All Rural Places Are Not Created Equal: Revisiting the Rural Mortality Penalty in the United States

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Objectives. I investigated mortality disparities between urban and rural areas by measuring disparities in urban US areas compared with 6 rural classifications, ranging from suburban to remote locales.

Methods. Data from the Compressed Mortality File, National Center for Health Statistics, from 1968 to 2007, was used to calculate age-adjusted mortality rates for all rural and urban regions by year. Criteria measuring disparity between regions included excess deaths, annual rate of change in mortality, and proportion of excess deaths by population size. I used multivariable analysis to test for differences in determinants across regions.

Results. The rural mortality penalty existed in all rural classifications, but the degree of disparity varied considerably. Rural–urban continuum code 6 was highly disadvantaged, and rural–urban continuum code 9 displayed a favorable mortality profile. Population, socioeconomic, and health care determinants of mortality varied across regions.

Conclusions. A 2-decade long trend in mortality disparities existed in all rural classifications, but the penalty was not distributed evenly. This constitutes an important public health problem. Research should target the slow rates of improvement in mortality in the rural United States as an area of concern. (*Am J Public Health.* 2014;104:2122–2129. doi:10.2105/AJPH.2014.301989)

Recent research has identified a new trend in rural–urban, macrolevel mortality disparities in the United States, called the rural mortality penalty.[1,2] Historically, there has been a penalty associated with urban places; however, in recent decades, a reversal has occurred. Beginning in the mid-1980s, rural and urban mortality rates diverged, and the gap between them has grown for more than 2 decades. According to previous publications that introduced the rural mortality penalty, the rural United States is an aggregation of 6 nonmetropolitan designations distinguished by population size and adjacency to an urban area; this is a typology used in many previous studies.[3,4] This research uncovers the disproportionate mortality burden across these rural classifications.

Throughout the 19th and early 20th centuries, there was a mortality penalty associated with urban areas.[5] The urban mortality penalty was largely attributed to the spread of contagious and infectious disease,[6,7] poor water quality,[8] and inadequate sewage disposal[9] in densely populated areas.[10,11] The first half of the 20th century transformed urban cities because of public works projects that improved water quality and sanitation[8] and public health advancements that included vaccinations, quarantines, physical examinations, health education, workplace safety, food quality, and controlling medication.[5] The result was unprecedented improvements in urban health from 1900 to 1940, highlighted by a 40% decline in mortality, an increased life expectancy from 47 to 63 years,[8,12] and generally equivalent rural and urban mortality rates.[5] This pattern persisted until the mid-1980s, when the rural mortality penalty emerged. Public health advances, however important, did not encompass all determinants of mortality.

The major determinants of mortality in the rural United States exist at the individual, structural, or contextual levels. Individual-level determinants include use of self-care,[13,14] low satisfaction of care,[14,15] lack of a regular source of care,[15,16] and lifestyle and behaviors.[17,18] Structural and contextual determinants include poverty,[15] high rates of female-headed households,[19] degree of urbanization,[15] age structure of the population,[20,21] income inequality,[22] high rates of chronic illnesses,[23] access to care,[13,15,24,25] physician and hospital shortages,[26–28] and unique cultural characteristics,[29,30] including an identity of resiliency.[31] Furthermore, macrolevel restructuring because of immigration and suburbanization has occurred in many rural communities. These changes create diverse economic opportunities,[19,32–34] populations,[34–37] and changing demographic characteristic structures.[34,37] Traditional social, racial, and ethnic boundaries have blurred,[34–37] and the cultural gap between rural and urban places has shrunk,[34,37] changing how we understand the dynamics among demographic, social, and economic processes, resources, constraints, and health policies in people's pursuit of better health.[37]

Innovative research investigating regional disparities in health outcomes has been published in the last decade, but there remains a gap in understanding intrarural differences. A recent study of life expectancy found widening disparities across rural–urban categories over a 40-year period, with poor rural Blacks having the lowest survival probability.[38] Another regional study of mortality, titled "Eight Americas" uncovered disparities in life expectancy, mortality, health insurance, and health care utilization by regions based on race, county, population density, race-specific county level per capita income, and homicide rate.[39,40] This work highlighted the complexity of "place" and its role in eliminating health disparities across population segments.[41] The rural United States is complex, and is often treated as a "nonurban" residual category lacking a clear conceptualization of poverty, opportunity structure, and other social processes.[42–44] With the emergent rural mortality penalty, it is paramount to understand the context and conditions unique to the rural part of the country.[29,30] I sought to uncover differing mortality profiles and determinants across rural regions.

