A Georgetown University medical school student celebrates his graduation with his parents.

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Introduction

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In 1999, stroke was the third leading cause of death in the United States and a leading cause of serious, long-term disability, placing an enormous burden on the public's health. Approximately 600,000 U.S. residents suffer a new or recurrent stroke each year, and roughly 167,000 die of a stroke each year.[1] In 1999, a total of 1.1 million U.S. adults reported functional limitations and difficulty with activities of daily living resulting from a stroke.[1] Substantial disparities in the health and economic burden of stroke among racial and ethnic populations have been documented, with African Americans far more likely to die of stroke than members of other racial and ethnic groups in the United States.[2]

In addition, an alarming trend has been observed in stroke mortality rates during the past decade. Although stroke mortality declined substantially for many racial and ethnic groups during the 1970s and early 1980s, little improvement was made during the 1990s.[3] Equally as disturbing, stroke hospitalizations actually increased 18.6% from 1988 through 1997.[4] These observations have raised awareness within the public health and medical professions that new and innovative efforts are needed to more effectively prevent stroke. In addition, there is increased appreciation of the need for public health agencies and other institutions to act locally to provide more targeted and culturally appropriate stroke prevention programs and policies.

To achieve these goals, the *Atlas of Stroke Mortality: Racial, Ethnic, and Geographic Disparities in the United States* presents county, state, and national data for 1991–1998. Data are presented for both women and men and for the five largest racial and ethnic groups in the United States—American Indians and Alaska Natives, Asians and Pacific Islanders, blacks, Hispanics, and whites. The national maps allow comparison of rates across all U.S. counties, whereas state maps allow comparison across counties within each state. This complementary information is useful for targeting resources to communities at high risk.

Substantial geographic disparities in stroke mortality have been observed in the United States for decades.[5–12] Early on, the term "stroke belt" was coined to describe the concentration of high stroke mortality rates in the southeastern United States. The first study that examined the geographic pattern of stroke mortality used the state as the unit of analysis.[5] Later studies have reported more detailed patterns in the geographic disparities in stroke mortality by using smaller units of analysis (i.e., health service areas, state economic areas, and counties).[6–8, 10–12]

Missing from the literature, however, are the patterns of geographic disparities in stroke mortality for racial and ethnic groups other than blacks and whites. In this publication, we present maps and tables that document these disparities among American Indians and Alaska Natives, Asians and Pacific Islanders, blacks, Hispanics, and whites during 1991–1998. The patterns of geographic disparities in stroke mortality vary dramatically among these groups and should be carefully studied when prevention programs and policies are planned or the determinants of these disparities are investigated.

Existing studies of the geographic disparities in stroke mortality have confirmed a concentration of high stroke mortality rates in the Southeast for all persons ages 35 and older, for blacks as well as whites, and for both women and men. Hypotheses regarding the determinants of the loosely defined stroke belt have evolved through the years. Initially, researchers believed the stroke belt was a fixed

geographic entity, prompting geologic hypotheses on the deficiency of trace elements (e.g., selenium) and the hardness of the water.[6] However, evidence exists that the geographic pattern of the stroke belt has changed substantially in only 25 years.[10]

In 1962, a large concentration of counties with high stroke death rates was reported in the coastal states of North Carolina, South Carolina, and Georgia. By 1988, this concentration had diminished, and a new concentration of counties with high rates was observed in the Mississippi Delta. This observation shifted the hypotheses away from properties of the physical environment and focused researchers' attention on the possibility that differential trends in social conditions—including the prevalence of risk factors, the social environment, access to care, and migration patterns—could be contributing to the observed geographic disparities in stroke mortality.[10,13] Although geographic bias in the accuracy of stroke diagnosis and/or death certificate reporting may also contribute to the observed geographic disparities in stroke mortality, no studies have confirmed this hypothesis to date.[14–16]

A few studies have examined the associations of geographic disparities in stroke risk factors with geographic disparities in stroke mortality. A 1977 study of blacks and whites in three geographically diverse communities with different rates of stroke mortality (low, medium, and high) reported that only blood glucose levels were correlated with stroke mortality for both blacks and whites. Blood pressure levels correlated only with stroke mortality rates for black women and white men across the three communities, and no consistent patterns were observed for the other risk factors included in the study (i.e., serum cholesterol, weight and height measurements, and cigarette smoking).[17]

Similarly, data from the first National Health and Nutrition Examination Survey (NHANES I) Epidemiologic Follow-Up Study indicated that, even after adjusting for the leading stroke risk factors (i.e., age, smoking, diabetes, history of heart disease, education, systolic blood pressure, alcohol use, and physical activity), people living in the Southeast still had the highest risk for stroke.[18] In 1997, the contribution of socioeconomic status (SES) (as measured by education and family income) to the geographic disparities in stroke mortality was evaluated using the National Longitudinal Mortality Study (NLMS).[19] Although individual SES was strongly associated with the risk for stroke, it did not contribute substantially to the geographic patterns of stroke mortality reported in the NLMS.

Two studies have examined the role of characteristics other than stroke risk factors. A study of the effect of interstate migration patterns on geographic disparities in stroke mortality during 1979–1981 reported that stroke mortality rates in several states were strongly influenced by the patterns of people migrating into the states and that these patterns differed for blacks and whites.[20] Although the rates for whites in three states (Florida, Arizona, and Colorado) and the District of Columbia were lower because of in-migration, rates for blacks were lower in only one state (Colorado), but were higher in 21 states.

Another study examined the association between occupational structure (a measure of the social and economic resources available to residents of a community) and stroke mortality rates in communities in the South. The results indicated that communities with the lowest levels of occupational structure (e.g., the fewest resources) experienced the highest rates of stroke mortality.[21]

The *Atlas of Stroke Mortality* reflects our conviction that one of the keys to reducing the burden of stroke nationwide is to focus our attention on patterns of stroke mortality in local areas. Why is it critical to understand local geographic disparities in the burden of stroke mortality? We contend that health disparities among places reflect underlying inequalities in local social environments that make some communities more health-promoting than others. The social environment provides the context within which individuals are exposed to structural risk factors (e.g., lack of economic opportunity, poverty, social isolation) that contribute to the adoption of unhealthy behaviors (e.g., cigarette smoking, physical inactivity, poor diet).

Ameliorating the social environment in local communities will require structural and institutional changes, improvements in community social relations, and reductions in inequalities within those communities. Identifying the places that bear the greatest burden of stroke mortality is a necessary first step to targeting appropriate resources to improving the local social environment and health outcomes in those communities.

An important strength of this publication is our examination of geographic disparities in stroke mortality for the five leading racial and ethnic groups in the United States. Previous reports have focused predominantly on blacks and whites. Although data quality limitations exist for groups other than blacks and whites, we hope that presenting these results will highlight the need to improve the quality of death certificate and population data for all racial and ethnic groups and provide useful information to public health agencies and advocacy groups working to improve the health outcomes of diverse populations.

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