Race and Rural: An Investigation of the Rural Mortality Penalty and the Role of Public Health Infrastructure

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Extended Abstract

Research across the last decade indicates that there was a new trend in macro-level rural-urban mortality trends in the United States (Cosby et al 2008, Cossman et al 2010). Specifically, many have found that the county-level age-adjusted mortality rates from the last 50 years showed a reversal in the divergence between urban and rural mortality rates. That is, historically, there was an urban mortality penalty—people who lived and died in urban areas had higher mortality rates than those who lived and died in rural areas. In the mid-1980s this trend reversed and now people who live and die in rural areas have higher mortality rates than those who live and die in urban areas.

The urban mortality penalty was a long-standing disparity having arisen in the Industrial Revolution and persisted through the 19th and 20th centuries (Haines, 2001) and mostly due to infectious and contagious diseases (Omran, 1971; Saloman and Murray, 2002), water quality (Cutler and Miller, 2005) and the poor sewage treatment (Condran and Crimmins-Garnder 1978) in densely populated (Preston and Haines, 1991; Higgs and Booth, 1979) urban areas. Twentieth century improvements in public health (Cutlet and Miller, 2005) reduced mortality rates substantially and resulted in a 50% growth in life expectancy (Smith and Bradshaw 2006), essentially removing the urban mortality penalty by the late 1940s.

Recent research has shown more disparities across rural and urban categories, mostly using recent data from the Centers for Disease Control. For example, Singh and Siahpush (2014) found that poor rural Blacks have the highest mortality rates. Murray and his colleagues also note (2005, 2006) that there are regional variations in life expectancy, mortality, health care utilization and insurance that are largely rooted in race, population density, and race-specific socioeconomics.

Typical measures of rural-urban areas are rooted in the aggregation of rural-urban continuum codes (Singh and Siahpush 2002 and Hall, Kaufman, and Ricketts 2006). First, descriptive analyses established mortality disparities over time, then multivariable analysis examined factors associated with these trends. We used the Compressed Mortality File from the National Center for Health Statistics, which tracks county-level mortality in the United States. We used data from 1968-2007 (85,868,225 deaths). The data are structured to show how many deaths occur in each race-sex-age category by cause (ICD-9, ICD-10 beginning 1999) and county (NCHS 2010). Denominators were calculated using census estimates of resident populations (NCHS 2000, 2001, 2010). Virginia's independent cities were collapsed into their appropriate counties.

We used the 2000 Standard Million to age-adjust the mortality rates using 11 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 each age group is of the total population is used as a weight for each age group in each region in the age-adjusted mortality rate calculations. Using this method, the urban and rural mortality rates are based on the same standard population distribution, which permits direct comparisons across counties (Swanson and Siegel, 2004). Essentially, this means that the effect of age has been removed from analysis and counties with aging populations can easily be compared to counties with younger populations. Beale codes were used to classify counties as urban or rural as outlined in James (2014). Urban classifications (codes 0-3 comprise about 83% of the US population, while rural codes (4-9) comprise about 17% of the total US population.

We then calculated four measures of mortality disparity: (1) excess deaths per 100,000, (2) total excess rural deaths, (3), the annual rate of change in mortality, and (4) a comparison of proportional populations. Each of these was calculated for whites and for blacks separately. The excess rural deaths per 100,000 is calculated as the difference between the age-adjusted mortality rate for the rural areas and that of urban areas. The total excess rural deaths is the rural deaths that would not have happened if rural areas experienced an urban rate of death. The annual rate of change in mortality is the difference in rates between each individual year, divided by the first year's rate (e.g., (1997-1998)/1997) multiplied by 100. Finally, we compare the proportions of the rural population in each region and the percentage of excess deaths—if the percent of the total population is higher than the percentage of deaths in that area, then they are experiencing a mortality advantage. If the percentage of deaths is higher than their respective percentage of the population, then they are experiencing a mortality penalty or disadvantage.

