

## Conclusions

There are clear geographic disparities in premature mortality from leading causes of death both at the national and regional levels. Several fairly distinct regions of the country experience excess premature mortality when compared to the U.S. as a whole: the Mississippi Delta, the Southeast U.S., and Appalachia. The national analyses update and confirm the earlier analyses of health disparities for all-cause, heart disease, all-site cancer, and stroke mortality measures. At the regional level, well defined clusters with higher rates of mortality for heart disease and all-site cancer are found in parts of Central and Southwestern Appalachian than other parts of the region that are comparably disadvantaged on several socioeconomic measures.

Patterns of association between measures of socioeconomic conditions and premature mortality are fairly consistent at both the national and regional levels although there is both local and regional variability for disease-specific analyses. The results from the local indicators of spatial association exhibit *two distinct types of statistically significant association* between measures of socioeconomic conditions and health outcomes among neighboring counties: *adverse outcomes* as measured by associations of neighboring counties with relatively high mortality rates and poor socioeconomic conditions, and; *favorable outcomes* for associations of neighboring counties with low mortality rates and good socioeconomic conditions.

At the national level the clearest spatial patterns of association are found when using the *poverty rate* and the *percentage of persons without health insurance* as the socioeconomic measures, with adverse health outcomes for heart disease and all-site cancer deaths spatially concentrated in the lower Mississippi Delta, parts the Southeastern U.S., and parts of Central and Southwestern portions of the Appalachian Region, as well as a few variable small clusters in the West. Favorable health outcomes are spatially concentrated in the upper and lower Great Plains, upper Mid-West, much of the Rocky Mountain counties, and several western Rio Grande counties, particularly for heart disease and all-site cancers. At the regional level well defined clusters with higher rates of mortality for heart disease and all-site cancer are found in parts of central and southwestern Appalachian, particularly when using the *poverty rate* and *percentage of persons without health insurance* measures.

**Premature all-cause mortality:** At the national level a few significant associations between measures of socioeconomic condition and *premature all-cause mortality* are found across the nation with the *poverty rate*, the *percentage of persons without health insurance* and the *unemployment rate* indicating adverse outcomes in the southeast, the lower Mississippi Delta, several counties in northern California and southern Nevada, a small pocket in central Appalachia and counties in the extreme southern portion of Appalachia. Regional analyses for *premature all-cause mortality* identify two spatial concentrations with significant associations of measures of socioeconomic condition and health outcomes: favorable outcomes in the north, and adverse outcomes in small pockets of the extreme south. The two measures of socioeconomic condition that stand out in these regional analyses are the *poverty rate* and

the *percentage of persons without health insurance*, with more counties in the southern part of the region experiencing high rates of poverty and high percentages of persons without health insurance. The limited number of significant associations for all-cause mortality in many parts of the U.S. and Appalachian is partially a reflection of the extreme high death rates in the Southern states and extreme low death rates among states in the upper Midwest and Great Plains. Due to the methodology these extreme values limit the number of significant associations.

**Premature heart disease mortality:** At the national level, the analysis finds significant adverse associations between poor socioeconomic conditions and premature heart disease mortality, principally in the central and southern portions of Appalachia, the southeast U.S., the Mississippi Delta region, and parts of the Ozarks and east Texas. The *poverty rate* and *percent of persons without health insurance* were the socioeconomic measures most often revealing adverse outcomes. Favorable health outcomes are spatially concentrated in the upper and lower Great Plains, the upper Mid-West, much of the Rocky Mountain counties, and several western Rio Grande counties, although many counties in sparsely populated areas west of the Mississippi River have insufficient data. Regional patterns of association between measures of socioeconomic conditions and premature heart disease mortality reveal three parts of the region with significant associations: counties in the extreme north, the central part of the region, and the extreme south. Counties in the central and southern regions experience more adverse outcomes and consistently share more adverse socioeconomic characteristics, particularly with regards to *poverty rates*, *the percentage of persons without health insurance*, and *unemployment rate*. The northern sub-region of Appalachia exhibited some favorable outcomes associated with better socioeconomic conditions.

**Premature cancer mortality:** At the national level, the analysis finds significant adverse associations between poor socioeconomic conditions and premature all-site cancer mortality, principally in the central and southern portions of Appalachia, the southeast U.S., the Mississippi Delta region, and parts of the Ozarks and east Texas. The *poverty rate* and *percent of persons without health insurance* were the socioeconomic measures most often revealing adverse outcomes. Favorable health outcomes are spatially concentrated in the upper and lower Great Plains, the upper Mid-West, much of the Rocky Mountain counties, and several western Rio Grande counties, although many counties in sparsely populated areas west of the Mississippi River have insufficient data. For the regional analysis, premature cancer mortality counties in the central part of the region stand out with a large cluster of counties showing significant associations with measures of socioeconomic condition. A noncontiguous group of counties in the southern part of the region show significant associations in addition to a group of counties along the Northeastern Appalachian boundary in Pennsylvania and West Virginia. Central Appalachia shows significant adverse associations on all five measures of socioeconomic condition.

