Author's response to reviews

Title: A Cross-Sectional Study on Health Differences Between Rural and Non-Rural Counties Using the County Health Rankings

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A Cross-Sectional Study on Health Differences Between Rural and Non-Rural Counties

Using the County Health Rankings

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Abstract

Background: By examining 2013 County Health Rankings and Roadmaps data from the University of Wisconsin and the Robert Wood Johnson Foundation, this paper seeks to add to the available literature on health variances between Americans living in rural and non-rural areas. We believe this is the first study to use the Rankings data to measure rural and urban health differences across the United States and therefore highlights the national need to address shortfalls in rural healthcare. The data indicates that Americans living in rural counties are generally in poorer health than their urban counterparts.

Methods: A cross-sectional study employing chi-square analysis and logit regression.

Results: We find that residents living in rural US counties are more likely to have poorer health outcomes along a variety of measurements that comprise the County Health Rankings’ indexed domains of health quality. These populations have statistically significant (p ≤ 0.05) lower scores in such areas as health behavior, morbidity factors, clinical care, and the physical environment. We attribute the differences to a variety of factors including limitations in infrastructure, socioeconomic differences, insurance coverage deficiencies and higher rates of traffic fatalities and accidents.

Conclusions: Our analysis revealed differences in health outcomes and the County Health Rankings’ indexed domains between rural and non-rural counties. We also describe limitations and offer commentary on the need for more uniform measurements in the classification of the terms rural and non-rural. Practitioners and policy makers must consider these disparities in their work.
Background

There is a disparity in health, access to and the quality of healthcare between rural and urban areas in the United States. Despite the various methods of classifying what constitutes a location as rural or urban [1], studies continue to find that health disparities between rural populations and their urban peers are real [2]. The literature indicates that variances exist in numerous measures and indicators of health. Physical health differences are seen as rural populations are more likely to have type 2 diabetes mellitus [3], rural children over the age of five are more likely to be obese or overweight [4], and overall self-ratings of individual health decrease in rural areas [5]. Moreover, dental problems such as tooth loss increase along the urban-rural gradient [6], owing in part to a lack of dentists and dental visits [7]. Centers for Disease Control and Prevention (CDC) data finds that rural citizens have fewer medical specialists per 100,000 people, including less pediatricians, obstetricians/gynecologists, and internists. Only the number of general and family physicians increase along the rural gradient [7].

Mental health in rural environments is just as problematic. Suicide rates for both males and females were found to be higher for those living in rural areas, with one study indicating rural men having twice the suicide rate when controlling for such variation as the divorce rate and ethnicity [8]. Children in rural areas are more likely to have behavioral and mental health problems as compared to their urban counterparts [9]. Access to mental health care can be limited in rural areas due to transportation problems, lack of reporting mental health issues, and a self-reliance that often includes self-care [10,11]. When rural citizens do receive mental health treatment, the quality of care has been questioned despite data indicating higher levels of need [12,13].

Differences are also seen in personal habits that influence health outcomes. Research indicates that both adolescents and adults in rural areas are more likely to smoke [7,14], consume fewer fruits and vegetables [15], and have greater rates of alcohol addiction and consumption than in
urban and suburban locations [16]. Levels of physical activity are also higher in urban areas, with physical inactivity being higher in rural locations, particularly in the American South [17].

CDC data also indicate that even unintentional injuries contributing to death, such as poisoning, suffocation, and falls are more likely to occur in rural areas. Motor vehicle injuries leading to death are higher in rural areas as well [7]. Some explanations for these health and injury disparities are due to rural residents having more hazardous occupations, experiencing delays in emergency response, as well as a lower number of healthcare facilities [7].

Clearly, place is an essential variable in determining disparities between different populations [1,18]. The geographic location of individuals has a strong association with their health. This study uses the County Health Rankings, a project created by the University of Wisconsin Population Health Institute and the Robert Wood Johnson Foundation. To our knowledge, this is the first study to examine differences in health outcomes between rural and non-rural regions utilizing County Health Rankings data. Nearly all counties in the United States are ranked in their respective state based on publically available data. Data used in these rankings include health outcomes, which are a measure of premature mortality (deaths under age 75) and morbidity (overall, physical and mental health), and health factors [19]. These health factors measure the health of a county and are comprised of weighted data on (1) health behaviors, (2) clinical care, (3) social and economic factors and the (4) physical environment. Figure 1 is the model of population health used by the County Health Rankings. The following measures make up the health factors that influence the health outcomes of mortality and morbidity:

1. Health behaviors are measured by diet and levels of exercise, sexual activity and the use of alcohol, tobacco, and drug use.