METHODS

Two analyses were performed in this research. Descriptive analyses were used to establish temporal trends in mortality disparities, and the multivariable analysis detected associations among factors related to mortality. These were based on mortality trend data available from the Compressed Mortality File/National Center for Health Statistics. The Compressed Mortality File is a controlled access database that documents the mortality history of the United States by county, beginning in 1968 and updating each year. The analytical sample contains information about the total number of US deaths from 1968 to 2007 (n = 85 868 225). The mortality file includes a record of each death by year, state and county of residence, race, gender, age group at death, and cause of death as indicated by *International Classification of Diseases* (*ICD*) codes. *ICD-8* codes indicated the underlying cause of death from 1968 to 1978,[45] *ICD-9* codes corresponded to deaths from 1979 to 1998,[46] and *ICD-10* codes corresponded to deaths from 1999 to 2007.[47] All causes of death were calculated. Population information was based on US Census estimates of total US, state, and county resident populations.[45–47] Population data were available by year, state and county of residence, race, gender, and age group. In the most recent year, 2007, there were 3105 counties or county equivalents included in the data after Virginia independent cities and other independent units were collapsed into their respective counties.

Mortality rates were age-adjusted to the 2000 Standard Million, a fixed population of 1 million people based on the 2000 US Census. The total population was separated into 11 mutually exclusive age categories: younger than 1 year, 1 to 4 years, 5 to 14 years, 15 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 64 years, 65 to 74 years, 75 to 84 years, and 85 years and older. The proportion of the total population for each age group was calculated as a weight and then applied respectively to each age group within each region when calculating age-adjusted mortality rates. As a result, urban and rural mortality rates were based on the same fixed population, allowing for direct comparisons between regions and across years.[48] Calculating mortality in this way removed the effects of age from crude rates.

Counties were classified as urban and rural based on Beale Codes, that is, rural–urban continuum codes (RUC codes) that were first created in the 1970s.[49,50] Urban counties were core areas containing a large population nucleus together and adjacent communities with a high degree of economic and social integration, whereas rural areas were residual locations that fell outside of urban statistical areas.[50] Urban classifications 0 through 3 ranged from a population of less than 250 000 to more than 1 million residents. RUCs 4 (adjacent to a metropolitan area) and 5 (not adjacent) were a population of 20 000 or more, RUCs 6 (adjacent) and 7 (not adjacent) were a population of 2500 to 19 999, and RUCs 8 (adjacent) and 9 (not adjacent) were a population of less than 2500. After 1996, code 0 was merged into code 1. The 2007 aggregate population of rural counties was approximately 49 million, roughly 17% of the nation's population.

The examination of the rural mortality penalty used both cross-sectional and temporal measures of mortality disparities between rural and urban areas. The following 4 indicators of disparity were calculated for 40 years of Compressed Mortality File data.

Excess Rural Deaths per 100 000 Population

A standardized measure of mortality disparities between rural and urban areas indicates the difference between age-adjusted mortality of the rural United States (and by individual rural region) per 100 000 population minus the age-adjusted mortality of the urban United States per 100 000 population, as illustrated in Equation 1. MR was used as an abbreviation for mortality rate:

$$(1)\quad \mathrm{MR}_{\mathrm{Rural}} - \mathrm{MR}_{\mathrm{Urban}}$$

Total Excess Rural Deaths

Total excess rural deaths is a calculation of the number of rural deaths that would not have occurred if the rural region had the same mortality rate as the urban region. This was calculated as the difference in mortality rates per 100 000 population between the rural United States (or individual rural region) and urban United States, multiplied by the population of the rural United States (or individual rural region), divided by 100 000 (Equation 2):

$$(2)\ \left(\mathrm{MR}_{\mathrm{Rural}} - \mathrm{MR}_{\mathrm{Urban}}\right) * \left(\mathrm{Pop}_{\mathrm{Rural}}/100,000\right)$$

