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Disparities in Premature Coronary Heart Disease Mortality by Region and Urbanicity Among Black and White Adults Ages 35–64, 1985–1995

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SYNOPSIS

Objectives. Regional and urban-rural disparities in premature coronary heart disease (CHD) mortality were evident in the US as early as 1950. Recent favorable trends at the national level may obscure less favorable outcomes for certain regions and localities. The authors examined trends in premature CHD mortality for 1985–1995 for black and white adults ages 35–64 years for four categories of urbanicity in two regions of the US (South and non-South).

Methods. All counties in the US (excluding Alaskan counties) were grouped by urbanicity and region. Annual age-adjusted CHD mortality rates were calculated for adults ages 35–64 by racial category (African American or white) and gender for each geographic area for the years 1985–1995. Log-linear regression models were used to estimate average annual percent declines in mortality for each of 28 geo-demographic groups. Data were also collected on selected socioeconomic resources by urbanicity for the non-South (excluding Alaska) and South.

Results. For both white and black adults ages 35–64, the highest rates of premature CHD mortality and slowest mortality declines were observed in the rural South. For white men and women, marked disparities in premature CHD mortality across categories of urbanicity were noted in the South but not outside the South. Unexpectedly high rates of premature CHD mortality were observed for African Americans in major metropolitan areas outside the South despite favorable levels of socioeconomic resources.

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Conclusions. Disparities in premature CHD mortality by region and urbanicity appear to have widened between 1985 and 1995. Residents of the rural South had the highest rates of premature CHD mortality, and rural communities in the South face significant barriers to effective heart disease prevention and control.

Early studies of the association of urbanicity with coronary heart disease (CHD) mortality from the US, Puerto Rico, Yugoslavia, Britain, Canada, Finland, Norway, and Japan were remarkably consistent in reporting higher mortality rates in urban than in rural areas.[1-9] A US study looked at county CHD mortality rates for white men and women for 1949–1951 and found that mortality was 37% higher in metropolitan center cities than in rural areas for men and 46% higher for women.[1] The Puerto Rico Heart Study found that for 1965–1968, CHD incidence was higher for urban men than for rural men. Interestingly, this study also found that recent arrivals in urban areas were at higher risk for CHD than long-term urban residents.[4] Twelve-year follow-up of this cohort found a 31% excess in CHD mortality in urban areas compared with rural areas.

Through the early 1980s, researchers continued to find higher rates of CHD mortality in urban areas, but studies also showed more favorable trends in urban areas, leading to a reduction in the urban excess over time. Studies of the onset of decline in CHD mortality among white US residents for the period 1962–1978 found an earlier onset of decline in metropolitan areas than in non-metropolitan areas.[10,11] By the early 1970s, all areas of the US were experiencing declines in CHD mortality. A comparison of CHD mortality trends for black adults and white adults using data from the Evans County Study (rural) and Charleston Heart Study (urban) for 1968–1978 found initially higher rates in Charleston accompanied by higher rates of decline, leading to a rural-urban convergence over time.[12] A similar study of New Jersey counties for 1968–1982 found faster rates of decline in CHD mortality in urban than in rural areas.[13]

The most recent studies have found evidence of rural excess in CHD mortality and differences in mortality trends by racial category. A study of prevalent heart disease in the US for 1983–1987 found that among adults ages 45–64, white men had a higher prevalence in non-metropolitan areas than in metropolitan central cities or metropolitan suburbs but black men and women had high prevalences in both central cities and non-metropolitan areas and the lowest prevalences in metropolitan suburbs.[14] Another study found that the proportion of sudden CHD deaths (CHD deaths occurring out of hospital or in emergency departments) among white men ages 55–64 in 1985 was higher in non-metropolitan areas than in metropolitan areas of the US.[15]

A study of CHD mortality among African Americans living in the South in 1968–1986 found the highest rates in large metropolitan areas and the lowest rates in rural areas for both men and women at the beginning of the study period.[16] However, CHD mortality declined much faster in metropolitan areas than in rural areas, leading to a convergence in mortality trends by 1986. The authors predicted the emergence of a rural excess in CHD mortality among African Americans in the South in the late 1980s. A similar study found a marked rural excess in CHD mortality in the South for white men for 1979–1985.[17]

