Risk Factors and Potentially Preventable Deaths in Rural Communities

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BACKGROUND

As the rural-urban mortality gap continues to expand, researchers have been exploring the reasons why the gap exists and how some of the deaths might be prevented. Studies show a higher percentage of rural residents die from preventable causes, specifically heart disease, cancer, unintentional injury, chronic lower respiratory disease,[1] and stroke (the five leading causes of death) than urban residents.[2,3] Researchers have also mapped deaths from specific causes with modifiable risk factors to estimate potentially preventable deaths.[4] Building on this work, we use a new model to estimate differences in death rates due to modifiable risk factors. The notion of what is a preventable or avoidable death is difficult to capture, and subject to multiple definitions and thus empirical approaches. For this study, we used variation in three risk factors – smoking, obesity, and excessive alcohol use – to identify their relative contribution to common causes of mortality. We hypothesize that the generally higher rates of smoking, excessive drinking, and obesity in rural areas lead to higher rates of potentially avoidable deaths than in urban areas.

KEY FINDINGS

- Rural counties have a higher rate of potentially avoidable death attributable to modifiable risk factors such as smoking, excessive drinking, and obesity. Approximately 43 percent of deaths in rural areas are potentially avoidable, compared to about 37 percent of urban deaths.
- The percent of deaths that are potentially preventable varies by cause of death, with roughly two-thirds of deaths due to chronic obstructive pulmonary disease (COPD) being avoidable versus less than one-third of diabetes deaths.
- The South has the highest percent of deaths that are potentially avoidable, and the West has the lowest, irrespective of condition considered here.

A deeper understanding of the relationship between modifiable risk factors, morbidity, and mortality may influence policy priorities. In addition to supporting the case for disease prevention, this method can help target how much of which intervention is needed where by estimating the magnitude of potential lives saved in rural communities. It may be the case that the most efficient strategies for targeting the overall rural-urban mortality rate are based in factors more "upstream" than previously thought. For example, while deaths from trauma (especially for those who had poor access to timely, high-quality trauma care) may grab headlines, the less visible deaths from lung cancer (as a result of higher smoking rates) and heart disease (as a result of obesity) may be disproportionately more responsible for the rural-urban disparity. Understanding the pathways that lead to illness and deaths across rural areas is important as policy makers and communities grapple with targeting limited resources.

The goals of the study are to use our new approach to compare (1) the rates of potentially avoidable deaths between rural and urban communities in the United States; (2) how rates of potentially avoidable deaths vary by census region; and (3) the relative contribution of the selected modifiable risk factors to rates of potentially avoidable deaths (e.g., the effect of smoking relative to the effect of excessive alcohol use).

METHOD

The basic method includes three steps:

1) Determining how county-level variation in three modifiable risk factors – smoking, excessive alcohol use, and obesity – correlates with causes of death[5] known to be associated with these risk factors;

2) Calculating the difference in death rates attributable to these risk factors. For example, the link between lung cancer and smoking is well-established. Suppose an analysis suggests that for every percentage point increase in the county adult smoking rate, the mortality rate for lung cancer increased by 1.5 per 100,000 population. A county with a 20 percent smoking rate, relative to one with a 12 percent smoking rate, would be expected to have a mortality rate that is (20-12) * 1.5 = 12 more deaths per 100,000 population. In a county of 50,000, this approach would generate six "avoidable" deaths resulting from the higher smoking rate. A key question is what to set as the "minimum" level of the behavior. We chose to set the floor at the minimum prevalence of the risky behavior – that is, the minimum observed level of smoking across the 3,142 U.S. counties.

3) Conducting multivariate analysis focused on five causes of death [defined by the 113 groups used by the Centers for Disease Control and Prevention (CDC) Compressed Mortality File], age-adjusted to the 2000 standard population, for the years 2012-2016 at the county level. Each regression includes a metropolitan (rural/urban) indicator and adjusts for the economics of the county using a quadratic in the Appalachian Regional Commission's (ARC's) Economic Index, a composite measure including the per capita income, poverty rate, and unemployment rate of the county.[6]

Standard errors were calculated by bootstrapping the regression samples over 1,000 replications. Age-adjusted mortality data for all residents in 2012-2016 were extracted from the CDC WONDER implementation of the compressed mortality file. Deaths were categorized by the 113 classifications, and we focused on the 20 conditions with the largest number of deaths. County-level data on smoking, alcohol use, and obesity were obtained from the 2016 County Health Rankings.[7] Economic conditions used the 2017 ARC Economic Index, and counties were classified as metro (urban) or non-metro (rural) based on their 2015 U.S. Office of Management and Budget (OMB) classification.[8] Linear regression, with county observations weighted by population, regressed each mortality as the outcome adjusting for the three behaviors, a quadratic in the economic index, and a rural indicator. The change in the age-adjusted death rate was calculated as (for example) [smoking rate in the county – benchmark smoking rate] * the effect of smoking on mortality; for the analysis here, the benchmark was the minimum value in the nation. The difference in the age-adjusted mortality rates, multiplied by the county population, simulated the number of deaths that potentially could be avoided due to reductions in risky behavior.

