0.35, 1.43)	
	Tertile 3	0.31	(0.08, 1.21)	

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Percent heavy drinkers	Tertile 1 Tertile 2 Tertile 3	Ref 7.23 10.54	(2.20, 23.83) (3.36, 33.06)	<0.001
Physical inactivity	Tertile 1 Tertile 2 Tertile 3	Ref 0.26 0.65	(0.12, 0.56) (0.16, 2.69)	0.002
Clinical Care				
R2: 0.177	C: 0.775	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Primary care physicians	Tertile 1 Tertile 2 Tertile 3	Ref 1.12 4.58	(0.28, 4.44) (1.79, 11.77)	<0.001
Mental health providers	Tertile 1 Tertile 2 Tertile 3	Ref 1.93 3.97	(0.61, 6.07) (1.14, 13.80)	0.096
Preventable hosp. stays	Tertile 1 Tertile 2 Tertile 3	Ref 0.18 0.03	(0.06, 0.56) (0.01, 0.13)	<0.001
Social and Economic Factors				
R2: 0.163	C: 0.765	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Some College	Tertile 1 Tertile 2 Tertile 3	Ref 1.36 16.55	(0.41, 4.50) (5.16, 53.05)	<0.001
Injury deaths	Tertile 1 Tertile 2 Tertile 3	Ref 0.24 0.06	(0.05, 1.11) (0.02, 0.13)	<0.001
Physical Environment				
R2: 0.050	C: 0.663	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Long commute-driving alone	Tertile 1 Tertile 2 Tertile 3	Ref 0.34 0.06	(0.07, 1.56) (0.02, 0.14)	<0.001

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Table 4. Final multivariable models, unadjusted and adjusted for income of respondents. Odds ratios describe odds of a county having high versus low well-being.

		Final multivariable model, unadjusted			Final multivariable model adjusted for income of respondents		
		R ² : 0.300, C-statistic: 0.829			R ² : 0.341, C-statistic: 0.843		
Variable		Odds Ratio	95% C.I.	Wald P value	Odds Ratio	95% C.I.	Wald P Value

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Percent Smoking	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.04 0.05 1.12	(0.01, 0.12) (0.01, 0.19) (0.20, 6.44)	<0.001	Ref 0.07 0.06 0.91	(0.03, 0.17) (0.01, 0.31) (0.17, 4.75)	<0.001
Percent heavy drinkers	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 6.33 6.39 1.01	(2.66, 15.06) (2.01, 20.36) (0.46, 2.20)	<0.001	Ref 5.58 4.74 0.85	(2.44, 12.80) (1.67, 13.50) (0.36, 1.99)	<0.001
Physical Inactivity	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.28 0.88 3.14	(0.10, 0.80) (0.28, 2.75) (0.96, 10.23)	0.042	Ref 0.41 1.08 2.64	(0.14, 1.22) (0.35, 3.36) (0.95, 7.35)	0.120
Primary Care Physicians	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.53 3.11 5.83	(0.11, 2.53) (1.53, 6.32) (1.49, 22.87)	<0.001	Ref 0.51 2.05 4.06	(0.12, 2.19) (1.05, 4.00) (1.03, 16.05)	0.021
Preventable hospital stays	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.35 0.30 0.86	(0.10, 1.15) (0.10, 0.90) (0.21, 3.56)	0.046	Ref 0.52 0.42 0.81	(0.15, 1.81) (0.14, 1.32) (0.20, 3.23)	0.282
Some college	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.94 2.72 2.91	(0.12, 7.05) (0.40, 18.42) (1.45, 5.82)	0.007	Ref 0.63 1.61 2.54	(0.09, 4.51) (0.24, 10.89) (0.98, 6.59)	0.157
Injury deaths	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 0.44 0.31 0.69	(0.16, 1.22) (0.11, 0.86) (0.24, 2.00)	0.067	Ref 0.64 0.44 0.68	(0.24, 1.69) (0.18, 1.06) (0.22, 2.13)	0.164
Long commute	Tertile 1 Tertile 2 vs 1 Tertile 3 vs 1 Tertile 3 vs 2	Ref 1.34 2.35 1.75	(0.56, 3.20) (0.64, 8.56) (0.59, 5.17)	0.433	Ref 0.93 1.53 1.65	(0.33, 2.58) (0.36, 6.43) (0.42, 6.53)	0.773

Categories

County Health Factors

County Characteristics

Health Behaviors

Tobacco Use

Diet & Exercise

Alcohol & Drug Use

Sexual Activity

Clinical Care

Access to Care

Quality of Care

Social and
Economic Factors

Education

Employment

Income

Family & Social
Support

Community Safety

Physical
Environment

Air & Water Quality

Housing & Transit

- Percent Smoking
- Adult Obesity
- Food environment Index
- Physical Inactivity
- Access to Exercise Opportunities
- Alcohol impaired driving deaths
- Heavy drinking
- Sexually transmitted infections
- Teen births

- Uninsured
- Primary care physicians
- Dentists
- Mental health providers
- Preventable hospital stays
- Diabetic screening
- Mammography screening

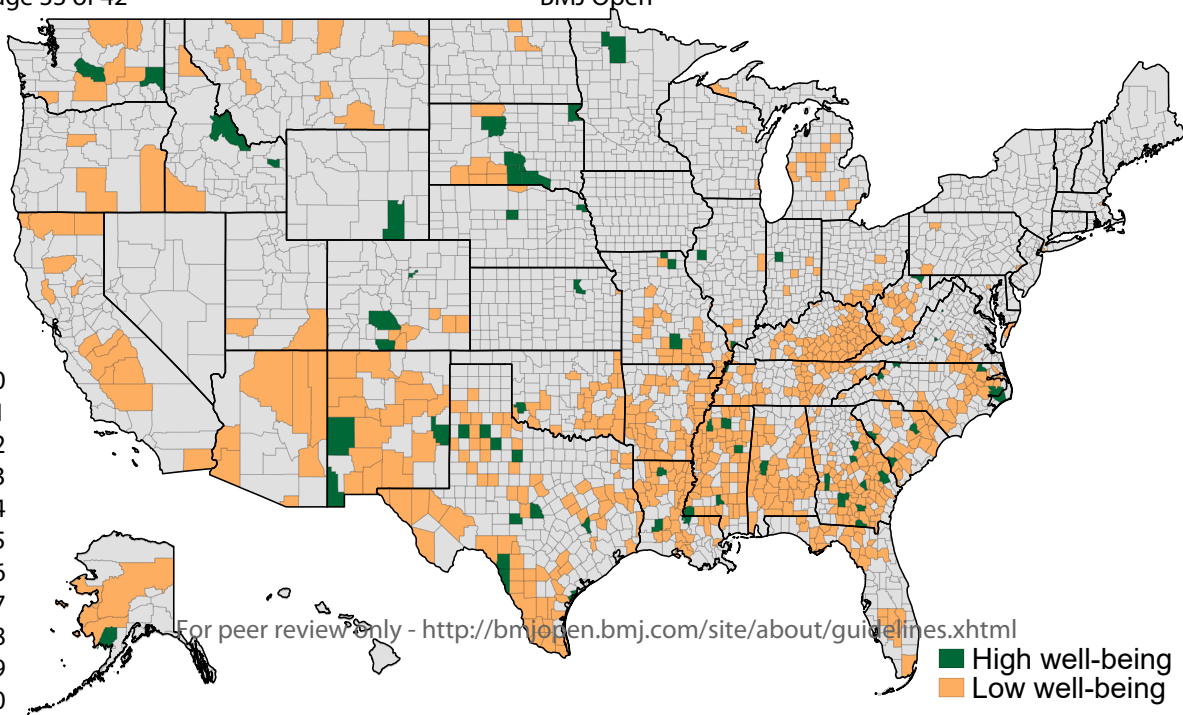
- High school graduation
- Some college
- Unemployment
- Children in poverty
- Income inequality
- Children in single-parent households
- Social associations
- Injury deaths

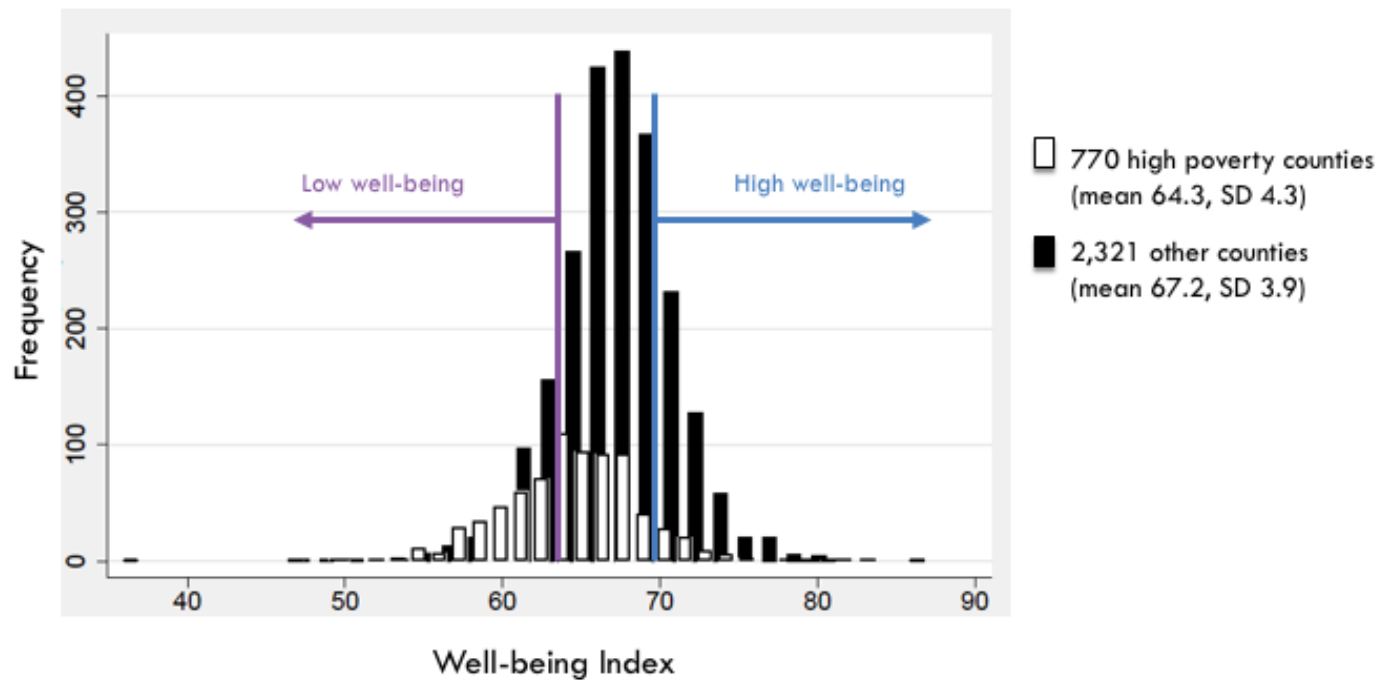
- Air pollution – particulate matter
- Drinking water violations
- Severe housing problems
- Driving alone to work
- Long commute

Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF CHRR. All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinking (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)

High poverty counties with high and low well-being

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Supplementary Figure 1. Distribution of well-being among high poverty counties and all other counties in the United States

Supplementary Table 1. High poverty counties with high well-being

	County or County Equivalent	State
1	Hale	Alabama
2	Dillingham	Alaska
3	Conejos	Colorado
4	Denver	Colorado
5	Saguache	Colorado
6	Atkinson	Georgia
7	Baldwin	Georgia

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8	Bulloch	Georgia
9	Echols	Georgia
10	Greene	Georgia
11	Marion	Georgia
12	Turner	Georgia
13	Webster	Georgia
14	Wheeler	Georgia
15	Worth	Georgia
16	Lemhi	Idaho
17	Madison	Idaho
18	McDonough	Illinois
19	Pulaski	Illinois
20	Tippecanoe	Indiana
21	Riley	Kansas
22	Allen	Louisiana
23	Lincoln	Louisiana
24	West Feliciana	Louisiana
25	Beltrami	Minnesota
26	Jefferson Davis	Mississippi
27	Lafayette	Mississippi
28	Oktibbeha	Mississippi
29	Quitman	Mississippi
30	Wilkinson	Mississippi
31	Knox	Missouri
32	Schuyler	Missouri
33	Texas	Missouri
34	Blaine	Nebraska
35	Thurston	Nebraska
36	Catron	New Mexico
37	Hidalgo	New Mexico
38	Roosevelt	New Mexico
39	Alleghany	North Carolina
40	Avery	North Carolina
41	Hertford	North Carolina
42	Hyde	North Carolina

43	Greer	Oklahoma
44	Allendale	South Carolina
45	Lee	South Carolina
46	McCormick	South Carolina
47	Charles Mix	South Dakota
48	Dewey	South Dakota
49	Gregory	South Dakota
50	Lyman	South Dakota
51	Roberts	South Dakota
52	Tripp	South Dakota
53	Lake	Tennessee
54	Aransas	Texas
55	Brazos	Texas
56	Dickens	Texas
57	Floyd	Texas
58	Haskell	Texas
59	Kinney	Texas
60	Lamb	Texas
61	Maverick	Texas
62	Menard	Texas
63	San Saba	Texas
64	Charlottesville City	Virginia
65	Harrisonburg City	Virginia
66	Lexington City	Virginia
67	Lynchburg City	Virginia
68	Radford City	Virginia
69	Kittitas	Washington
70	Whitman	Washington
71	Monongalia	West Virginia
72	Albany	Wyoming

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Supplementary Table 2: Bivariate Associations of 29 Community Factors

Category: Health Behaviors	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P- value	R2	C-stat
	GHD: % Smoking				n (%)	<0.001	0.2229	0.792
		T1 [12.68-25.67]	256 (33.2)	42 (13.5)	46 (63.9)			
		T2 [25.68-28.46]	257 (33.4)	106 (34.1)	17 (23.6)			
		T3 [28.47-39.50]	255 (33.1)	163 (52.4)	9 (12.5)			
		Missing	2 (0.3)	0 (0.0)	0 (0.0)			
	GHD: % Heavy drinkers							
						<0.001	0.0684	0.679
		T1 [2.40-5.90]	258 (33.5)	142 (45.7)	13 (18.1)			
		T2 [6.00-7.50]	269 (34.9)	103 (33.1)	25 (34.7)			
		T3 [7.60-21.40]	241 (31.3)	66 (21.2)	34 (47.2)			
		Missing	2(0.3)	0 (0.0)	0 (0.0)			
	RWJ: Adult obesity					<0.001	0.0664	0.678
		T1 [0.18-0.32]	265 (34.4)	82 (26.4)	40 (55.6)			
		T2 [0.32-0.35]	255 (33.1)	106 (34.1)	21 (29.2)			
		T3 [0.35-0.48]	250 (32.5)	123 (39.5)	11 (15.3)			
	RWJ: Food environment index					0.116	0.0059	0.553
		T1 [0.00-6.06]	257 (33.4)	102 (32.8)	27 (37.5)			
		T2 [6.06-7.04]	257 (33.4)	87 (28.0)	24 (33.3)			
		T3 [7.04-8.77]	256 (33.2)	122 (39.2)	21 (29.2)			
	RWJ: Physical inactivity					<0.001	0.1036	0.711
		T1 [0.14-0.29]	257 (33.4)	61 (19.6)	40 (55.6)			
		T2 [0.29-0.33]	262 (34.0)	113 (36.3)	20 (27.8)			
		T3 [0.34-0.44]	251 (32.6)	137 (44.1)	12 (16.7)			
	RWJ: Access to exercise opportunities					<0.001	0.0126	0.558
		T1 [0.00-0.29]	255 (33.1)	121 (38.9)	25 (34.7)			
		T2 [0.29-0.52]	254 (33.0)	111 (35.7)	18 (25.0)			
		T3 [0.53-1.00]	254 (33.0)	78 (25.1)	27 (37.5)			
		Missing	7 (0.9)	1 (0.3)	2 (2.8)			

	RWJ: Alcohol-impaired driving deaths					0.475	0.0069	0.552
		T1 [0.00-0.25]	267 (34.7)	113 (36.3)	30 (41.7)			
		T2 [0.25-0.36]	246 (31.9)	92 (29.6)	13 (18.1)			
		T3 [0.36-1.00]	255 (33.1)	106 (34.1)	28 (38.9)			
		Missing	2 (0.3)	0 (0.0)	1 (1.4)			
	RWJ: Sexually transmitted infections					0.006	0.0103	0.564
		T1 [43.00-323.60]	252 (32.7)	136 (43.7)	20 (27.8)			
		T2 [324.40-619.00]	252 (32.7)	96 (30.9)	27 (37.5)			
		T3 [619.70-2701.60]	252 (32.7)	74 (23.8)	20 (27.8)			
		Missing	14 (1.8)	5 (1.6)	5 (6.9)			
	RWJ: Teen births					<0.001	0.0347	0.627
		T1 [4.62-54.95]	256 (33.2)	88 (28.3)	37 (51.4)			
		T2 [55.01-69.16]	255 (33.1)	101 (32.5)	14 (19.4)			
		T3 [69.20-130.43]	255 (33.1)	122 (39.2)	20 (27.8)			
		Missing	4 (0.5)	0 (0.0)	1 (1.4)			
Category: Clinical Care	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: Uninsured					0.888	0.0063	0.465
		T1 [0.06-0.19]	257 (33.4)	114 (36.7)	25 (34.7)			
		T2 [0.19-0.23]	257 (33.4)	105 (33.8)	15 (20.8)			
		T3 [0.23-0.39]	256 (33.2)	92 (29.6)	32 (44.4)			
	RWJ: Primary care physicians					<0.001	0.0576	0.667
		T1 [0.00-33.53]	244 (31.7)	131 (42.1)	16 (22.2)			
		T2 [33.56-52.14]	244 (31.7)	99 (31.8)	14 (19.4)			
		T3 [52.44-268.90]	243 (31.6)	65 (20.9)	32 (44.4)			
		Missing	39 (5.1)	16 (5.1)	10 (13.9)			
	RWJ: Dentists					<0.001	0.0153	0.564
		T1 [0.00-20.83]	246 (31.9)	120 (38.6)	24 (33.3)			
		T2 [20.83-34.53]	245 (31.8)	109 (35.0)	21 (29.2)			
		T3 [34.53-166.08]	245 (31.8)	61 (19.6)	24 (33.3)			
		Missing	34 (4.4)	21 (6.8)	3 (4.2)			
	RWJ: Mental health providers					<0.001	0.0612	0.666

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		T1 [0.00-26.55]	219 (28.4)	103 (33.1)	12 (16.7)			
		T2 [26.56-76.03]	219 (28.4)	97 (31.2)	11 (15.3)			
		T3 [76.77-1387.78]	218 (28.3)	57 (18.3)	28 (38.9)			
		Missing	114 (14.8)	54 (17.4)	21 (29.2)			
	RWJ: Preventable hospital stays					<0.001	0.1191	0.734
		T1 [27.44-75.59]	246 (31.9)	50 (16.1)	34 (47.2)			
		T2 [75.66-101.23]	245 (31.8)	98 (31.5)	20 (27.8)			
		T3 [101.45-280.58]	245 (31.8)	149 (47.9)	10 (13.9)			
		Missing	34 (4.4)	14 (4.5)	8 (11.1)			
	RWJ: Diabetic screening					0.384	0.0075	0.521
		T1 [0.18-0.81]	256 (33.2)	114 (36.7)	24 (33.3)			
		T2 [0.81-0.85]	256 (33.2)	101 (32.5)	15 (20.8)			
		T3 [0.85-0.94]	254 (33.0)	95 (30.5)	31 (43.1)			
		Missing	4 (0.5)	1 (0.3)	2 (2.8)			
	RWJ: Mammography screening					<0.001	0.0493	0.624
		T1 [0.26-0.53]	252 (32.7)	134 (43.1)	22 (30.6)			
		T2 [0.53-0.60]	251 (32.6)	96 (30.9)	12 (16.7)			
		T3 [0.60-0.80]	251 (32.6)	75 (24.1)	35 (48.6)			
		Missing	16 (2.1)	6 (1.9)	3 (4.2)			
Category: Social and Economic Factors			All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: High school graduation					0.315	0.0011	0.507
		T1 [0.29-0.73]	232 (30.1)	86 (27.7)	17 (23.6)			
		T2 [0.73-0.82]	239 (31.0)	105 (33.8)	15 (20.8)			
		T3 [0.83-1.00]	224 (29.1)	94 (30.2)	16 (22.2)			
		Missing	75 (9.7)	26 (8.4)	24 (33.3)			
	RWJ: Some college					<0.001	0.1156	0.704
		T1 [0.19-0.41]	257 (33.4)	142 (45.7)	15 (20.8)			
		T2 [0.41-0.49]	257 (33.4)	116 (37.3)	18 (25.0)			
		T3 [0.49-0.88]	256 (33.2)	53 (17.0)	39 (54.2)			
	RWJ: Unemployment					<0.001	0.0494	0.656
		T1 [0.03-0.08]	257 (33.4)	83 (26.7)	38 (52.8)			
		T2 [0.08-0.11]	257 (33.4)	101 (32.5)	20 (27.8)			