Annual Rate of Change of Mortality

This calculation is the difference between the age-adjusted mortality rate for year X, minus the age-adjusted mortality rate for year X + 1, divided by the age-adjusted mortality rate for year X, multiplied by 100 (Equation 3). This equation provided the percent annual change in mortality over a specified period of years. The annual rate of change of mortality was interpreted as an index of the rate of mortality improvement.

$$(3)\quad \left[\left(\mathrm{MR}_{2006} - \mathrm{MR}_{2007}\right)/\mathrm{MR}_{2006}\right] * 100$$

Comparison of Proportions

This calculation compares the percentage of the population of the rural United States that each individual region comprises with the percentage of the total excess deaths that each rural region comprises. Regions where the percentage of the total population was greater than the percentage of total excess deaths were considered to have a positive mortality profile. Regions where the percentage of the total population was less than the percentage of the total excess deaths were considered to have a negative mortality profile. This assessed which rural regions were disproportionately affected by the rural mortality penalty.

In addition, ordinary least-square multivariable regression analysis was used to test the effects of the population, socioeconomics, and health care infrastructure or utilization on mortality across region. These classifications of variables represented the major determinants of mortality. The data were county-level estimates extracted from the 2007 Area Health Resource File. The population and socioeconomic indicators were county-level estimates, including percent Black (2006), percent in poverty (2005), percent older than 65 years (2006), segregation (dissimilarity index, 2000), and census region dummy variables (2000). Variables for percent female head of household (2000) and median household income (2005) were removed because of multicollinearity problems. Measures of health care utilization or

infrastructure (per 1000 persons) included total hospital physicians (2006) and hospital beds as baseline measures of health care availability, general practitioners (2006) as a measure of primary care access, and emergency department (ED) visits (2005) as a measure of utilization, particularly for the uninsured. Measures indicating specialists (2006) and general surgeons per 1000 persons (2006) were removed because of multicollinearity problems. Other measures tested, but considered insignificant, were number of hospitals and health professional shortage areas (primary care). Analysis was conducted in PASW Statistics 18.0 (IBM, Hong Kong), and the file was split by RUC designation.

RESULTS

In the mid-1980s, a new trend of departure between US urban and rural mortality rates appeared. In 1986, the rural mortality rate climbed higher than its urban counterpart, and the disparity grew quickly in subsequent decades. In 2007, rural areas experienced 78 more deaths per 100 000 than urban areas, resulting in 38 249 total rural excess deaths. Over the 23-year duration of the rural penalty, more than 448 000 excess deaths occurred in the rural United States. Furthermore, the annual rate of improvement in mortality for urban and rural areas was nearly identical from 1968 to 1985, at 1.56% and 1.57% per year, respectively. Since 1986, the rate of improvement in rural areas slowed considerably to 0.75%, compared with 1.19% in urban areas, an alarming trend. Figure 1 displays the diverging rates of age-adjusted mortality per 100 000 persons.

Excess deaths per 100 000 persons between urban areas and RUCs 4 and 5, 6 and 7, and 8 and 9 are illustrated in Figure 2. RUCs 4 and 5 had a population of 20 000 or more. RUC 4 was adjacent to an urban area, and RUC 5 was not adjacent. Figure 2 shows that RUC 5 displayed a consistently wide disparity from the urban United States throughout the majority of the time series, although the gap shrunk in the 1980s, widened again beginning in 1990, and peaked in 2007 at nearly 70 excess deaths per 100 000 persons. A divergence in mortality from 1990 onward took place in RUC 4, mirroring the recent 20-year trend in RUC 5.

A comparison of proportionate excess deaths is given in Table 1. RUC 4 was the most heavily populated rural classification, with more than 14 million residents in 2007, approximately 30% of the total rural population. RUC 4 was 24% of the total rural excess deaths, meaning it was underrepresented in terms of proportion of total excess deaths. The RUC 5 population accounted for 11% of the 2007 total rural population, and its proportion of total excess deaths was also slightly underrepresented at 9.4%. The annual rate of decrease in mortality since 1986 in RUC 4 was 0.82%; the annual rate of decrease in mortality in RUC 5 was 0.74%, compared with 0.75% for rural areas and 1.19% in urban areas. Although they did not improve at the urban rate, RUCs 4 and 5 had an average annual decrease in mortality better than the overall rural United States.