Finally, we performed multivariate analyses that examine the effects of demographics, socioeconomics and health care measures on mortality disparities across the country. These variable come from either the Area Health Resource File of from the US Census. Demographic measures include percent Black (2006), percent in poverty (2005), percent older than 65 years (2006), segregation (dissimilarity index, 2000), and census region dummy variables (2000). Health care related variables include 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. Analysis was conducted in SPSS 22.0 (IBM, Hong Kong), and the file was split by RUC designation, as well as by race.

Of specific interest for this research, we calculated a public health infrastructure index. We know that there are geographic variations in public health spending (Mays and Smith, 2009), but that they exist has not yet been linked to health-related disparities nationwide. One recent study examined how changes in public health expenditures effected health outcomes, but only examined California (Brown, Martinez-Gutierrez, & Navab, 2014) and Georgia (Marton, Sung, and Honore, 2015). Our public health infrastructure index includes several measures of physician workforce and several measures of rural health care facilities.

Results

Figure 1 shows that the rural mortality penalty is substantially different for whites and blacks. Black Americans have much higher mortality rates than white Americans. Also,

the rural mortality penalty did not hit the black population until the late 1990s, while it began for the white population in the mid-1980s. Even though it started later, the rural mortality for black Americans is now as large as it is for white Americans. That is, although the rural mortality penalty started later for African Americans it is now as substantial a problem in minority mortality as it is among whites.

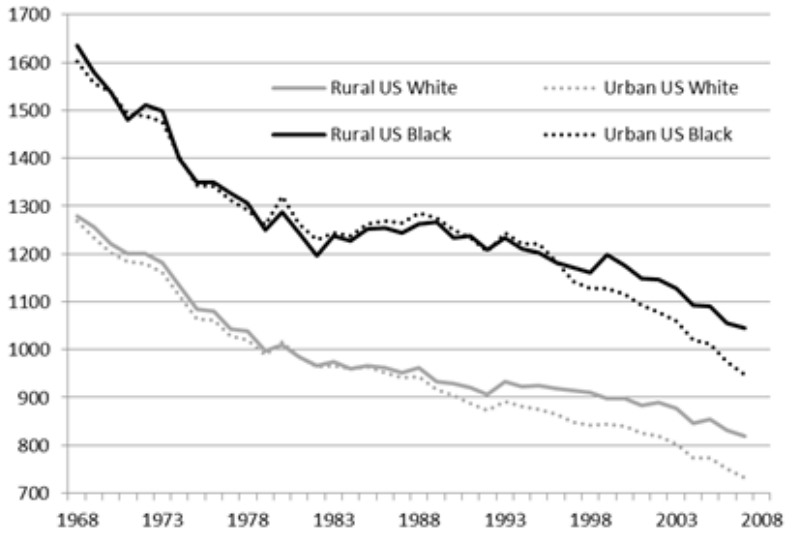

Figure 1. Age-adjusted mortality among rural and urban blacks and whites, 1968-2010.

Figure 2A plots the excess white and blacks deaths in rural-urban continuum areas of 4 and 5 (population of 20,000 or more, and less than a quarter million, adjacent or not to a metropolitan area). Excess deaths are highest among rural black Americans who live in RUC5, which is non-adjacent areas of 20,000-249,999 in population. The excess deaths in these areas have been especially high since the rural mortality penalty emerged for African Americans in the late 1990s.