		T3 [0.11-0.28]	256 (33.2)	127 (40.8)	14 (19.4)			
	RWJ: Children in poverty					<0.001	0.0327	0.612
		T1 [0.12-0.32]	258 (33.5)	74 (23.8)	32 (44.4)			
		T2 [0.32-0.38]	259 (33.6)	109 (35.0)	20 (27.8)			
		T3 [0.38-0.60]	253 (32.9)	128 (41.2)	20 (27.8)			
	RWJ: Children in single-parent households					0.040	0.0007	0.518
		T1 [0.11-0.35]	257 (33.4)	114 (36.7)	29 (40.3)			
		T2 [0.35-0.44]	257 (33.4)	97 (31.2)	23 (31.9)			
		T3 [0.44-0.79]	256 (33.2)	100 (32.2)	20 (27.8)			
	RWJ: Social associations					0.316	0.0004	0.529
		Q1 [0.00-9.64]	257 (33.4)	120 (38.6)	20 (27.8)			
		Q2 [9.66-13.14]	257 (33.4)	102 (32.8)	22 (30.6)			
		Q3 [13.15-33.50]	256 (33.2)	89 (28.6)	30 (41.7)			
	RWJ: Injury deaths					<0.001	0.0754	0.683
		T1 [28.00-75.10]	245 (31.8)	60 (19.3)	32 (44.4)			
		T2 [75.30-96.30]	246 (31.9)	97 (31.2)	15 (20.8)			
		T3 [96.50-251.90]	244 (31.7)	143 (46.0)	14 (19.4)			
		Missing	35 (4.5)	11 (3.5)	11 (15.3)			
	RWJ: GINI coefficient					0.128	0.0035	0.513
		T1 [37.80-44.90]	261 (33.9)	105 (33.8)	19 (26.4)			
		T2 [45.00-47.10]	257 (33.4)	106 (34.1)	22 (30.6)			
		T3 [47.20-58.60]	252 (32.7)	100 (32.2)	31 (43.1)			
Category: Physical Environment		Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: Air pollution - particulate matter					0.004	0.0031	0.567
		T1 [7.21-11.37]	255 (33.1)	76 (24.4)	30 (41.7)			
		T2 [11.38-12.72]	260 (33.8)	107 (34.4)	23 (31.9)			
		T3 [12.73-14.50]	250 (32.5)	126 (40.5)	18 (25.0)			
		Missing	5 (0.6)	2 (0.6)	1 (1.4)			
	RWJ: Drinking water violations					0.076	0.0045	0.553
		T1 [0.00-0.00]	311 (40.4)	142 (45.7)	30 (41.7)			
		T2 [0.00-0.09]	190 (24.7)	60 (19.3)	18 (25.0)			
		T3 [0.09-1.00]	250 (32.5)	105 (33.8)	19 (26.4)			

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		Missing	19 (2.5)	4 (1.3)	5 (6.9)			
	RWJ: Severe housing problems					<0.001	0.0392	0.608
		T1 [0.05-0.14]	257 (33.4)	134 (43.1)	23 (31.9)			
		T2 [0.14-0.17]	257 (33.4)	106 (34.1)	16 (22.2)			
		T3 [0.17-0.69]	256 (33.2)	71 (22.8)	33 (45.8)			
	RWJ: Driving alone to work					<0.001	0.0477	0.647
		T1 [0.04-0.78]	257 (33.4)	96 (30.9)	41 (56.9)			
		T2 [0.78-0.82]	257 (33.4)	94 (30.2)	17 (23.6)			
		T3 [0.82-0.91]	256 (33.2)	121 (38.9)	14 (19.4)			
	RWJ: Long commute - driving alone					<0.001	0.0589	0.663
		T1 [0.00-0.24]	259 (33.6)	74 (23.8)	38 (52.8)			
		T2 [0.24-0.35]	256 (33.2)	109 (35.0)	19 (26.4)			
		T3 [0.35-0.66]	255 (33.1)	128 (41.2)	15 (20.8)			

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	7-8
		(d) If applicable, describe analytical methods taking account of sampling strategy	9
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10

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(b) Indicate number of participants with missing data for each variable of interest			Supplementary table 1
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(b) Report category boundaries when continuous variables were categorized	10
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Identifying Characteristics of High-poverty Counties in the United States with High Well-being: An Observational Cross-Sectional Study

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High-poverty Counties with High Well-Being

TITLE Identifying Characteristics of High-poverty Counties in the United States with High Well-being: An Observational Cross-Sectional Study

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High-poverty Counties with High Well-Being

Abstract

OBJECTIVE To identify county characteristics associated with high versus low well-being among high-poverty counties.

DESIGN Observational cross-sectional study at the county level to investigate the associations of 29 county characteristics with the odds of a high-poverty county reporting population well-being in the top quintile versus the bottom quintile of well-being in the United States. County characteristics representing key determinants of health were drawn from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps population health model.

SETTING Counties in the United States that are in the highest quartile of poverty rate.

MAIN OUTCOME MEASURE Gallup-Sharecare Well-being Index, a comprehensive population-level measure of physical, mental and social health. Counties were classified as having a well-being index score in the top or bottom 20% of all counties in the U.S.

RESULTS Among 770 high-poverty counties, 72 were categorized as having high well-being and 311 as having low well-being. The high well-being counties had a mean well-being score of 71.8 with a SD of 2.3, while the low well-being counties had a mean well-being score of 60.2 with a SD of 2.8. Among the 6 domains of well-being, basic access, which includes access to housing and healthcare, and life evaluation, which includes life satisfaction and optimism, differed the most between high- and low-well-being counties. Among 29 county characteristics tested, 6 were independently and significantly associated with high well-being ($p<0.05$). These were: lower rates of preventable hospital stays, higher supply of primary care physicians, lower prevalence of smoking, lower physical inactivity, higher percentage of some college education and higher percentage of heavy drinkers.

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CONCLUSIONS Among 770 high-poverty counties, approximately 9% outperformed expectations, reporting a collective well-being score in the top 20% of all counties in the United States. High-poverty counties reporting high well-being differed from high-poverty counties reporting low well-being in several characteristics.

For peer review only

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Strengths and Limitations of this Study

- In this study of high-poverty counties in the United States, we used a unique and validated measure of population well-being, the Gallup-Sharecare Well-being Index.
- We described high-poverty counties with high and low well-being using 29 characteristics from the Robert Wood Johnson Foundation (RWJF) County Health Rankings and Roadmaps, a well-established model of population health.
- As this was a cross-sectional study, we were unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties.
- Our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county level.

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96 Introduction

97 Poverty is negatively associated with physical, mental and social health. [1-14] In particular,
98 studies have linked poverty with higher rates of obesity and greater incidence of coronary artery
99 disease, as well as lower levels of life satisfaction and social capital. [1, 5, 9-12] Though it is
100 essential to decrease rates of poverty in the United States, there is also a need to mitigate its
101 adverse health consequences through policies and programs focused on high-poverty
102 populations. [15]

103
104 One approach to understanding how to reduce the consequences of poverty is to study
105 populations with high rates of poverty that report high levels of physical, mental and social
106 health, together defined as high well-being. [16] Well-being includes not only the absence of
107 disease, but also a sense of opportunity, happiness and lack of stress. It reflects the ability to
108 afford food, housing and healthcare, to live in a safe neighborhood, and to work in a trusting,
109 respectful environment. [16-19] As poverty is negatively associated with many aspects of well-
110 being, if high-poverty populations report high well-being, these populations have outperformed
111 expectations. [1-8, 20] By exploring the characteristics of high-poverty populations with high
112 well-being and comparing them to high-poverty populations with low well-being, we may
113 identify potential targets for well-being improvement efforts.

114
115 Accordingly, we sought to identify the community characteristics most strongly associated with
116 high versus low well-being among counties with high rates of poverty. We conducted this
117 analysis using county-level estimates of well-being from the Gallup-Sharecare Well-Being
118 Index, a survey that comprehensively evaluates well-being across the nation. [17] We compared

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the characteristics of high-poverty counties with high and low well-being, relative to the distribution of all counties, using data from the Robert Wood Johnson Foundation (RWJF) County Health Rankings and Roadmaps (CHRR), which includes a robust portfolio of factors describing counties in the United States. [17, 21, 22]

Methods

We conducted an observational cross-sectional positive-deviance study of high-poverty counties or county equivalents (e.g., parishes and boroughs) to determine which domains of the Gallup-Sharecare Well-Being Index differed the most between high- and low-well-being counties, and to identify the county characteristics that were most strongly associated with high versus low well-being.

Data Sources and Measures

County-level poverty prevalence was measured by 2010 county-level percent of persons in poverty from the Area Health Resources Files (AHRF) of the Health Resources and Services Administration. These estimates are from the Bureau of Census' Small Area Income Poverty Estimates (SAIPE) files for 2010 and are constructed from statistical models which include data from federal income tax returns, participation in the Food Stamp program, and the previous census. [23]

Well-being data were obtained from the 2010-2012 Gallup-Sharecare Well-Being Index, a national survey that comprehensively measures subjective well-being. [17] The Gallup-Sharecare Well-Being Index has been validated as a measure of population well-being

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142 by Gallup, Inc. and prior studies have linked it with life expectancy, employee
143 productivity, health care utilization and spending, and voting patterns.[17, 19, 24-27]
144
145 Data were collected in a national telephone survey of individuals age eighteen and older from all
146 fifty states and the District of Columbia; approximately 1,000 telephone (landline and
147 cell) surveys were conducted each day during the fielding period. [17] Six well-being
148 domains, as well as population demographics, were evaluated with fifty-five survey
149 questions. "Physical health" assesses the burden of chronic disease and recent illness.
150 "Emotional health" measures daily emotions and the presence or absence of depression.
151 "Healthy behaviors" assess the prevalence of smoking, exercising, and eating fruit and
152 vegetables. "Life evaluation" measures life satisfaction and optimism about the future.
153 "Basic access" includes perception of safety and access to housing and health care.
154 "Work environment" assesses job satisfaction, trust and respect in the workplace and,
155 unlike the other domains, it is collected only from the subset of respondents who report
156 being employed. Each domain is represented on a scale of 0 to 100. The composite well-
157 being score is an unweighted mean of all six domains. [17]
158
159 In order to describe the demographics of survey respondents and their counties of
160 residence, we used 2013 rural-urban continuum codes from AHRF as well as region of
161 the United States and annual household income of respondents from the Gallup-
162 Sharecare Well-Being Index. Data on county-level characteristics were obtained from the

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2014 RWJF CHRR, a well-established population health model. [21] In this model, county factors that influence the health of a county are organized into four categories: clinical care, social and economic factors, health behaviors, and physical environment. Each factor is represented by 1-4 county characteristics. (Figure 1) Data for four county characteristics - excessive drinking, inadequate social support, tobacco use and violent crime rates - were not comparable across states or missing for many counties. [21, 22] Tobacco use and excessive drinking were replaced with 2011 estimates of mean smoking prevalence and percent heavy drinkers, respectively, from the Institute for Health Metrics and Evaluation (IHME). [28-30] Heavy drinking was defined as the consumption, on average, of more than one drink per day for women or two drinks per day for men in the past 30 days. [29] Inadequate social support was replaced with the number of social associations from the 2015 RWJF CHRR. [31] We were unable to find an alternative data source for violent crime rates, so this variable was excluded. Finally, we included income inequality, measured as a Gini coefficient, in the list of characteristics, because this county characteristic was added to the CHRR in 2015, and because income disparities within a community may affect well-being.[31, 32] These data were also obtained from the 2015 RWJF CHRR. [31] The 29 characteristics used in our study were categorized into tertiles based on each characteristic's distribution across our sample of high-poverty counties.