Comparative mortality trends in RUCs 6 and 7 are illustrated in Figure 2 as well. Both regions constituted a population of less than 20 000, with RUC 6 adjacent to an urban area and RUC 7 not adjacent. RUC 6 demonstrated the most pronounced rural departure from urban mortality, as evidenced by a disparity of 102 per 100 000 persons in 2007. RUC 7 exhibited a disparity of 80 deaths per 100 000 persons, constituting the second largest region of disparity. The temporal patterns corresponded closely to the overall rural mortality penalty because both regions diverged from the urban United States around 1986, the same as the nationwide trend.

A comparison of proportions in RUC 6 lent further evidence that it was the most disproportionately disadvantaged rural region, as seen in Table 1. RUC 6 had 31% of rural US persons in 2007, yet more than 41% of excess deaths occurred here. RUC 7, however, represented 17% of both the total rural population and of total rural excess deaths, because it was perfectly representative of its population size. The annual rate of improvement since 1986 for RUC 6 was 0.68%, the slowest of all rural regions. The rate in RUC 7 was 0.73%, which was representative of the US rural rate. In every measurable way, RUC 6 exhibited a disadvantaged mortality profile.

RUCs 8 and 9 were characterized as open country and small settlements (termed "completely rural"), with a population of 2500 or less. RUC 8 was adjacent to an urban area, and RUC 9 was not adjacent.[49] The mortality trend in RUC 8 diverged in the early 1980s and peaked with a disparity of nearly 80 deaths per 100 000 persons in 2007. The most remote region, RUC 9, had the smallest disparity, at 60 excess deaths per 100 000 persons in recent years. Of note, the mortality penalty began more than 5 years later in RUC 9 than it did in RUC 8.