2. Clinical care is measured by access to and quality of care.
Social and economic factors are measured by community safety, education, employment, family and social support, and income.

Physical environment consists of air and water pollution, housing problems, driving alone, and driving commute.

The objective of this study was to determine whether differences in the 2013 *County Health Rankings* indexed domains of health outcomes and their causal health factors exist between non-rural and rural counties. There are several benefits to using the *County Health Rankings*. As described above, the model incorporates a vast array of data covering numerous aspects related to the health of the American population. Created by a credentialed team of scientists and public health experts, the rankings have been used by other researchers in peer-reviewed articles to study community health, mortality, and the data’s implications on public policy.

**Methods**

(The authors have nothing to report regarding an Ethics Statement. Research is IRB exempt.)

Using the *County Health Rankings* data from 2013, all counties with data available in the U.S. were indexed into performance quartiles (where the first quartile are the top 25% of counties within each state, and the fourth quartile are the bottom 25% of counties within each state) and compared by the two geographic locales of non-rural (n=1088) or rural (n=1965). The Metropolitan Statistical Area (MSA) was used to define place of residence as either rural or non-rural. Rural residents were defined as persons living either within an MSA that had no city center or outside an MSA. Non-rural residents included all respondents living in a city center of an MSA, outside the city center of an MSA but inside the county containing the city center, or inside a suburban county of the MSA. We used the *County Health Rankings*’ six indexed domains in our analysis: mortality, morbidity, health behaviors, clinical care, social and economic factors, and physical environment.
We first compared the six indexed domains between rural and non-rural counties using the chi-square test for significance at alpha level 5%, where significance was set at \( p \leq 0.05 \). We also used logistic regression analysis where the dependent variable was rural versus non-rural counties and the six domains accounted for the independent variables. Adjusted estimated odds ratios are presented along with 95% confidence intervals. All analyses were performed using SPSS v.21 (SPSS Chicago, Ill).

Results

Overall, our analyses revealed health disparities between rural and non-rural counties in the U.S. Table 1 shows the six indexed domains (mortality, morbidity, health behaviors, clinical care, social and economic factors, and physical environment) by quartile for rural and non-rural counties. Significant differences in each index were observed between rural and non-rural counties, with a greater proportion of rural counties in the fourth (worst) quartile. For example, among mortality, 31.5% of rural counties and only 13.1% of non-rural counties were in the fourth quartile \( (p < 0.001) \).

Similarly, a significantly greater proportion of rural counties versus non-rural counties was observed for the morbidity (29.1% vs 17.9%), health behaviors (27.9% vs 20.0%), clinical care (32.2% vs 12.3%), social and economic factors (30.4% vs 15.6%), and physical environment (27.2% vs 21.3%) domains (Table 1).

Table 2 presents the results of a logistic regression model among rural counties for the indexed domains. For mortality, rural counties were at a significantly increased \( (OR=3.110, 95\% CI 2.306, 4.195) \) odds of being in the worst quartile than the best. Rural counties were also at a significantly increased odds of being in the worst versus the best quartile for clinical care \( (OR=5.192, 95\% CI 4.001, 6.738) \) and social and economic factors \( (OR=1.792, 95\% CI 1.328, 2.419) \). However, rural counties were at significantly decreased odds of being in the worst versus the best
Discussion

Our results demonstrate generally poorer mortality, clinical care, and social and economic scores for rural versus non-rural counties. Overall, rural counties were more likely to be in the fourth quartile of their respective states than non-rural counties. However, we also found that rural counties compared favorably to non-rural counties for the physical environment and morbidity domains. To our knowledge, this study is the first of its kind to utilize the County Health Rankings data to determine whether health differences exist between rural and non-rural counties. The largest differences between rural and non-rural counties were in the indexed domains mortality and clinical care. Rural counties had three times the odds of being in the 4th quartile of mortality than non-rural counties, and about five times the odds of being in the 4th quartile of clinical care. In addition, the morbidity domain is comprised in part by mental health data, specifically the number of poor mental health days reported by a survey respondent. Given the research on mental health in rural populations, rural performance in this quartile may be surprising. It is possible that higher scores in the morbidity domain are attributable to other measurements outside of mental health. The disparity in mortality found in rural counties is attributable to a host of causes. One of the domains we believe is likely driving the large disparity in mortality is poorer access and worse quality of clinical care in rural counties. Sommers et al (2012) found that Medicaid expansion to low-income adults significantly reduced mortality and reduced rates of delayed care [20]. There is evidence to suggest that rural residents may also tend to delay the receiving of care, increasing the risk of a poorer health outcome [21]. There are also barriers that rural residents have to face that include longer driving times [22,23] as well as being uninsured, and having fewer providers of care [24].
A lack of healthy eating habits may also be attributable to increases in mortality in rural environments. This could possibly be due to a lack of healthier, low cost eating options [25,26]. In part because of travel restrictions and cost, rural residents may be more likely to buy food at convenience stores rather than at conventional stores such as supermarkets. “Food deserts,” areas of the country where residents have less access to affordable and healthful food tend to be in rural areas although they can also be present in highly urban populations [27,28].