**Premature stroke mortality:** In both the national and regional analyses the associations between premature stroke mortality and measures of socioeconomic condition are sporadic. This is largely due to the fact that premature stroke deaths are rare and therefore stable death rates (unsmoothed) for premature stroke mortality cannot be

generated for the majority of counties in the country and the Appalachian Region. In the national analysis there are a few spatial concentrations in the lower Mississippi Delta, Alabama and the Carolinas. In the regional analysis a singular spatial concentration occurs in central Alabama where a relatively large cluster of counties exhibits significant associations with measures of socioeconomic condition. However, there appears to be a relative lack of consistency among these counties with regards to how rates of premature stroke mortality associate with measures of socioeconomic condition.

The method used to derive the associations in this study is promising and highlights a number of key parts of the region where socioeconomic conditions may significantly contribute to adverse health outcomes. One of the limitations of this method, however, is the dependence on the overall mean in the distributions of socioeconomic measures and rates of premature mortality. Therefore associations derived from these analyses are relative only to national and regional averages. More localized analyses with more constrained geographic areas will likely yield more detailed results.

In addition, it is not clear why areas which share similar measures of socioeconomic condition often experience vastly different health outcomes. Nationally, socioeconomically disadvantaged areas in the southeastern and eastern U.S. suffer disproportionately higher rates of mortality than areas of comparable socioeconomic disadvantage in the Western U.S. Similarly, areas in the central and southern part of Appalachia suffer disproportionately higher rates of mortality than the Northern part of the region despite similarity on most socioeconomic measures. There are likely to be other key factors than socioeconomic that need to be considered for further analyses.

Of the five measures of socioeconomic condition evaluated in this study, *poverty* and the *percentage of persons without health insurance* appear to more consistently define localized areas that suffer the highest rates of premature mortality. It is noteworthy that the results from both *percent urban population* and *median family income* seem to function more as screens to reveal spatially contiguous areas with significant associations across both high and low values for these variables. The *unemployment variable* seems to lack explanatory power across the various causes of premature death perhaps reflecting the short term volatility of this socioeconomic measure. Thus, variability in associations of different socioeconomic conditions with different causes of premature death provides a useful screening tool for disease specific associations at the local level. There are however, other variables that should be explored as possible socioeconomic measures, particularly *industrial structure* as measured by employment shares and *occupational structure* as measured by the ratio of supervisory to production worker measures.

Taken together these analyses elucidate how local socioeconomic conditions, particularly *poverty rates* and the *percentage of persons with health insurance*, contribute to variations in the rates of premature mortality. These findings aid in understanding which broad socioeconomic conditions are associated with particular disparities in health outcomes. Yet further more localized work is required to understand how these underlying factors give rise to conditions that may either impede or facilitate behavioral, medical, and social interventions aimed at improving health at the local level. Traditional approaches to public health intervention that are aimed at reducing individual risk may be

less effective among populations whose lifestyle choices are restricted by structural impediments such as poverty, limited social and public health infrastructure, and the broader socioeconomic adversity that arises from the availability of few employment, medical care, and recreation options.

Health care accessibility is perhaps one variable which may help explain the variability in premature mortality. Many areas in the U.S. and the Appalachian region lack sufficient infrastructure to support an adequate number of health care facilities. As a result, many people may need to travel long distances to obtain both preventive care and treatment for existing conditions. For many, travel distances may be a major limiting factor to regular medical care. Further consideration should be given to research the extent to which significant proportions of the population experience limitations in medical care access due to costs and/or lack of health insurance.

Methodologically there is the prospect of applying geographically weighted regression analysis to these data to develop a multivariate analysis of health disparities. Geographically weighted regression may provide more complete geographic coverage in determining local levels of associations.

Since short term, structural improvements in local socioeconomic conditions among areas with high premature mortality are not likely, practical local interventions need to be tailored to account for existing structural impediments that limit the effectiveness of traditional approaches to public health intervention. Developing a keen understanding of the local context within which populations live is critical to the development of effective intervention strategies that focus on appropriate regional, community, family and individual approaches. As such the areas identified in this report with adverse health outcomes and poor socioeconomic conditions represent clear candidates for community level research to address these issues.

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