Comparisons of proportions (Table 1) revealed that RUC 8 accounted for 5% of the

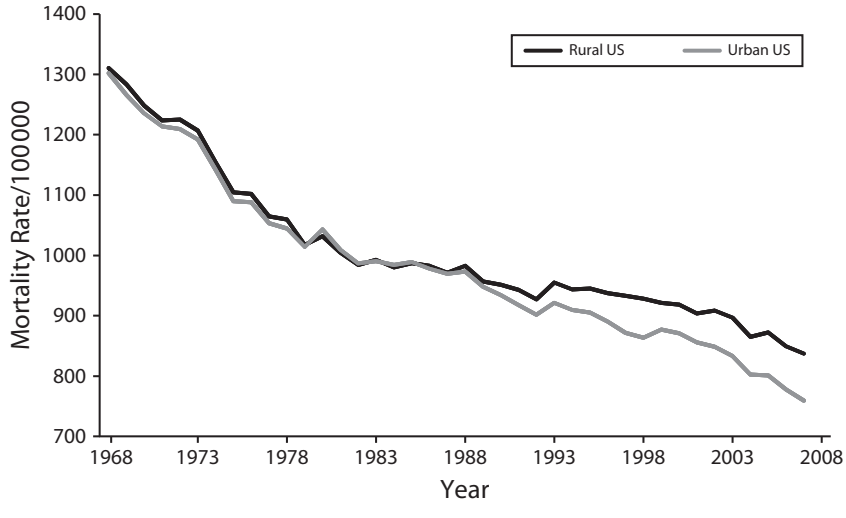
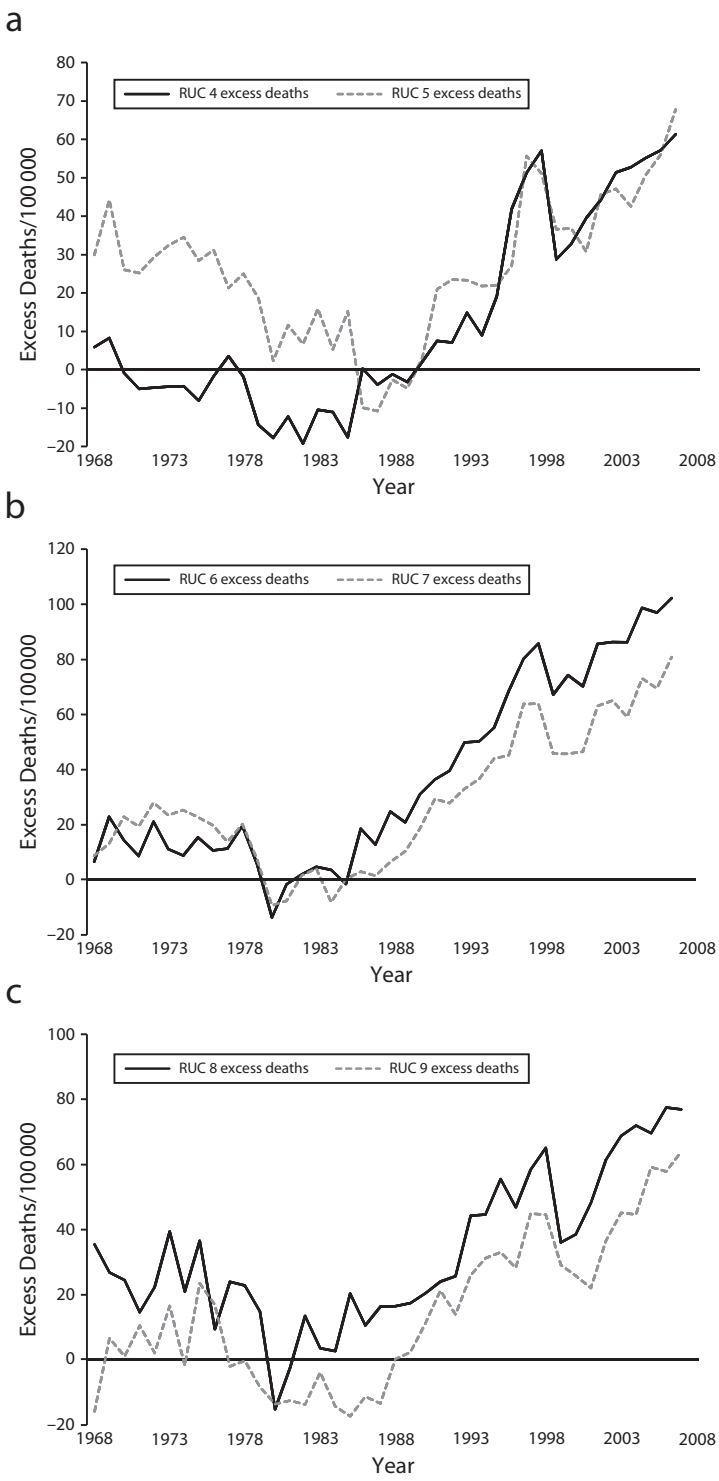


FIGURE 1—Rural and urban mortality rates per 100 000 population: Rural Mortality Penalty Study, United States, 1968–2007.



Note. RUC codes subdivide all US counties into 3 metro and 6 nonmetro designations based on population size and proximity to a metro county.

FIGURE 2—Excess deaths per 100 000 population between urban and (a) rural–urban continuum (RUC) codes 4 and 5, (b) RUC codes 6 and 7, and (c) RUC codes 8 and 9: Rural Mortality Penalty Study, United States, 1968–2007.

total rural population and 4.9% of the total rural excess deaths. RUC 9 represented 5.5% of the rural population and 4.5% of the rural excess deaths. This suggested that the degree of mortality disparity experienced in RUC 8 was representative of its population size, but was underrepresented in RUC 9. The annual rate of mortality decrease since 1986 revealed that both regions were on par with rural areas at 0.78% and 0.75%, respectively. Results suggested that RUC 9 displayed a relatively positive mortality profile.