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183 Statistical Analysis

184 We first examined the distribution of poverty rates and well-being across counties in the
185 United States. We determined that defining high-poverty counties as those where the
186 percent of persons in poverty was in the top 25% of all counties in the United States would
187 allow for adequate sample sizes of high and low well-being counties. These high-
188 poverty counties are characterized by at least 20.2 % of individuals living in poverty.
189 Among these high-poverty counties, we defined high-well-being counties as those with
190 a well-being score in the top 20% of all counties in the United States and low-well-being
191 counties as those with a well-being score in the bottom 20% of all counties in the
192 United States. We summarized well-being as well as respondent and county
193 characteristics for these two groups of counties. We also calculated Cohen's D
194 standardized differences for each of the six domain scores to determine which domains
195 differed the most between high- and low-well-being counties.
196
197 We then used a multi-step procedure to identify which of the 29 community
198 characteristics from the RWJF CHRR model of population health differed the most
199 between high and low well-being counties. Since we expected that many county
200 characteristics would be correlated within and across categories, we used an approach
201 similar to that previously utilized in other studies to reduce many related factors to a
202 smaller representative set. [33, 34] First, we estimated a series of bivariate logistic

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203 regression models, one for each characteristic in Figure 1. The outcome of each model
204 was whether the high-poverty county was classified as high versus low well-being. To
205 account for differing precision of the well-being estimates, each county-level
206 observation was weighted by the number of survey respondents. To account for
207 correlation of observations within each state, we used generalized estimating equations
208 models, and to account for missing values of independent variables, we used multiple
209 imputation. [35, 36] For each model, we calculated R^2 as the squared correlation
210 between predicted and observed values, as well as the C-statistic. [37] From the bivariate
211 results, we retained characteristics significantly associated with the county composite
212 well-being score ($p<0.05$) and those that explained a meaningful amount of variance in
213 the outcome ($R^2>0.05$). Among the characteristics retained, we assessed for multi-
214 collinearity within each category of characteristics using variance decomposition,
215 eliminating the characteristic with smallest variance decomposition component when
216 the singular value was greater than 20. [38] We estimated a model for each category of
217 characteristics including only those characteristics retained from the prior steps. In two
218 final models, we included all variables independently significant ($p<0.05$) in their
219 respective category models. The first of these models included only these variables; in
220 order to assess any impact of differential respondent income, the second included the
221 percent of respondents in each income category. For each logistic regression model, we
222 report the C-statistic and R^2 as defined above.

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223

Analyses were performed using Stata 15.1 (2018, StataCorp, College Station, TX). The Yale University Institutional Review Board approved this study.

226

Patient and Public Involvement

No patients or the public were involved in the planning and design of this study.

229

Results

Well-being data were available for 3,091 counties in the United States. Among these counties, 770 met our definition of being "high-poverty", with percent of persons in poverty in the top quartile of all counties in the United States.

234

Among all 3,091 counties, well-being scores ranged from 35.6 to 87.1 (mean 66.5, SD 4.2). When the sample was limited to high-poverty counties, well-being scores ranged from 46.2 to 81.3, with a mean score of 64.3 and standard deviation of 4.3. In comparison, the mean well-being score for all other counties in the United States was 67.2 and the standard deviation was 3.9. (Supplementary file, figure 1)

240

Among high-poverty counties, 72 had a composite well-being score in the top 20% of all counties in the United States and were classified as "high-well-being" and 311 had a composite well-being score in the bottom 20% of all counties in the United States and

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244 were classified as “low-well-being.” High-well-being counties had a mean well-being score of
245 71.8 with a SD of 2.3, while low-well-being counties had a mean well-being score of 60.2 with a
246 SD of 2.8. (Table 1) The majority of counties in both the high- and low-well-being groups
247 were urban and the distributions of urban and rural counties in these two groups were
248 not significantly different from each other. The majority of both high- and low-well-
249 being counties were located in the South, but typically in different regions within the
250 South, with the largest percentage of high-well-being counties located in the South
251 Atlantic region and the largest percentage of low-well-being counties located in the East
252 South Central region. (Table 1; Figure 2; Supplementary file, table 1) Finally, the incomes
253 of survey respondents were slightly higher in high-well-being counties compared to
254 those in low-well-being counties and a joint test of differences in all income groups was
255 significant ($p<0.001$). (Table 1)

256

257 When the six domains of well-being were compared between high- and low-well-being
258 counties, the largest standardized differences were for the basic access and life
259 evaluation domain scores. Compared with domain scores in low well-being counties,
260 basic access and life evaluation domain scores in high well-being counties were 2.56 and
261 2.51 standard deviations higher, respectively. (Table 2)

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263 In bivariate analyses, among the 29 community characteristics tested, 21 were
264 significantly associated with high versus low well-being ($p < 0.05$). (Supplementary file,
265 table 2) Among these 21 characteristics, 10 explained greater than 5% of the variation in
266 well-being. These characteristics were primary care physicians, mental health providers,
267 preventable hospital stays, some college, injury deaths, smoking, obesity, physical
268 inactivity, heavy drinking, and long commute. These 10 characteristics were retained and
269 used to estimate a model for each category. The health behaviors category model
270 explained the greatest amount of variance (R^2 : 0.24; C-statistic: 0.81) and the physical
271 environment model explained the least amount of variance (R^2 : 0.05; C-statistic: 0.66).
272 (Table 3) Eight characteristics were significant in their respective category models with a
273 p -value < 0.05 , and these eight characteristics were included in the final combined model.
274 (Table 4)

275

276 In the final combined model, six characteristics remained significantly associated
277 ($p < 0.05$) with high versus low well-being: lower rates of preventable hospital stays, higher
278 supply of primary care physicians, lower prevalence of smoking, lower physical inactivity,
279 higher percentage of heavy drinkers, and higher percentage of residents with some college
280 education. In the final model, the R^2 value was 0.30 and the C-statistic was 0.83. After
281 adjusting for respondent-level income, three factors remained significantly associated
282 with higher well-being: heavy drinking, smoking, and primary care physician density. In
283 this final adjusted model, the R^2 was 0.34 and the C-statistic was 0.84. (Table 4)

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284

285 **Discussion**

286 In this study of 770 high-poverty counties, approximately 9% achieved high well-being despite
287 economic disadvantage. These counties shared distinctive characteristics, including lower rates
288 of preventable hospital stays, higher supply of primary care physicians, lower prevalence of
289 smoking, lower physical inactivity, higher percentage of some college education, and
290 paradoxically a higher percentage of heavy drinkers.

291

292 Recently, our team identified twelve county characteristics explaining over two-thirds of the
293 variation in well-being across all counties in the United States.[39] As we found in this study,
294 characteristics in clinical care and social and economic categories were significantly associated
295 with higher well-being, suggesting that access to high-quality healthcare and affordable
296 education may be especially important to well-being, both in all counties and in this sample of
297 high-poverty counties.

298

299 Higher supply of primary care physicians and lower rates of preventable hospital stays were both
300 significantly associated with high versus low well-being. These findings are consistent with prior
301 research showing better health outcomes among populations served by primary care-based health
302 systems. [40, 41] For example, a 2005 study showed that a higher supply of primary care
303 providers at the county level was associated with lower total and heart disease mortality rates,
304 even after controlling for socioeconomic and demographic characteristics. [42] In addition, in
305 our recent study of all counties in the United States, we found a significant negative association

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306 between rates of preventable hospital stays and individual-level resident well-being. [39] Lower
307 preventable hospital stays may reflect greater access and quality of care in the outpatient setting,
308 better insurance coverage and stronger partnerships between a hospital and its surrounding
309 community; factors that may be especially important to the well-being of high-poverty
310 populations. [21, 43-47]

311
312 We were surprised to find that heavy drinking was associated with high versus low well-being,
313 given that excessive drinking has previously been linked with multiple adverse health outcomes.
314 [29, 48, 49] It is important to note, however, that excessive drinking is inconsistently defined in
315 the literature. In our study, heavy drinking was defined as greater than 1 drink per day for
316 women and greater than 2 drinks per day for men [30], but others have used higher thresholds.
317 [48, 49] It is possible that heavy drinking as defined amongst our sample served as a signal for
318 one or more unmeasured confounders. Additional exploration into this relationship would be
319 required to understand true targets for well-being improvement.

320
321 Lower rates of smoking and higher levels of some college education were significantly
322 associated with high versus low well-being. The percentage of some college education includes
323 the percentage of individuals with an associate's, bachelor's, graduate or professional degree, as
324 well as those who completed some post-secondary education but did not attain a degree. [22, 50]
325 Smoking and post-secondary education were highlighted in a 2016 analysis of the geographic
326 variation in life expectancy among low-income populations. Authors found that life expectancy
327 in low-income areas was negatively correlated with rates of smoking and positively correlated
328 with the fraction of college graduates. [51] There are many reasons why measures of smoking

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prevalence and post-secondary education may help to explain both variation in life expectancy and variation in well-being among high-poverty populations. Potential harms of smoking include not only adverse health consequences to smokers themselves, but also to those exposed to second-hand smoke, while potential benefits of post-secondary education include access to more employment opportunities, as well as better health outcomes among both educated individuals and their children. [52-56]

Finally, higher rates of physical activity were associated with high versus low well-being, consistent with prior work linking physical activity with mental and physical health. [57, 58] For example, in a recent report from the Appalachian Regional Commission, RWJF, and the Foundation for a Healthy Kentucky, both physical activity and smoking were shown to explain variation in health outcomes amongst Appalachian counties. [59] Our results suggest that efforts to encourage exercise, such as improving neighborhood walkability and allowing for greater access to parks and recreation facilities may be especially impactful in high-poverty counties. [7]

Measures of community safety, family and social support were not significant in our final model. This finding was unexpected, as prior work has suggested that community violence and lower social capital, including trust and cohesion between neighbors, mediate the relationship between poverty and poor health outcomes. [1] We used only one measure of community safety: “injury death rate,” because the other measure “violent crime rates,” was incomparable across counties, and we were unable to find an alternative data source. In addition, though we were able to utilize both “children in single-parent households” and “social associations” to represent family and social support, these measures may not adequately capture aspects of social capital that have the

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strongest influence on well-being. If other measures of social capital and community violence had been available at the county level, these characteristics may have helped to explain variation in well-being across high-poverty counties.

Although our sample was limited to counties in the highest quartile of poverty, the income of respondents varied, with respondents in high-well-being counties reporting higher incomes than respondents in low-well-being counties. (Table 1) Similarly, we found that the percent of children in poverty, a measure of county-level income, was significantly and negatively associated with well-being. (Supplementary file, table 2) Therefore, differences in income partly explained differences in well-being across these high-poverty counties. However, although the bivariate association between percent children in poverty and well-being was significant, this variable explained less than 5% of variance in well-being. (Supplementary file, table 2) We found that other county characteristics more fully explained differences in well-being among these high-poverty counties. Similarly, even after controlling for differences in individual income, three factors remained significantly associated with high versus low well-being: heavy drinking, smoking, and primary care physician density, confirming that individual income does not fully account for variation in well-being among high-poverty counties. The associations of physical inactivity, preventable hospital stays, and some college with well-being became insignificant, suggesting that income may be the underlying confounder in the relationships of these factors with well-being.