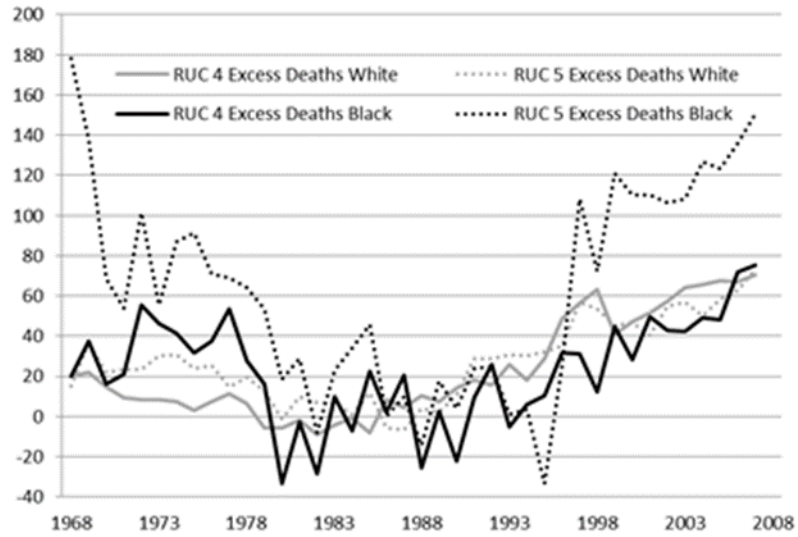

Figure 2a. Excess Deaths of black and white rural American in RUC 4/5

Figure 2B plots the excess white and blacks deaths in rural-urban continuum areas of 6 (adjacent) and 7 (nonadjacent) (population of 2500 or more, and less than a 20,000). Excess deaths are highest among rural black Americans who live in RUC5, which is non-adjacent areas of 20,000-249,999 in population. Historically, whites in these areas had the highest rate of excess deaths—the largest rural mortality penalty and blacks in RUC6 had the lowest rates for most of this time frame. In more recent years, both races in both rural areas had relatively comparable mortality penalties, but they are the highest of the time period under study.

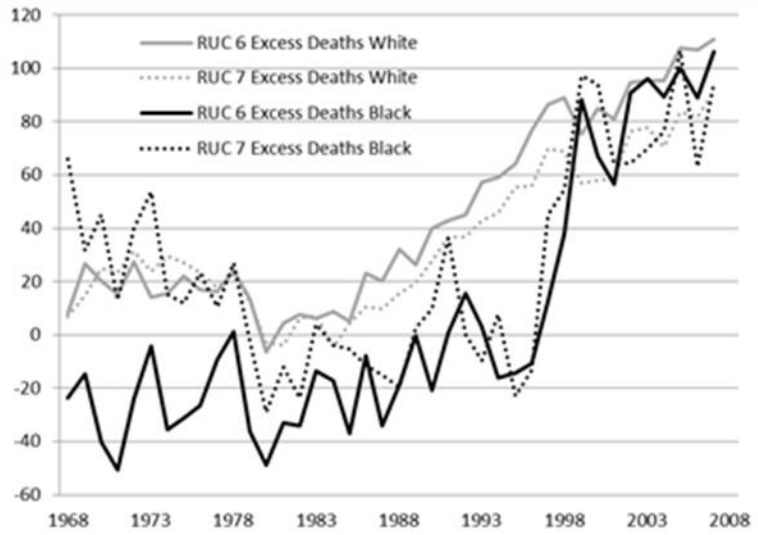

Figure 2b. Excess Deaths of black and white rural American in RUC 6/7

Figure 2C plots the excess white and blacks deaths in rural-urban continuum areas of 8 (adjacent) and 9 (nonadjacent) (population of less than 2500). Excess deaths are highest among rural black Americans in RUC8; until recently, excess deaths have been highest for whites who live in RUC 8. Very recently the excess deaths for blacks in RUC8 jumped to a point that it exceeded white excess deaths.