The descriptive analysis provided strong evidence that the rural mortality penalty was not applied equally across all rural regions. Multivariable analysis revealed notable differences in the determinants of mortality across regions (Table 2). As a reference, in urban areas, all variables significantly predicted mortality with the exception of hospital beds and general practitioners per 1000 persons. In RUC 4, percent Black and poverty were significant, and the South had higher mortality than the Northeast and West. Regarding health care infrastructure, ED visits and hospital physicians per 1000 persons significantly predicted mortality. Percent poverty and region (Midwest), ED visits, and hospital physicians per 1000 persons predicted mortality in RUC 5. In RUC 6, the significant predictors were percent Black, poverty, and region (all regions), but no health care variables were significant. In RUC 7, only poverty and region (Midwest) were significant among the population and socioeconomic determinants, and ED visits and total hospital physicians predicted mortality among the health care measures. RUC 8 exhibited the most significant health care variables, with hospital physicians, hospital beds, and general practitioners as the significant predictors, along with poverty, age 65+ years, segregation and region (Midwest and West). Only poverty, region (Midwest and West), and ED visits predicted mortality in RUC 9. According to the *R*-squared statistic, this model was the weakest predictor of mortality in RUCs 6 and 9, with the latter being substantially the weakest.

DISCUSSION

My deeper investigation of the rural mortality penalty revealed that all rural places are

TABLE 1—Crude Numbers and Percentages of Population and Excess Deaths for Rural–Urban Continuum (RUC) Codes 4–9: Rural Mortality Penalty Study, United States, 1968–2007

Classification	Rural Population, Total No. (%)	Excess Deaths, No./100 000 Persons (%)
RUC 4	14 950 923 (30.36)	61.31 (23.97)
RUC 5	5 325 533 (10.81)	67.71 (9.43)
RUC 6	15 442 326 (31.36)	102.23 (41.27)
RUC 7	8 372 278 (17.00)	80.81 (17.69)
RUC 8	2 441 203 (4.96)	76.90 (4.91)
RUC 9	2 714 354 (5.51)	63.86 (4.53)

Note. RUC codes subdivide all US counties into 3 metro and 6 nonmetro designations based on population size and proximity to a metro county.

not created equal. This finding was in direct response to the original rural mortality publication[1] that urged future research to investigate individual RUC categories to better understand the nature of the trends and disparities. I uncovered a better understanding. This was best evidenced by the strikingly high level of disparity between the urban regions and RUC 6. Population characteristics probably provided at least a partial explanation. More than half of the 15 million RUC 6 residents resided in the South, the most southern-centric region. The excessively high mortality disparity experienced by those in RUC 6 might be closely associated with unhealthy cultural characteristics that exist in the South, such as the high prevalence of smoking,[51] sedentary lifestyles, and obesity.[52] However, social characteristics might provide a deeper understanding. The context of place was intimately tied to opportunity structures and barriers that effected population groups.[53] The Black population had higher than average mortality[54,55] because of exposure to long-term poverty (including childhood poverty),[56,57] real[55,58] and perceived discrimination,[59] segregation and stress,[37,60,61] and unequal access to high-quality health care,[55,56] all of which predicted negative health outcomes throughout the life course. The multivariable analysis accounted for several of these factors, and revealed that race and poverty were significantly associated with mortality in RUC 6, whereas these factors (particularly race) were not as significant in many other rural regions. This region clearly stood out as unique with regard to health care infrastructure, where no health care utilization or infrastructure measures were meaningful. Overall, population and socioeconomic conditions were far more associated with mortality in RUC 6 than was health care infrastructure. No other rural region could make this claim.

The comparatively positive mortality profile of RUC 9 was another noteworthy finding. Clearly, access to care is a pervasive problem in the rural United States.[26,28] Rural patients traveled farther than urban patients for medical, surgical, and specialist care.[24] Additionally, many rural hospitals closed in the 1980s and 1990s because of rising costs and shrinking revenues, until the Balanced Budget Act of 1997 allowed eligible rural hospitals to become critical access hospitals.[27] However, access to care was not the only factor that predicted mortality. Social,[19–21] economic,[15,32–34] demographic,[34–37] and cultural factors[29–31] were also key determinants. Evidence from Eight Americas' research demonstrated that northern White rural counties (America 2) were an anomaly because there was a life expectancy advantage despite an income disadvantage, likely pointing to the importance of other mortality determinants, such as social and demographic factors. RUC 9 counties were disproportionately located in the Midwest and perhaps mirrored America 2 counties, at least partially, as having positive health profiles despite other disadvantaged conditions. Considering the many mortality determinants beyond simply accessing health care, it should not be a surprise that RUC 9 displayed a mortality advantage. Findings from the multivariable analysis confirmed that health infrastructure was not as strongly associated with mortality as it was in other regions.