Among the six domains of well-being, we found that the “basic access” and “life evaluation” scores were most different between high- and low well-being counties, suggesting that efforts

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focused on these domains may be especially impactful in high-poverty counties. These domains may be related to the community characteristics we identified in this study. For example, perception of neighborhood safety, a component of the basic access domain, has previously been negatively associated with the prevalence of smoking. [60] Similarly, percentage of college graduates at the county level has been associated with average life satisfaction, a component of the life evaluation domain. [5] Future work should explore the relationships between these community characteristics and each of the well-being domains, as these analyses may provide additional insights into predictors of well-being in the setting of economic disadvantage.

This study has several limitations. First, as this was a cross-sectional study, we are unable to assess whether or not improving these characteristics would actually improve well-being in high-poverty counties. It is possible that other unmeasured factors explain the relationships we found between these community characteristics and well-being, and which represent the true targets for well-being improvement efforts. For example, the positive association between some college and well-being may reflect other characteristics of high-well-being counties such as access to affordable community colleges or state universities, parenting styles and cultural beliefs that promote higher education, or sufficient employment opportunities for individuals with post-secondary education. A mixed methods approach incorporating qualitative analyses may be useful in further exploring the relationships between the characteristics identified in our study and the well-being of high-poverty counties. Second, though the Gallup-Sharecare Well-Being Index is a national survey that uses stratified random sampling, design weights were not

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available at the county level; however, though this may limit inferences about the well-being of any individual county, it does not affect inferences about associations among counties. Finally, our study examined associations by county, due to lack of well-being data at the city or neighborhood level, and both poverty and well-being are likely to be heterogeneous at the county level. However, counties are important units for policy action and represent municipalities for which there are a number of key metrics available.

As poverty is negatively associated with many aspects of well-being, it is essential to reduce the burden of poverty affecting many counties in the United States.[1-8, 13, 14] Though poverty eradication remains an essential priority, our findings suggest that targeting certain county characteristics may mitigate the negative influence of poverty on well-being. Specifically, efforts to improve access to high-quality primary care and affordable post-secondary education, increase taxes on tobacco, reduce barriers to tobacco cessation treatment, and improve neighborhood walkability may be especially impactful among high-poverty populations, an idea worth testing. [7, 42, 47, 54, 55]

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Contributors

AA, ES, JH, CR, BR, ER, KK and HK contributed to the study concept and design, analysis and interpretation of the data, drafting and revising the manuscript. JH completed all statistical analyses.

Competing interests

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451 litigation; chairs a Cardiac Scientific Advisory Board for UnitedHealth; was a member of the
452 IBM Watson Health Life Sciences Board; is a member of the Advisory Board for Element
453 Science, the Advisory Board for Facebook, and the Physician Advisory Board for Aetna; and is
454 the co-founder of HugoHealth, a personal health information platform, and co-founder of
455 Refactor Health, an enterprise healthcare AI-augmented data management company.

456

457 **Patient consent for publication** Not required.

458

459 **Data sharing statement**

460 If the paper is accepted for publication, we will post a de-identified data set with county well-
461 being data from Gallup-Sharecare on ICSPR Open, a publicly available site. County

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characteristic data from the Robert Wood Johnson Foundation County Health Rankings and Roadmaps are available from www.countyhealthrankings.org.

References

1. Chen, E. and G.E. Miller, *Socioeconomic status and health: mediating and moderating factors*. Annu Rev Clin Psychol, 2013. **9**: p. 723-49.
2. Bikdeli, B., et al., *Place of residence and outcomes of patients with heart failure: analysis from the telemonitoring to improve heart failure outcomes trial*. Circ Cardiovasc Qual Outcomes, 2014. **7**(5): p. 749-56.
3. Sampson, R.J., *The neighborhood context of well-being*. Perspect Biol Med, 2003. **46**(3 Suppl): p. S53-64.
4. O'Campo, P., et al., *The Neighbourhood Effects on Health and Well-being (NEHW) study*. Health Place, 2015. **31**: p. 65-74.
5. Lawless, N.M. and R.E. Lucas, *Predictors of Regional Well-Being: A County Level Analysis*. Social Indicators Research, 2011. **101**(3): p. 341-357.
6. Ludwig, J., et al., *Neighborhood effects on the long-term well-being of low-income adults*. Science, 2012. **337**(6101): p. 1505-10.
7. Diez Roux, A.V. and C. Mair, *Neighborhoods and health*. Ann N Y Acad Sci, 2010. **1186**: p. 125-45.
8. Robinette, J.W., S.T. Charles, and T.L. Gruenewald, *Neighborhood Socioeconomic Status and Health: A Longitudinal Analysis*. J Community Health, 2017.
9. Levine, J.A., *Poverty and obesity in the U.S. Diabetes*, 2011. **60**(11): p. 2667-8.
10. Sundquist, K., et al., *Neighborhood socioeconomic environment and incidence of coronary heart disease: a follow-up study of 25,319 women and men in Sweden*. Am J Epidemiol, 2004. **159**(7): p. 655-62.

High-poverty Counties with High Well-Being

11. Arcaya, M.C., et al., *Research on neighborhood effects on health in the United States: A systematic review of study characteristics*. Social Science & Medicine, 2016. **168**: p. 16-29.
12. Haan, M., G.A. Kaplan, and T. Camacho, *Poverty and health. Prospective evidence from the Alameda County Study*. Am J Epidemiol, 1987. **125**(6): p. 989-98.
13. Egen, O., et al., *Health and Social Conditions of the Poorest Versus Wealthiest Counties in the United States*. Am J Public Health, 2017. **107**(1): p. 130-135.
14. Galea, S. and R. Vaughan, *A Public Health of Consequence: Review of the January 2017 Issue of AJPH*. Am J Public Health, 2017. **107**(1): p. 17-18.
15. McGinnis, J.M., *Income, Life Expectancy, and Community Health: Underscoring the Opportunity*. Jama, 2016. **315**(16): p. 1709-10.
16. *Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference*. 1946, New York: 19–22 June 1946, and entered into force on 7 April 1948.
17. Gallup-Healthways, *Gallup-Healthways Well-Being Index: Methodology Report for Indexes*. 2009: Available at <http://www.gallup.com/poll/195539/gallup-healthways-index-methodology-report-indexes.aspx>.
18. Kobau, R., et al., *Mental, social, and physical well-being in New Hampshire, Oregon, and Washington, 2010 Behavioral Risk Factor Surveillance System: implications for public health research and practice related to Healthy People 2020 foundation health measures on well-being*. Population Health Metrics, 2013. **11**: p. 19-19.
19. Arora, A., et al., *Population Well-Being Measures Help Explain Geographic Disparities in Life Expectancy At The County Level*. Health Aff (Millwood), 2016. **35**(11): p. 2075-2082.
20. Chen, E. and G.E. Miller, *"Shift-and-Persist" Strategies: Why Low Socioeconomic Status Isn't Always Bad for Health*. Perspect Psychol Sci, 2012. **7**(2): p. 135-58.
21. Institute, U.o.W.P.H. *County Health Rankings 2014*. Available from: www.countyhealthrankings.org.
22. Remington, P.L., B.B. Catlin, and K.P. Gennuso, *The County Health Rankings: rationale and methods*. Population Health Metrics, 2015. **13**(1): p. 1-12.
23. *Area Health Resources Files 2013-2014*. U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Workforce: Rockville, MD.
24. Sears, L.E., et al., *Overall well-being as a predictor of health care, productivity, and retention outcomes in a large employer*. Popul Health Manag, 2013. **16**(6): p. 397-405.
25. Gandy, W.M., et al., *Well-being and employee health-how employees' well-being scores interact with demographic factors to influence risk of hospitalization or an emergency room visit*. Popul Health Manag, 2014. **17**(1): p. 13-20.
26. Herrin, J., et al., *Population well-being and electoral shifts*. PLoS One, 2018. **13**(3): p. e0193401.
27. Riley, C., et al., *Association of the overall well-being of a population with health care spending for people 65 years of age or older*. JAMA Network Open, 2018. **1**(5): p. e182136.
28. (IHME), I.o.H.M.a.E., *United States Smoking Prevalence by County 1996-2012*. 2014, Institute for Health Metrics and Evaluation (IHME): Seattle, United States.
29. Dwyer-Lindgren, L., et al., *Drinking Patterns in US Counties From 2002 to 2012*. American journal of public health, 2015. **105**(6): p. 1120-1127.

High-poverty Counties with High Well-Being

30. Institute for Health Metrics and Evaluation (IHME). *United States Alcohol Use Prevalence by County 2002-2012*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2015.

31. Institute, U.o.W.P.H. *County Health Rankings 2015*. Available from: www.countyhealthrankings.org.

32. Institute, U.o.W.P.H., *2015 County Health Rankings Key Findings Report*. 2015.

33. Bradley, E.H., et al., *Hospital strategies for reducing risk-standardized mortality rates in acute myocardial infarction*. *Ann Intern Med*, 2012. **156**(9): p. 618-26.

34. Herrin, J., et al., *Community factors and hospital readmission rates*. *Health Serv Res*, 2015. **50**(1): p. 20-39.

35. Hardin, J. and J. Hilbe, *Generalized Estimating Equations*. 2003, London: Chapman and Hall.

36. Little, R. and D. Rubin, *Statistical analysis with missing data*. 2nd ed. 2002, New York: Wiley.

37. Efron, B., *Regression and ANOVA with Zero-One Data: Measures of Residual Variation*. *Journal of the American Statistical Association*, 1978. **73**(361): p. 113-121.

38. Belsley DA, K.E., Welsch RE, *Regression diagnostics*. 1980, New York, New York: J. Wiley & Sons.

39. Roy, B., et al., *Identifying county characteristics associated with resident well-being: A population based study*. *PLoS One*, 2018. **13**(5): p. e0196720.

40. Phillips, R.L., Jr. and B. Starfield, *Why does a U.S. primary care physician workforce crisis matter?* *Am Fam Physician*, 2004. **70**(3): p. 440, 442, 445-6.

41. Goodman, D.C. and K. Grumbach, *Does having more physicians lead to better health system performance?* *Jama*, 2008. **299**(3): p. 335-7.

42. Starfield, B., et al., *The effects of specialist supply on populations' health: assessing the evidence*. *Health Aff (Millwood)*, 2005. **Suppl Web Exclusives**: p. W5-97-w5-107.

43. Billings, J., et al., *Impact of socioeconomic status on hospital use in New York City*. *Health Aff (Millwood)*, 1993. **12**(1): p. 162-73.

44. Erickson, D. and N. Andrews, *Partnerships among community development, public health, and health care could improve the well-being of low-income people*. *Health Aff (Millwood)*, 2011. **30**(11): p. 2056-63.