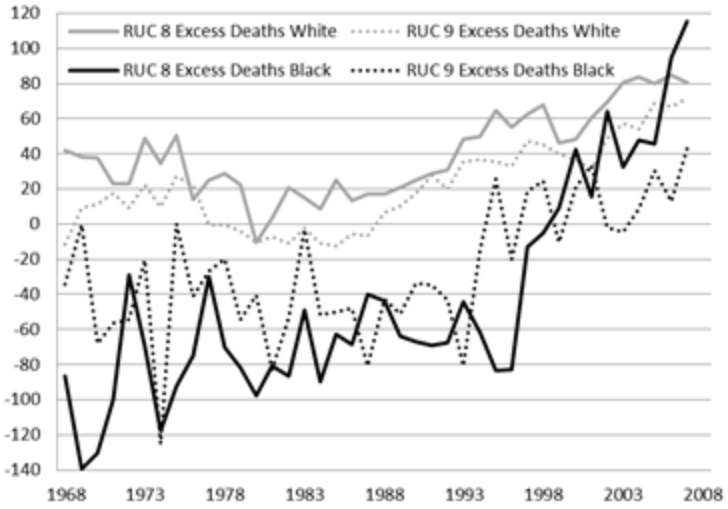

Figure 2c. Excess Deaths of black and white rural American in RUC 8/9

In summary, excess deaths in RUC 5 (non-adjacent 20,000-249,999) are very high for blacks at the beginning and end of our time series, but not in the middle. In RUC 6 (adjacent) and 7 (nonadjacent, 2500-19,999), the conditions were once favorable for black mortality, but in the late 1990s these areas became far more hostile toward black mortality (compared to urban black mortality). Still both of these areas have high mortality for whites and blacks from the late 1990s into the early 2000s. In the RUC 8 (adjacent, less than 2500) high rates of excessive deaths for whites have been consistent and more recently, there have been high rates of excess deaths for black Americans as well. Finally in RUC 9 (non-adjacent less than 2500) the most rural region, we see high rates of excess deaths for blacks and nearly as bad excess deaths rates for whites. Across all of the graphs, you can see that the rate of excess deaths are less stable for blacks than they are for whites—an artifact of the data and the lower percentage of the population that is African American.

Finally, we calculated the average annual rate of change in mortality for rural and urban whites and blacks, and that of each intra-rural race group. From 1968-1985 (before the onset of the national RMP), all group/regions had a rate of decline of roughly 1.3% per year to 1.75% per year. The fastest rate of mortality decline was for RUC 4 whites and, surprisingly, RUC 5 blacks. Since the onset of the overall RMP in 1986, the rate of mortality decline slowed for all group/regions considerably. All but 1 slowed to less than 1% improvement per year. The slowest rate of improvement is for RUC 6 and 8 black and RUC 6 white. Once again, RUC 6 is a bad region for both races, as was found in James 2014. As a general statement, both black and white mortality are improving at slower rates, and black mortality is improving slightly slower than white mortality, but it varies tremendously by region.

Annual Rate of Change (%) White	1968-2007	1968-1985	1986-2007
Rural White	1.122	1.620	0.737
Urban White	1.386	1.590	1.229
Rural Black	1.121	1.522	0.811
Urban Black	1.319	1.367	1.282
Annual Rate of Change (%) White	**1968-2007**	**1968-1985**	**1986-2007**
RUC 4 White	1.189	1.727	0.773
RUC 5 White	1.172	1.585	0.852
RUC 6 White	1.044	1.599	0.614
RUC 7 White	1.100	1.596	0.717
RUC 8 White	1.202	1.629	0.872
RUC 9 White	1.121	1.610	0.744
Annual Rate of Change (%) Black	**1968-2007**	**1968-1985**	**1986-2007**
RUC 4 Black	1.152	1.326	1.018
RUC 5 Black	1.201	1.757	0.772
RUC 6 Black	0.997	1.441	0.654
RUC 7 Black	1.162	1.607	0.819
RUC 8 Black	0.854	1.291	0.516
RUC 9 Black	1.101	1.393	0.874

Table 1. Annual Rates of Change in Mortality, 1968-2007

Multivariate analyses are underway to help us ascertain why the rates of excess deaths for Black Americans have recently increased – and for this research we are focusing on variations in public health infrastructure across rural places. We want to know the underlying reasons for these changes.

Conclusions

The rural mortality penalty exists for both white and black specific mortality rates, but the onset of the black rural mortality penalty happened nearly 10 years later than the white penalty. The most advantaged regions for black mortality displays substantially higher death rates than the most disadvantaged white regions. Furthermore, intra-rural variations exist within each race-specific mortality penalty. RUC 6 is a disadvantaged region for both races, and RUC 8 is disadvantaged for blacks. RUC's 6 and 8 are proximate to urban areas, lending further evidence that access to health care is not an adequate predictor of mortality in and of itself. Instead, social, economic, and possibly cultural characteristics of these communities are key predictors of aggregate mortality. Lastly, policy makers should focus on the declining rate of mortality improvement in many rural regions, specifically to better understand how their decisions concerning public health spending influence rural mortality different for black and white residents.

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