RESULTS

Weighted means are presented in Table 1. Compared to urban areas, rural counties have higher mean rates of smoking and obesity, but not drinking. This suggests that mortality conditions driven by excessive alcohol use may be higher in urban areas, while factors driven by smoking and obesity – acute myocardial infarction, for example – may be much higher in rural counties.

Table 1. Modifiable Risk Factor Rates in Rural and Urban Areas

	Total mean (SD)	Rural mean (SD)	Urban mean (SD)	p-value
Smoking (Percentage of adults who are current smokers**)**	16.3 (3.51)	19.1 (3.46)	15.8 (3.29)	<.001
Excessive Alcohol Use (Percentage of adults reporting binge or heavy drinking)	17.7 (2.79)	16.5 (3.45)	17.9 (2.60)	<.001
Obesity (Percentage of adults that report a BMI of 30 or more)	27.4 (4.93)	31.5 (4.46)	26.7 (4.66)	<.001
N (U.S. Counties)	3,110	1,999	1,147	

Figure 1 shows the results graphically. **We present the percent of deaths that potentially could be avoided if the counties of each type had the risk profile of the minimum value across all U.S. counties for each of the three considered risk factors: smoking (6.9%), excessive alcohol use (8.4%), and obesity (10.7%).** Overall, roughly 40 percent of all deaths would be prevented, which compares to the roughly 50 percent predicted by Danaei, et al., who effectively used a baseline of *zero* rates of risky behavior; that is, we defined as "potentially preventable" the rate due to smoking rates greater than the *minimum* observed value, rather than zero.[4] We also found that a greater percent of rural deaths are preventable (43.5% versus 37.0%) than urban deaths. The condition-specific prevention rates vary between rural and urban areas from highly preventable COPD (62.1% versus 64.1%) to diabetes (29.8% versus 24.8%). (All rural-urban differences are statistically significant except acute myocardial infarction (AMI) and COPD.)

Figure 1. Percent of Potentially Preventable Deaths Attributable to Specific Conditions by Rural and Urban Areas

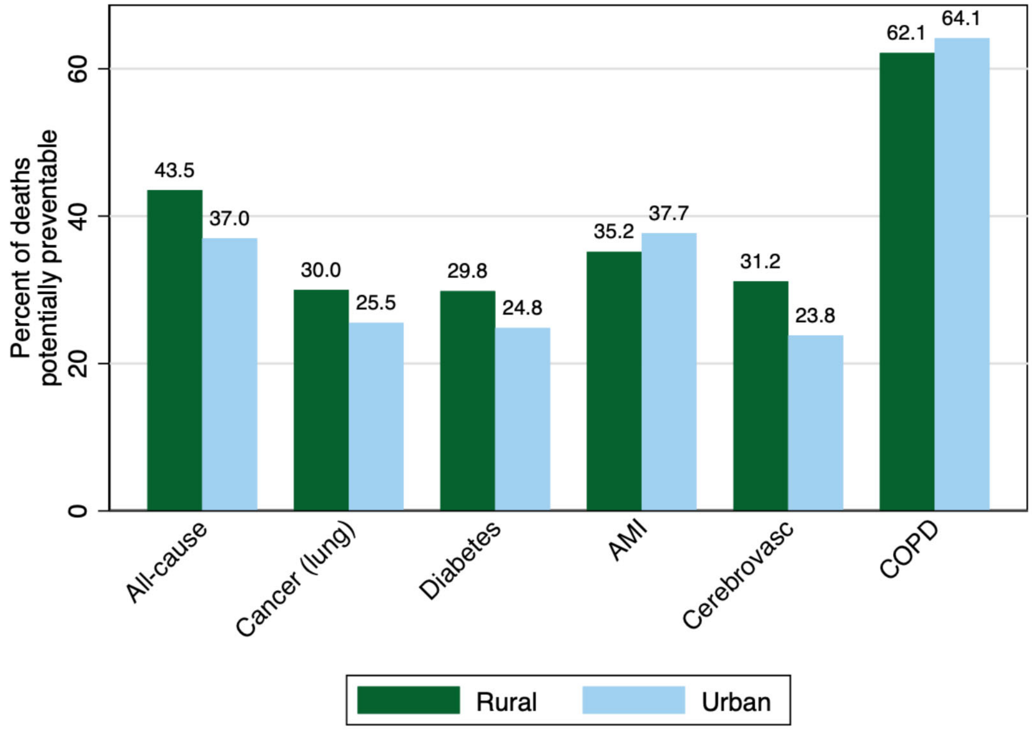
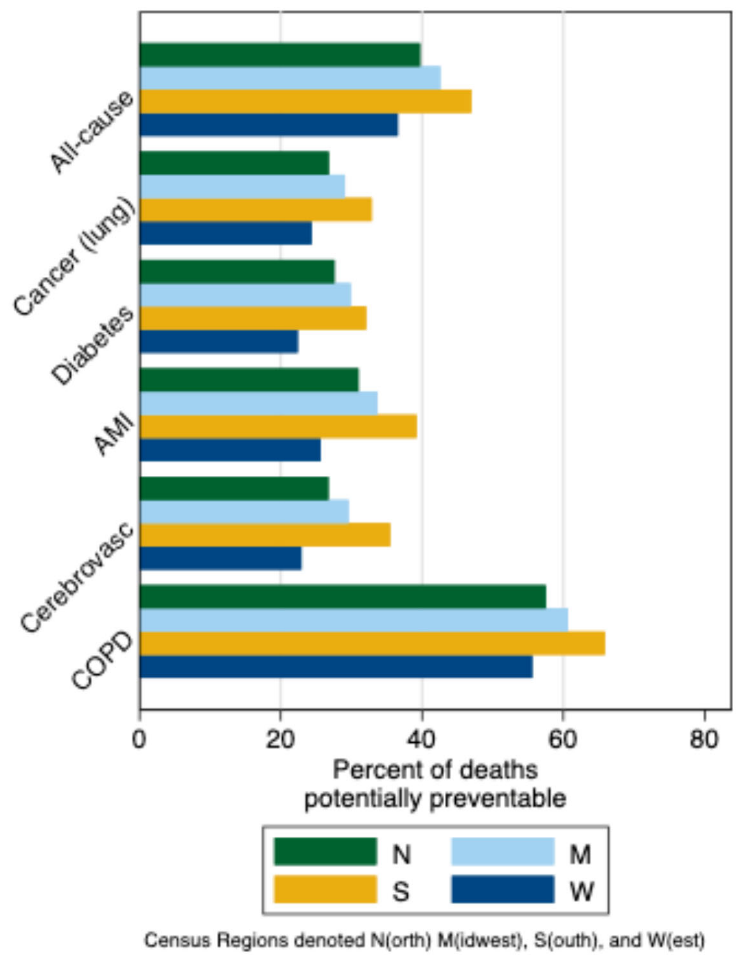