45. Antonisse L, G.R., Rudowitz R, Artiga S *The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review*. 2017.

46. Pappas, G., et al., *Potentially avoidable hospitalizations: inequalities in rates between US socioeconomic groups*. *American Journal of Public Health*, 1997. **87**(5): p. 811-816.

47. Parchman, M.L. and S.D. Culler, *Preventable hospitalizations in primary care shortage areas. An analysis of vulnerable Medicare beneficiaries*. *Arch Fam Med*, 1999. **8**(6): p. 487-91.

48. Rehm, J., et al., *The relation between different dimensions of alcohol consumption and burden of disease: an overview*. *Addiction (Abingdon, England)*, 2010. **105**(5): p. 817-843.

49. Rehm, J., et al., *The relationship between different dimensions of alcohol use and the burden of disease-an update*. *Addiction (Abingdon, England)*, 2017. **112**(6): p. 968-1001.

50. *County Health Rankings & Roadmaps*. [cited 2017 February 25]; Available from: <http://www.countyhealthrankings.org/our-approach>.

51. Chetty, R., et al., *The Association Between Income and Life Expectancy in the United States, 2001-2014*. *Jama*, 2016.

High-poverty Counties with High Well-Being

52. Olshansky, S.J., et al., *Differences in life expectancy due to race and educational differences are widening, and many may not catch up*. Health Aff (Millwood), 2012. **31**(8): p. 1803-13.
53. Egerter S, B.P., Sadegh-Nobari T, Grossman-Kahn R, Dekker M. Education Matters for Health. Princeton, NJ: RWJF Commission to Build a Healthier America; 2009. Issue Brief 6.
54. Hout, M., *Social and Economic Returns to College Education in the United States*. Annual Review of Sociology, 2012. **38**(1): p. 379-400.
55. Ekpu, V.U. and A.K. Brown, *The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence*. Tobacco Use Insights, 2015. **8**: p. 1-35.
56. U.S. Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General. Atlanta, G.U.S.D.
57. Harris, M.A., *The relationship between physical inactivity and mental wellbeing: Findings from a gamification-based community-wide physical activity intervention*. Health psychology open, 2018. **5**(1): p. 2055102917753853-2055102917753853.
58. Penedo, F.J. and J.R. Dahn, *Exercise and well-being: a review of mental and physical health benefits associated with physical activity*. Curr Opin Psychiatry, 2005. **18**(2): p. 189-93.
59. G. Mark Holmes, N.M.L., William Holding, Randy Randolph, Jonathan Rodgers, Pam Silberman, Lisa Villamil, Thomas A. Arcury, Kelly Ivey, Daniel Goolsby, Ashli Keyser, and J&J Editorial, *Identifying Bright Spots in Appalachian Health: Statistical Analysis*. 2018, Appalachian Regional Commission; PDA, Inc.; Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill.
60. Mayne, S.L., et al., *Cross-sectional and longitudinal associations of neighbourhood social environment and smoking behaviour: the multiethnic study of atherosclerosis*. J Epidemiol Community Health, 2017. **71**(4): p. 396-403.

Tables and figures:

Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF County Health Rankings and Roadmaps (CHRR). All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinkers (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)

Figure 2. Map of high poverty counties with high and low well-being. Source: Gallup-Sharecare Well-Being Index

Table 1. Geography and demographics of all high poverty counties, and of high-poverty counties with high and low well-being

Variable	Value	All high poverty counties	Low well-being counties	High well-being counties	P-value
N		770 (100)	311 (100)	72 (100)	

High-poverty Counties with High Well-Being

Urban/rural status N (%)	Urban Rural	595 (77.3) 175 (22.7)	215 (69.1) 96 (30.9)	44 (61.1) 28 (38.9)	0.190
Region of the United States N (%)	New England Mid Atlantic East North Central West North Central South Atlantic East South Central West South Central Mountain Pacific	1 (0.1) 5 (0.6) 36 (4.7) 49 (6.4) 216 (28.1) 201 (26.1) 183 (23.8) 50 (6.5) 29 (3.8)	0 (0.0) 0 (0.0) 11 (3.5) 22 (7.1) 86 (27.7) 110 (35.4) 65 (20.9) 13 (4.2) 4 (1.3)	0 (0.0) 0 (0.0) 3 (4.2) 13 (18.1) 23 (31.9) 7 (9.7) 14 (19.4) 9 (12.5) 3 (4.2)	<0.001
Income of respondents Mean (SD)	% >120 k % 60k-120k % 36k-60k % 12k-36k % <12k % Unknown	5.8 (3.6) 14.7 (5.7) 18.6 (6.1) 29.6 (7.3) 12.6 (6.0) 18.7 (6.8)	4.9 (3.4) 12.7 (5.1) 18.4 (6.4) 31.6 (7.2) 14.1 (6.0) 18.2 (6.1)	6.3 (5.3) 18.2 (7.8) 19.6 (8.0) 25.7 (8.7) 9.7 (6.0) 20.5 (13.0)	0.005 <0.001 0.185 <0.001 <0.001 0.031
Well-being score Mean (SD)		64.3 (4.3)	60.2 (2.8)	71.8 (2.3)	<0.001

Table 2. Standardized differences in domain scores when comparing high and low well-being counties among all high-poverty counties (all significant at p<0.001)

Domain	Standardized difference (95% confidence interval)
Basic Access	2.56 (2.25, 2.87)
Life evaluation	2.51 (2.20, 2.82)
Physical Health	2.46 (2.15, 2.77)

High-poverty Counties with High Well-Being

Emotional Health	1.71 (1.43, 1.99)
Healthy Behaviors	1.51 (1.23, 1.78)
Work Environment	1.25 (0.97, 1.52)

Table 3. Category-specific models: Odds ratios describe odds of a county having high versus low well-being

Health Behaviors				
R2: 0.243	C: 0.812	N: 383		

High-poverty Counties with High Well-Being

Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Percent smoking	Tertile 1 Tertile 2 Tertile 3	Ref 0.03 0.02	 (0.01, 0.10) (0.01, 0.06)	<0.001
Adult obesity	Tertile 1 Tertile 2 Tertile 3	Ref 0.71 0.31	 (0.35, 1.43) (0.08, 1.21)	0.241
Percent heavy drinkers	Tertile 1 Tertile 2 Tertile 3	Ref 7.23 10.54	 (2.20, 23.83) (3.36, 33.06)	<0.001
Physical inactivity	Tertile 1 Tertile 2 Tertile 3	Ref 0.26 0.65	 (0.12, 0.56) (0.16, 2.69)	0.002
Clinical Care				
R2: 0.177	C: 0.775	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Primary care physicians	Tertile 1 Tertile 2 Tertile 3	Ref 1.12 4.58	 (0.28, 4.44) (1.79, 11.77)	<0.001
Mental health providers	Tertile 1 Tertile 2 Tertile 3	Ref 1.93 3.97	 (0.61, 6.07) (1.14, 13.80)	0.096
Preventable hosp. stays	Tertile 1 Tertile 2 Tertile 3	Ref 0.18 0.03	 (0.06, 0.56) (0.01, 0.13)	<0.001
Social and Economic Factors				
R2: 0.163	C: 0.765	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Some College	Tertile 1 Tertile 2 Tertile 3	Ref 1.36 16.55	 (0.41, 4.50) (5.16, 53.05)	<0.001
Injury deaths	Tertile 1 Tertile 2 Tertile 3	Ref 0.24 0.06	 (0.05, 1.11) (0.02, 0.13)	<0.001
Physical Environment				

High-poverty Counties with High Well-Being

R²: 0.050	C: 0.663	N: 383		
Variable		Odds Ratio	95% Confidence Interval	Wald P-value
Long commute-driving alone	Tertile 1 Tertile 2 Tertile 3	Ref 0.34 0.06	 (0.07, 1.56) (0.02, 0.14)	<0.001

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High-poverty Counties with High Well-Being

Table 4. Final multivariable models, unadjusted and adjusted for income of respondents. Odds ratios describe odds of a county having high versus low well-being.

		Final multivariable model, unadjusted			Final multivariable model adjusted for income of respondents		
		R ² : 0.300, C-statistic: 0.829			R ² : 0.341, C-statistic: 0.843		
Variable		Odds Ratio	95% C.I.	Wald P value	Odds Ratio	95% C.I.	Wald P Value
Percent Smoking	Tertile 1	Ref		<0.001	Ref		<0.001
	Tertile 2 vs 1	0.04	(0.01, 0.12)		0.07	(0.03, 0.17)	
	Tertile 3 vs 1	0.05	(0.01, 0.19)		0.06	(0.01, 0.31)	
	Tertile 3 vs 2	1.12	(0.20, 6.44)		0.91	(0.17, 4.75)	
Percent heavy drinkers	Tertile 1	Ref		<0.001	Ref		<0.001
	Tertile 2 vs 1	6.33	(2.66, 15.06)		5.58	(2.44, 12.80)	
	Tertile 3 vs 1	6.39	(2.01, 20.36)		4.74	(1.67, 13.50)	
	Tertile 3 vs 2	1.01	(0.46, 2.20)		0.85	(0.36, 1.99)	
Physical Inactivity	Tertile 1	Ref		0.042	Ref		0.120
	Tertile 2 vs 1	0.28	(0.10, 0.80)		0.41	(0.14, 1.22)	
	Tertile 3 vs 1	0.88	(0.28, 2.75)		1.08	(0.35, 3.36)	
	Tertile 3 vs 2	3.14	(0.96, 10.23)		2.64	(0.95, 7.35)	
Primary Care Physicians	Tertile 1	Ref		<0.001	Ref		0.021
	Tertile 2 vs 1	0.53	(0.11, 2.53)		0.51	(0.12, 2.19)	
	Tertile 3 vs 1	3.11	(1.53, 6.32)		2.05	(1.05, 4.00)	
	Tertile 3 vs 2	5.83	(1.49, 22.87)		4.06	(1.03, 16.05)	
Preventable hospital stays	Tertile 1	Ref		0.046	Ref		0.282
	Tertile 2 vs 1	0.35	(0.10, 1.15)		0.52	(0.15, 1.81)	
	Tertile 3 vs 1	0.30	(0.10, 0.90)		0.42	(0.14, 1.32)	
	Tertile 3 vs 2	0.86	(0.21, 3.56)		0.81	(0.20, 3.23)	
Some college	Tertile 1	Ref		0.007	Ref		0.157
	Tertile 2 vs 1	0.94	(0.12, 7.05)		0.63	(0.09, 4.51)	
	Tertile 3 vs 1	2.72	(0.40, 18.42)		1.61	(0.24, 10.89)	
	Tertile 3 vs 2	2.91	(1.45, 5.82)		2.54	(0.98, 6.59)	
Injury deaths	Tertile 1	Ref		0.067	Ref		0.164
	Tertile 2 vs 1	0.44	(0.16, 1.22)		0.64	(0.24, 1.69)	
	Tertile 3 vs 1	0.31	(0.11, 0.86)		0.44	(0.18, 1.06)	
	Tertile 3 vs 2	0.69	(0.24, 2.00)		0.68	(0.22, 2.13)	
Long commute	Tertile 1	Ref		0.433	Ref		0.773
	Tertile 2 vs 1	1.34	(0.56, 3.20)		0.93	(0.33, 2.58)	
	Tertile 3 vs 1	2.35	(0.64, 8.56)		1.53	(0.36, 6.43)	
	Tertile 3 vs 2	1.75	(0.59, 5.17)		1.65	(0.42, 6.53)	