Rural counties were also at greater odds of being in the fourth quartile of the social and economic factor domain. This domain in part uses motor vehicle injury data and research has found that rural residents are less likely to survive motor vehicle accidents, in part due to access restrictions [29,30]. The domain also takes into account education, employment and income factors, where it was found that residents in rural counties were at the lower end on these measurements.

Conclusion

Limitations

On a conceptual level, there is a lack of agreement between invested parties on what ‘rural’ means and how the term should be defined and measured. This creates problems for policymakers and the health-care providing community [31]. Standardizing the definition and measurement of rurality is a difficult task and likely impossible given the variety of interests on how the terms should be used. The U.S. federal government has over a dozen definitions for the term [32]. Scholars should choose definitions in line with their research question and available data and resources.

Another limitation is that the County Health Rankings does not take into account all possible factors that determine community health. For example, the physical environment domain encompasses multiple factors (i.e., air and water quality, and housing and transit), but it does not account for all factors that make up the physical environment. Therefore, some caution must be used when making statements about study results. Given the problem of limitations caused by
infrequent data reporting or unavailability for certain regions, we believe the *Rankings* team has
compiled a respectable dataset.

As this paper is a cross-sectional study, causality cannot be confirmed. Furthermore, the
methodology for this paper divided counties into four quartiles based on each state's quartile
rankings. This means that counties in one state may have overall poorer health than counties in
other states that have the same quartile rankings. There may be an argument against using quartiles
and instead using natural breaks in the entire US county dataset where quartiles are set a-priori, and
only counties meeting a predetermined threshold would fall in each quartile making nationwide
studies possible. While perhaps problematic in certain respects, the data limitations do not prevent
the production of meaningful observations and results.

Ultimately, our results indicate that there are significant differences in the overall health and
health determinants of rural populations as compared to urban populations. Populations in rural
counties tended to score below their non-rural peers in the six indexed domains of health measured
by the *County Health Rankings*, although the results of our logit regression indicate better performance
for rural counties in physical environment and morbidity scores. This research furthers the evidence
of the divide in health and healthcare between the observed rural and non-rural populations. We
believe public health professionals and policy makers must consider these differences when
implementing programs addressing the needs of a geographically diverse population.

**Competing Interests**

TA and DS are both employees of EIRH, which is a member of BioMed Central.

MNL is an employee of the University of Minnesota, which is a supporting member of BioMed
Central.
Author Contributions

All authors contributed equally to study design, data analysis, manuscript preparation and approval.

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Author Information

Timothy J. Anderson joined EIRH in 2012 as a grants and contracts administrator. He received a master’s degree in political science from the University of Wisconsin-Milwaukee in 2008 and a bachelor’s degree in political science from the University of Minnesota-Duluth in 2007. He was a research assistant and teaching assistant while studying in UW-Milwaukee’s doctoral program for political science. While attending UW-Milwaukee, Mr. Anderson worked at the Center for Urban Initiatives and Research, co-authoring numerous reports for local school districts, municipalities and non-profits.

Dr. Daniel M. Saman is an associate research scientist who joined the Essentia Institute of Rural Health in September 2012. He received his master of public health and doctor of public health degrees in epidemiology in May 2008 and December 2011 from the University of Kentucky College of Public Health in Lexington, Ky. He received his bachelor’s degree in anthropology and philosophy from Centre College in Danville, Kentucky. Dr. Saman has authored or co-authored numerous publications and in 2008 was awarded the Anthony Westwater Jong Community Dental Public Health Post-Professional Award for his work on assessing the dental workforce distribution across rural, urban, and Appalachian Kentucky.