To further illustrate that rural regions varied tremendously, only poverty predicted mortality across all rural regions. Race, age structure, segregation, and percent Black varied in their predictive power. Region also predicted mortality, although a distinct southern mortality disadvantage existed in most regions. The effects of health infrastructure variables varied widely also, with ED visits and hospital physicians being the most impactful, but these were hardly associated with mortality across the board. This reaffirmed that each rural region was a unique place with complex and overlapping determinants of mortality. Clearly, the roles of contextual factors mattered, but the collection of these factors told a different story by rural region, further confirming previous findings that researchers should continue to conceptualize region in new and innovative ways because of mounting evidence that unique characteristics exist across different places.[39,40,62]

Finally, it must be emphasized that the rural mortality penalty was the product of improving mortality rates, not declining mortality rates. Since the inception of the rural mortality penalty in 1986, mortality rates in urban America improved on average 1.2% per year, compared with 0.82% in RUC 4, 0.74% in RUC 5, 0.68% in RUC 6, 0.73% in RUC 7, 0.78% in RUC 8, and 0.75% in RUC 9. To further illustrate the significance of this discrepancy, before the mid-1980s, many rural regions exhibited a mortality advantage compared with urban areas, most notably in RUCs 4, 6, 7, and 9. The advantage was particularly evident in RUCs 4 and 9, because it lasted nearly 2 decades, dating back to the early 1970s. Future research and policy should focus on the slow rate of mortality improvement in the rural United States.

Limitations

My findings should be interpreted with several limitations. My research used RUC codes, but there were numerous rural–urban classifications, each potentially revealing different degrees of regional difference. Next, there were many methods to account for the change in county status over time. I tested 1 alternative by applying 1974 RUC codes to all data points, revealing similar patterns. However, other methods of classification should be

TABLE 2—Ordinary Least-Square Regression of 2007 Age-Adjusted Mortality Rates per 100 000 Regressed on Population, Socioeconomic, and Health Care Infrastructure Variables by 2003 Rural–Urban Continuum (RUC) Codes: Rural Mortality Penalty Study, United States, 1968–2007