Categories

County Health Factors

County Characteristics

Health Behaviors

Tobacco Use

Diet & Exercise

Alcohol & Drug Use

Sexual Activity

Clinical Care

Access to Care

Quality of Care

Social and
Economic Factors

Education

Employment

Income

Family & Social
Support

Community Safety

Physical
Environment

Air & Water Quality

Housing & Transit

- Percent Smoking
- Adult Obesity
- Food environment Index
- Physical Inactivity
- Access to Exercise Opportunities
- Alcohol impaired driving deaths
- Heavy drinking
- Sexually transmitted infections
- Teen births

- Uninsured
- Primary care physicians
- Dentists
- Mental health providers
- Preventable hospital stays
- Diabetic screening
- Mammography screening

- High school graduation
- Some college
- Unemployment
- Children in poverty
- Income inequality
- Children in single-parent households
- Social associations
- Injury deaths

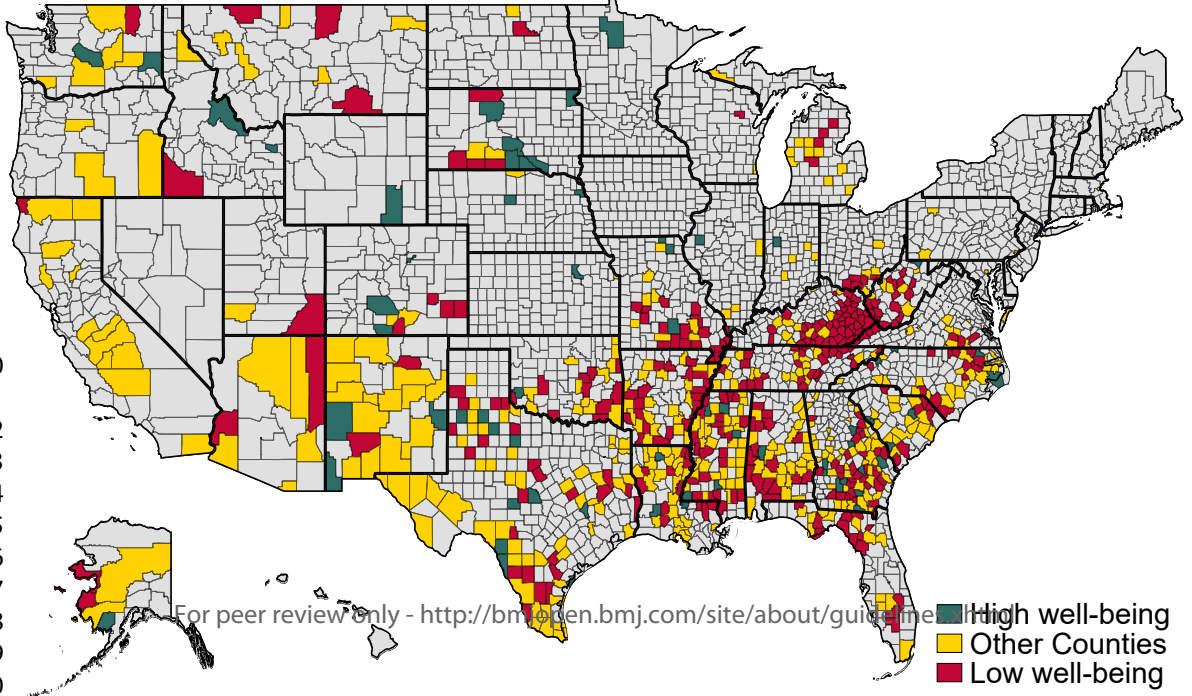
- Air pollution – particulate matter
- Drinking water violations
- Severe housing problems
- Driving alone to work
- Long commute

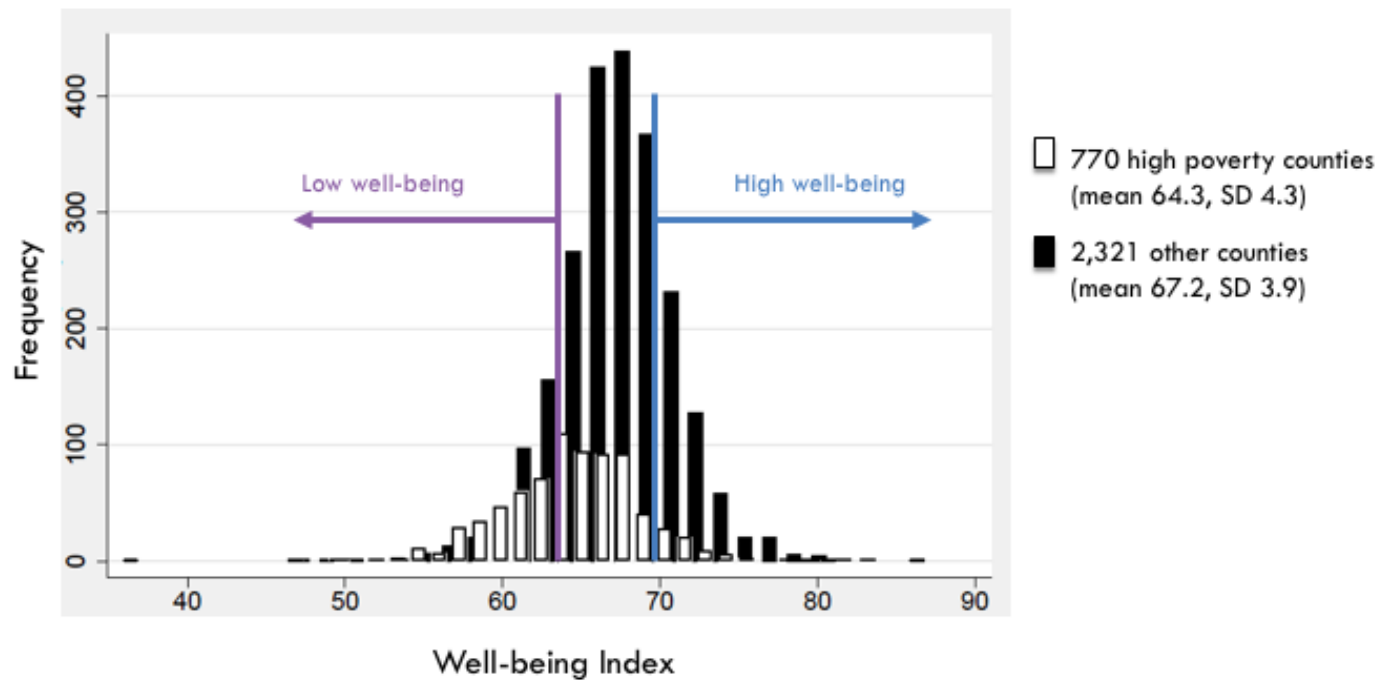
Figure 1. County Characteristics, organized into categories, adapted from the 2014 RWJF CHRR. All measures obtained from 2014 RWJF CHRR except for percent smoking and percent heavy drinking (from the Institute for Health Metrics and Evaluation) and income inequality and social associations (from 2015 RWJF CHRR)

High poverty counties

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Supplementary Figure 1. Distribution of well-being among high poverty counties and all other counties in the United States

Supplementary Table 1. High poverty counties with high well-being

	County or County Equivalent	State
1	Hale	Alabama
2	Dillingham	Alaska
3	Conejos	Colorado
4	Denver	Colorado
5	Saguache	Colorado
6	Atkinson	Georgia
7	Baldwin	Georgia

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8	Bulloch	Georgia
9	Echols	Georgia
10	Greene	Georgia
11	Marion	Georgia
12	Turner	Georgia
13	Webster	Georgia
14	Wheeler	Georgia
15	Worth	Georgia
16	Lemhi	Idaho
17	Madison	Idaho
18	McDonough	Illinois
19	Pulaski	Illinois
20	Tippecanoe	Indiana
21	Riley	Kansas
22	Allen	Louisiana
23	Lincoln	Louisiana
24	West Feliciana	Louisiana
25	Beltrami	Minnesota
26	Jefferson Davis	Mississippi
27	Lafayette	Mississippi
28	Oktibbeha	Mississippi
29	Quitman	Mississippi
30	Wilkinson	Mississippi
31	Knox	Missouri
32	Schuyler	Missouri
33	Texas	Missouri
34	Blaine	Nebraska
35	Thurston	Nebraska
36	Catron	New Mexico
37	Hidalgo	New Mexico
38	Roosevelt	New Mexico
39	Alleghany	North Carolina
40	Avery	North Carolina
41	Hertford	North Carolina
42	Hyde	North Carolina

43	Greer	Oklahoma
44	Allendale	South Carolina
45	Lee	South Carolina
46	McCormick	South Carolina
47	Charles Mix	South Dakota
48	Dewey	South Dakota
49	Gregory	South Dakota
50	Lyman	South Dakota
51	Roberts	South Dakota
52	Tripp	South Dakota
53	Lake	Tennessee
54	Aransas	Texas
55	Brazos	Texas
56	Dickens	Texas
57	Floyd	Texas
58	Haskell	Texas
59	Kinney	Texas
60	Lamb	Texas
61	Maverick	Texas
62	Menard	Texas
63	San Saba	Texas
64	Charlottesville City	Virginia
65	Harrisonburg City	Virginia
66	Lexington City	Virginia
67	Lynchburg City	Virginia
68	Radford City	Virginia
69	Kittitas	Washington
70	Whitman	Washington
71	Monongalia	West Virginia
72	Albany	Wyoming

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Supplementary Table 2: Bivariate Associations of 29 Community Factors