Dr. Nawal Lutfiyya is a senior research scientist and professor at the University of Minnesota. She joined the National Center for Interprofessional Practice and Education in 2013 after working at EIRH where she served as a senior research scientist. Dr. Lutfiyya heads an interprofessional faculty research fellowship and also directs a longitudinal research fellowship for ambulatory care and acute care PGY-1 PharmD residents. She is also the director for a longitudinal evidence-based medicine and research curriculum for family medicine residents. She holds a PhD from the University of Massachusetts at Amherst and a master’s in social psychology from the University of Iowa. Dr. Lutfiyya’s undergraduate training was in sociology and social psychology at the University of Manitoba.
References


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297 **Figure Legends**

298 Figure 1: County Health Rankings Population Health Model

299 Figure Legend: Percentages indicate weights based on comparative importance within a factor and
data quality.
Table 1. Indexed U.S. County Domain Quartiles by Geographic Locale
2013 U.S. County Health Rankings Data

<table>
<thead>
<tr>
<th>Indexed Domains*</th>
<th>Quartile†</th>
<th>Geographic Locale</th>
<th>P value for Chi Square</th>
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<td></td>
<td></td>
<td>% Rural n=1965</td>
<td>% Non-Rural n=1088</td>
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<tr>
<td>Mortality</td>
<td>1</td>
<td>17.0</td>
<td>39.9</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>24.9</td>
<td>26.3</td>
</tr>
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<td></td>
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<td>20.7</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>31.5</td>
<td>13.1</td>
</tr>
<tr>
<td>Morbidity</td>
<td>1</td>
<td>22.1</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>24.0</td>
<td>26.8</td>
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<tr>
<td></td>
<td>3</td>
<td>24.8</td>
<td>24.4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>29.1</td>
<td>17.9</td>
</tr>
<tr>
<td>Health Behaviors</td>
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<td>19.3</td>
<td>35.8</td>
</tr>
<tr>
<td></td>
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<td>24.3</td>
<td>26.3</td>
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<tr>
<td></td>
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<td>28.4</td>
<td>17.8</td>
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<tr>
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<td>4</td>
<td>27.9</td>
<td>20.0</td>
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<td>Clinical Care</td>
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<td>14.8</td>
<td>43.9</td>
</tr>
<tr>
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<td>2</td>
<td>24.3</td>
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<td>17.5</td>
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<tr>
<td></td>
<td>4</td>
<td>32.2</td>
<td>12.3</td>
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<td>Social and Economic Factors</td>
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<td>18.1</td>
<td>38.0</td>
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<tr>
<td></td>
<td>2</td>
<td>24.3</td>
<td>26.2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>27.2</td>
<td>20.1</td>
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<tr>
<td></td>
<td>4</td>
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<td>15.6</td>
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<td>25.2</td>
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<td>4</td>
<td>27.2</td>
<td>21.3</td>
</tr>
</tbody>
</table>

*Each index is comprised of multiple variables that are given different weights
†The first quartile is considered the best and the fourth the worst

Source: Author
<table>
<thead>
<tr>
<th>Indexed Domain</th>
<th>Quartile</th>
<th>Adjusted Odds Ratio (95% CI)</th>
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<tr>
<td>Mortality</td>
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</tr>
<tr>
<td></td>
<td>2</td>
<td>1.691 (1.337, 2.140)</td>
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<tr>
<td></td>
<td>3</td>
<td>1.955 (1.511, 2.530)</td>
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<td></td>
<td>4</td>
<td>3.110 (2.306, 4.195)</td>
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<tr>
<td>Morbidity</td>
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<tr>
<td></td>
<td>2</td>
<td>.819 (.646, 1.037)†</td>
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<td>3</td>
<td>.646 (.498, .838)</td>
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<tr>
<td></td>
<td>4</td>
<td>.712 (.531, .955)</td>
</tr>
<tr>
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<td>--*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.028 (.811, 1.302)†</td>
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<tr>
<td></td>
<td>3</td>
<td>1.278 (.981, 1.666)†</td>
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<tr>
<td></td>
<td>4</td>
<td>.860 (.649, 1.140)†</td>
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<td>2.354 (1.891, 2.931)</td>
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<td>4</td>
<td>.706 (.555, .899)</td>
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*Reference category
†Odds Ratio not statistically significant
(Dependent variable is rural/non-rural classification of county)

Source: Author