Variable	RUCs 1-3, B (95% CI)	RUC 4, B (95% CI)	RUC 5, B (95% CI)	RUC 6, B (95% CI)	RUC 7, B (95% CI)	RUC 8, B (95% CI)	RUC 9, B (95% CI)
% Black	0.110*** (0.94, 3.30)	0.297*** (2.90, 8.20)	0.206 (−0.65, 8.24)	0.156*** (1.28, 4.51)	0.016 (−1.74, 2.47)	0.110 (−0.27, 5.42)	−0.071 (−6.70, 1.08)
% in poverty	0.273*** (4.96, 7.64)	0.182** (0.85, 5.76)	0.252* (0.32, 10.56)	0.234*** (3.29, 7.48)	0.459*** (8.29, 13.08)	0.360*** (6.48, 13.11)	0.388*** (9.05, 15.72)
% aged ≥ 65 y	−0.066** (−4.55, −0.57)	−0.016 (−4.29, 3.16)	0.130 (−1.79, 14.19)	−0.024 (−4.90, 2.39)	−0.043 (−5.39, 1.63)	−0.135** (−11.38, −1.36)	−0.048 (−6.96, 2.40)
Segregation index	0.058* (2.80, 83.77)	0.021 (−73.75, 108.26)	0.047 (−144.94, 253.58)	0.039 (−26.76, 100.09)	0.037 (−39.41, 117.84)	0.147** (48.32, 254.49)	0.032 (−64.09, 138.02)
Region (Northeast dummy)	−0.168*** (−84.48, −42.56)	−0.154* (−87.68, −8.09)	−0.059 (−161.92, 80.56)	−0.149*** (−144.05, −50.33)	−0.041 (−104.09, 32.87)	−0.085 (−204.69, 20.81)	−0.006 (−216.96, 188.51)
Region (Midwest dummy)	−0.188*** (−67.03, −35.45)	−0.105 (−59.61, 9.36)	−0.239* (−133.61, −8.71)	−0.246*** (−103.73, −50.67)	−0.109* (−70.04, −1.62)	−0.201*** (−126.26, −32.25)	−0.199*** (−142.87, −40.09)
Region (West dummy)	−0.306*** (−132.01, −91.72)	−0.173** (−93.46, −15.21)	0.057 (−58.57, 101.16)	−0.220*** (−142.17, −72.02)	−0.073 (−67.74, 9.57)	−0.258*** (−187.87, −75.39)	−0.136** (−150.90, −16.79)
Emergency department visits/1000 persons	0.090** (.01, .07)	0.279*** (0.09, 0.23)	0.254** (0.04, 0.28)	0.075 (0.00, 0.08)	0.202*** (0.06, 0.15)	0.059 (−0.03, 0.09)	0.114* (0.01, 0.16)
Hospital physicians/1000 persons	−0.294*** (−23.66, −15.31)	−0.274*** (−66.89, −22.77)	−0.206* (−55.09, −1.36)	−0.026 (−13.21, 6.65)	−0.158*** (−54.61, −15.62)	0.191* (18.72, 148.92)	−0.125 (−93.11, 3.13)
Hospital beds/1000 persons	−0.005 (−2.61, 2.17)	0.061 (−2.33, 7.17)	0.132 (−2.46, 16.59)	0.051 (−0.93, 5.00)	0.004 (−2.09, 2.35)	0.122* (0.27, 8.49)	0.050 (−1.42, 4.23)
General practice/1000 persons	0.037 (−17.57, 72.53)	0.037 (−58.73, 112.56)	0.075 (−88.89, 212.15)	−0.042 (−87.99, 21.80)	−0.024 (−81.56, 44.75)	−0.218** (−290.10, −62.76)	0.027 (−61.22, 93.31)
R^2	0.379	0.490	0.527	0.367	0.433	0.490	0.270

Note. RUC codes subdivide all US counties into 3 metro and 6 nonmetro designations based on population size and proximity to a metro county.
$^{*}P < .05$; $^{**}P < .01$; $^{***}P < .001$.

considered in future research. Furthermore, cause-, race-, and gender-specific mortality trends were not included in the descriptive analysis, nor were there statistical analyses that tested the interactions of race, gender, region, and rurality. Future research should consider these, and spatial analyses testing should consider the significance of county size and proximity to care, leading to potentially innovative reconceptualizations of region. In addition, health and lifestyle variables were key determinants of mortality but were not included in this research because available survey data (e.g., the Behavioral Risk Factor Surveillance System and the National Health and Nutrition Examination Survey) did not provide broad geographic coverage at the county level to match the Compressed Mortality File. Finally, the US Census designated geographic regions were used as an indicator of regional differences, but in reality, these were too large to be a reliable proxy for cultural differences across regions; thus, the references to unhealthy cultural characteristics in the South should be considered with caution.

Conclusions

The rural United States displayed consistently high all-cause mortality rates compared with its urban counterpart for more than 2 decades. However, all rural places are not created equal. After disaggregating rural areas into subcategories that ranged from very small populations in remote geographic locations to sizable suburban populations close to a city, meaningful differences in the mortality profile of each rural region was uncovered. These differences were robust to several measures of disparity, including comparisons of mortality rates, excess deaths, and annual rates of improvement. Multivariable analysis results showed that the determinants of mortality varied greatly across rural regions, and that health care infrastructure mattered in some places more than others. RUCs 6 and 9 emerged as the most distinct unhealthy and healthy regions, respectively. This suggested that the rural mortality penalty was a "black box" that, when opened, revealed complex interactions among mortality determinants that included a broad spectrum of associated factors, such as poverty, demographic characteristics, health care infrastructure, degree of rurality, geography, and much more. ■

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Human Participant Protection

This study received exemption from human participants review by The University of Memphis institutional review board for these analyses because it used publicly available, secondary data.

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