Category: Health Behaviors	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P- value	R2	C-stat
	GHD: % Smoking				n (%)	<0.001	0.2229	0.792
		T1 [12.68-25.67]	256 (33.2)	42 (13.5)	46 (63.9)			
		T2 [25.68-28.46]	257 (33.4)	106 (34.1)	17 (23.6)			
		T3 [28.47-39.50]	255 (33.1)	163 (52.4)	9 (12.5)			
		Missing	2 (0.3)	0 (0.0)	0 (0.0)			
	GHD: % Heavy drinkers							
						<0.001	0.0684	0.679
		T1 [2.40-5.90]	258 (33.5)	142 (45.7)	13 (18.1)			
		T2 [6.00-7.50]	269 (34.9)	103 (33.1)	25 (34.7)			
		T3 [7.60-21.40]	241 (31.3)	66 (21.2)	34 (47.2)			
		Missing	2(0.3)	0 (0.0)	0 (0.0)			
	RWJ: Adult obesity					<0.001	0.0664	0.678
		T1 [0.18-0.32]	265 (34.4)	82 (26.4)	40 (55.6)			
		T2 [0.32-0.35]	255 (33.1)	106 (34.1)	21 (29.2)			
		T3 [0.35-0.48]	250 (32.5)	123 (39.5)	11 (15.3)			
	RWJ: Food environment index					0.116	0.0059	0.553
		T1 [0.00-6.06]	257 (33.4)	102 (32.8)	27 (37.5)			
		T2 [6.06-7.04]	257 (33.4)	87 (28.0)	24 (33.3)			
		T3 [7.04-8.77]	256 (33.2)	122 (39.2)	21 (29.2)			
	RWJ: Physical inactivity					<0.001	0.1036	0.711
		T1 [0.14-0.29]	257 (33.4)	61 (19.6)	40 (55.6)			
		T2 [0.29-0.33]	262 (34.0)	113 (36.3)	20 (27.8)			
		T3 [0.34-0.44]	251 (32.6)	137 (44.1)	12 (16.7)			
	RWJ: Access to exercise opportunities					<0.001	0.0126	0.558
		T1 [0.00-0.29]	255 (33.1)	121 (38.9)	25 (34.7)			
		T2 [0.29-0.52]	254 (33.0)	111 (35.7)	18 (25.0)			
		T3 [0.53-1.00]	254 (33.0)	78 (25.1)	27 (37.5)			
		Missing	7 (0.9)	1 (0.3)	2 (2.8)			

	RWJ: Alcohol-impaired driving deaths					0.475	0.0069	0.552
		T1 [0.00-0.25]	267 (34.7)	113 (36.3)	30 (41.7)			
		T2 [0.25-0.36]	246 (31.9)	92 (29.6)	13 (18.1)			
		T3 [0.36-1.00]	255 (33.1)	106 (34.1)	28 (38.9)			
		Missing	2 (0.3)	0 (0.0)	1 (1.4)			
	RWJ: Sexually transmitted infections					0.006	0.0103	0.564
		T1 [43.00-323.60]	252 (32.7)	136 (43.7)	20 (27.8)			
		T2 [324.40-619.00]	252 (32.7)	96 (30.9)	27 (37.5)			
		T3 [619.70-2701.60]	252 (32.7)	74 (23.8)	20 (27.8)			
		Missing	14 (1.8)	5 (1.6)	5 (6.9)			
	RWJ: Teen births					<0.001	0.0347	0.627
		T1 [4.62-54.95]	256 (33.2)	88 (28.3)	37 (51.4)			
		T2 [55.01-69.16]	255 (33.1)	101 (32.5)	14 (19.4)			
		T3 [69.20-130.43]	255 (33.1)	122 (39.2)	20 (27.8)			
		Missing	4 (0.5)	0 (0.0)	1 (1.4)			
Category: Clinical Care	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: Uninsured					0.888	0.0063	0.465
		T1 [0.06-0.19]	257 (33.4)	114 (36.7)	25 (34.7)			
		T2 [0.19-0.23]	257 (33.4)	105 (33.8)	15 (20.8)			
		T3 [0.23-0.39]	256 (33.2)	92 (29.6)	32 (44.4)			
	RWJ: Primary care physicians					<0.001	0.0576	0.667
		T1 [0.00-33.53]	244 (31.7)	131 (42.1)	16 (22.2)			
		T2 [33.56-52.14]	244 (31.7)	99 (31.8)	14 (19.4)			
		T3 [52.44-268.90]	243 (31.6)	65 (20.9)	32 (44.4)			
		Missing	39 (5.1)	16 (5.1)	10 (13.9)			
	RWJ: Dentists					<0.001	0.0153	0.564
		T1 [0.00-20.83]	246 (31.9)	120 (38.6)	24 (33.3)			
		T2 [20.83-34.53]	245 (31.8)	109 (35.0)	21 (29.2)			
		T3 [34.53-166.08]	245 (31.8)	61 (19.6)	24 (33.3)			
		Missing	34 (4.4)	21 (6.8)	3 (4.2)			
	RWJ: Mental health providers					<0.001	0.0612	0.666

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		T1 [0.00-26.55]	219 (28.4)	103 (33.1)	12 (16.7)			
		T2 [26.56-76.03]	219 (28.4)	97 (31.2)	11 (15.3)			
		T3 [76.77-1387.78]	218 (28.3)	57 (18.3)	28 (38.9)			
		Missing	114 (14.8)	54 (17.4)	21 (29.2)			
	RWJ: Preventable hospital stays					<0.001	0.1191	0.734
		T1 [27.44-75.59]	246 (31.9)	50 (16.1)	34 (47.2)			
		T2 [75.66-101.23]	245 (31.8)	98 (31.5)	20 (27.8)			
		T3 [101.45-280.58]	245 (31.8)	149 (47.9)	10 (13.9)			
		Missing	34 (4.4)	14 (4.5)	8 (11.1)			
	RWJ: Diabetic screening					0.384	0.0075	0.521
		T1 [0.18-0.81]	256 (33.2)	114 (36.7)	24 (33.3)			
		T2 [0.81-0.85]	256 (33.2)	101 (32.5)	15 (20.8)			
		T3 [0.85-0.94]	254 (33.0)	95 (30.5)	31 (43.1)			
		Missing	4 (0.5)	1 (0.3)	2 (2.8)			
	RWJ: Mammography screening					<0.001	0.0493	0.624
		T1 [0.26-0.53]	252 (32.7)	134 (43.1)	22 (30.6)			
		T2 [0.53-0.60]	251 (32.6)	96 (30.9)	12 (16.7)			
		T3 [0.60-0.80]	251 (32.6)	75 (24.1)	35 (48.6)			
		Missing	16 (2.1)	6 (1.9)	3 (4.2)			
Category: Social and Economic Factors	Factor	Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: High school graduation					0.315	0.0011	0.507
		T1 [0.29-0.73]	232 (30.1)	86 (27.7)	17 (23.6)			
		T2 [0.73-0.82]	239 (31.0)	105 (33.8)	15 (20.8)			
		T3 [0.83-1.00]	224 (29.1)	94 (30.2)	16 (22.2)			
		Missing	75 (9.7)	26 (8.4)	24 (33.3)			
	RWJ: Some college					<0.001	0.1156	0.704
		T1 [0.19-0.41]	257 (33.4)	142 (45.7)	15 (20.8)			
		T2 [0.41-0.49]	257 (33.4)	116 (37.3)	18 (25.0)			
		T3 [0.49-0.88]	256 (33.2)	53 (17.0)	39 (54.2)			
	RWJ: Unemployment					<0.001	0.0494	0.656
		T1 [0.03-0.08]	257 (33.4)	83 (26.7)	38 (52.8)			
		T2 [0.08-0.11]	257 (33.4)	101 (32.5)	20 (27.8)			

		T3 [0.11-0.28]	256 (33.2)	127 (40.8)	14 (19.4)			
	RWJ: Children in poverty					<0.001	0.0327	0.612
		T1 [0.12-0.32]	258 (33.5)	74 (23.8)	32 (44.4)			
		T2 [0.32-0.38]	259 (33.6)	109 (35.0)	20 (27.8)			
		T3 [0.38-0.60]	253 (32.9)	128 (41.2)	20 (27.8)			
	RWJ: Children in single-parent households					0.040	0.0007	0.518
		T1 [0.11-0.35]	257 (33.4)	114 (36.7)	29 (40.3)			
		T2 [0.35-0.44]	257 (33.4)	97 (31.2)	23 (31.9)			
		T3 [0.44-0.79]	256 (33.2)	100 (32.2)	20 (27.8)			
	RWJ: Social associations					0.316	0.0004	0.529
		Q1 [0.00-9.64]	257 (33.4)	120 (38.6)	20 (27.8)			
		Q2 [9.66-13.14]	257 (33.4)	102 (32.8)	22 (30.6)			
		Q3 [13.15-33.50]	256 (33.2)	89 (28.6)	30 (41.7)			
	RWJ: Injury deaths					<0.001	0.0754	0.683
		T1 [28.00-75.10]	245 (31.8)	60 (19.3)	32 (44.4)			
		T2 [75.30-96.30]	246 (31.9)	97 (31.2)	15 (20.8)			
		T3 [96.50-251.90]	244 (31.7)	143 (46.0)	14 (19.4)			
		Missing	35 (4.5)	11 (3.5)	11 (15.3)			
	RWJ: GINI coefficient					0.128	0.0035	0.513
		T1 [37.80-44.90]	261 (33.9)	105 (33.8)	19 (26.4)			
		T2 [45.00-47.10]	257 (33.4)	106 (34.1)	22 (30.6)			
		T3 [47.20-58.60]	252 (32.7)	100 (32.2)	31 (43.1)			
Category: Physical Environment		Value	All Low SES n (%)	Low WBI n (%)	High WBI N (%)	P-value	R2	C-stat
	RWJ: Air pollution - particulate matter					0.004	0.0031	0.567
		T1 [7.21-11.37]	255 (33.1)	76 (24.4)	30 (41.7)			
		T2 [11.38-12.72]	260 (33.8)	107 (34.4)	23 (31.9)			
		T3 [12.73-14.50]	250 (32.5)	126 (40.5)	18 (25.0)			
		Missing	5 (0.6)	2 (0.6)	1 (1.4)			
	RWJ: Drinking water violations					0.076	0.0045	0.553
		T1 [0.00-0.00]	311 (40.4)	142 (45.7)	30 (41.7)			
		T2 [0.00-0.09]	190 (24.7)	60 (19.3)	18 (25.0)			
		T3 [0.09-1.00]	250 (32.5)	105 (33.8)	19 (26.4)			

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		Missing	19 (2.5)	4 (1.3)	5 (6.9)			
	RWJ: Severe housing problems					<0.001	0.0392	0.608
		T1 [0.05-0.14]	257 (33.4)	134 (43.1)	23 (31.9)			
		T2 [0.14-0.17]	257 (33.4)	106 (34.1)	16 (22.2)			
		T3 [0.17-0.69]	256 (33.2)	71 (22.8)	33 (45.8)			
	RWJ: Driving alone to work					<0.001	0.0477	0.647
		T1 [0.04-0.78]	257 (33.4)	96 (30.9)	41 (56.9)			
		T2 [0.78-0.82]	257 (33.4)	94 (30.2)	17 (23.6)			
		T3 [0.82-0.91]	256 (33.2)	121 (38.9)	14 (19.4)			
	RWJ: Long commute - driving alone					<0.001	0.0589	0.663
		T1 [0.00-0.24]	259 (33.6)	74 (23.8)	38 (52.8)			
		T2 [0.24-0.35]	256 (33.2)	109 (35.0)	19 (26.4)			
		T3 [0.35-0.66]	255 (33.1)	128 (41.2)	15 (20.8)			

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	7-8
		(d) If applicable, describe analytical methods taking account of sampling strategy	9
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10

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(b) Indicate number of participants with missing data for each variable of interest			Supplementary table 1
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(b) Report category boundaries when continuous variables were categorized	10
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.