Figure 2 separates the relative effects into regional effects. Across the conditions, the South has the highest rate of potentially avoidable deaths, and the West has the lowest rate.

Figure 2. Rural Rates of Potentially Preventable Deaths by Census Region



To better understand the impact of these risk factors, we calculate the implied reduction in mortality for a three percentage point reduction – roughly one standard deviation – in each county for each of the risk factors (Table 2). For example, a three percentage point reduction in the smoking rate in every rural county is projected to decrease the number of deaths by about 103,000. A three percentage point reduction in the obesity rate is projected to save about 71,000 lives per year.

Table 2. Potentially Preventable Deaths after Reducing Risk by Three Percentage Points in Rural and Urban Areas

Three percentage point reduction in the county rate of…	**Rural Potentially Preventable Deaths**	**Urban Potentially Preventable Deaths**
…smoking	103,279	602,185
…obesity	71,442	416,554

LIMITATIONS

This approach makes a number of simplifying assumptions, including that the county rate of risk factors is a proxy for the individual lifetime risk – that is, that the current rate of smoking in a county is reasonable proxy for the lifetime behavior of the individuals living in that county. A possible confounding variable comparing county to county is the information on death certificates (e.g., whether the death certificate is completed by a medical examiner or coroner). The model of mortality is quite oversimplified, assuming only a few factors drive mortality. Finally, all three risk factors are synthetic estimates based on county characteristics and known associations with risk factor prevalence.

CONCLUSIONS

The notion of what is a preventable or avoidable death is difficult to capture, and subject to multiple definitions and thus empirical approaches. Here, we used variation in three risk factors – smoking, obesity, and excessive alcohol use – to identify their relative contribution to common causes of mortality. As expected, we found that rural counties had a higher proportion of deaths attributable to health risk factors than urban counties, and there was significant variation across common conditions. Although we employ a considerably different approach from others who have tackled this issue, we find similar conclusions – rural areas tend to have a higher rate of potentially avoidable deaths. This brief underscores the need for prevention-minded interventions across multiple dimensions to improve population health. Even modest changes in modifiable risk factors can have considerable impact – e.g., a three percentage point reduction in the obesity rate is projected to save 71,000 lives in rural communities per year. Efforts to move upstream focusing on health drivers to change risk factors can have considerable mortality payoff; these findings echo those of other researchers suggesting large benefits could be found by targeting preventive efforts toward changing health behaviors.

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