In contrast to the changing association of urbanicity with CHD mortality, regional disparities have remained fairly constant. The Southern excess in CHD mortality, first observed for whites in 1950,[1] appears to have persisted over time.[18-22] In the *Atlas of United States Mortality*, published by the National Center for Health Statistics (NCHS) in 1996, maps of smoothed (estimated) heart disease mortality rates for 1988–1992 showed a clear Southern excess at ages 40 years and 70 years.[20]

For the present study, we used death certificate data for all US states except Alaska to analyze CHD mortality trends for 1985–1995 for adults ages 35 to 64 years old. (Deaths of people in this age range represent premature, preventable mortality.) We analyzed data for two regions (South and non-South) and four categories of urbanicity. We posed several research questions: Did a rural excess in premature CHD mortality among both African Americans and white Americans become evident after 1985? Do these data confirm that a Southern excess in premature CHD mortality persisted into the 1990s? Were temporal trends in premature CHD mortality equally favorable across regions and level of urbanicity? Did CHD mortality differ by the socioeconomic characteristics of geographic areas that were defined by region and urbanicity?

METHODS

The study population consisted of white and African American adults who resided in the United States during the years 1985–1995. (Following guidelines from the federal Office of Management and Budget, we use the terms "black" and "African American" interchangeably.)

Using county-level death certificate data for adults ages 35–64 for the years 1985–1995 from NCHS, we looked at CHD mortality and trends separately for decedents identified as white and African American. We looked at the African American and white populations separately not because we view race as a biological risk factor for CHD but because race is an important sociological category that represents "the interaction of biological, cultural, socioeconomic, political, and legal determinants (including racism)" on health outcomes.[23] Both racial groups included people who identified themselves as Hispanic. In most states prior to 1989, death certificates did not record data on Hispanic ethnicity; consequently we were unable to examine CHD mortality trends separately for Hispanic adults. In addition, we did not analyze data for American Indians and Alaska Natives or for Asians and Pacific Islanders because of small numbers and because the spatial distributions of these populations were highly skewed with reference to urbanicity.

Geo-demographic groups. We initially focused on 32 geo-demographic groups, defined by gender, "race" (white or African American), age (35–64 years old), region (South or non-South), and urbanicity of residence. We used the US Census Bureau definition of the South, which includes 15 states (Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia) and the District of Columbia.

We defined urbanicity of residence based on county of residence at the time of death, as recorded on the death certificate. We grouped 3079 counties in 49 states into four categories of urbanicity. (We were unable to include Alaska due to lack of urbanicity data for counties.) *Major metropolitan* counties consisted of the central and fringe counties of large metropolitan areas with total populations of one million or more people. Counties in metropolitan areas with total populations of fewer than one million people constituted the *lesser metropolitan* group. *Small urban* counties were non-metropolitan counties with total urban populations of at least 20,000 people. *Rural* counties were non-metropolitan and contained total urban populations of less than 20,000.

CHD deaths. We obtained computer files of death certificate data from NCHS. We defined CHD deaths based on the underlying cause of death as recorded on the death certificate. Specifically, we included deaths with underlying cause of death codes 402 (hypertensive heart disease), 410–414 (ischemic heart disease), and 429.2 (cardiovascular disease, unspecified), as defined in the International Classification of Disease, Ninth Revision.[24] This definition of CHD has been recommended and used in several previous studies.[17,25–27]

For each CHD death, we abstracted data on age, race, gender, year of death, and county of residence. We used Census Bureau intercensal race-, gender-, and age-specific (by five-year age category) population counts for counties for each year from 1985 through 1995 as denominators in calculating CHD death rates. We obtained these county-level population estimates as computer data files from the Bureau of the Census.

We calculated the population distribution for 1990, person-years for 1985–1995, and premature CHD deaths for 1985–1995 for each race-gender group, by region and urbanicity of residence (Table 1). (Person-years represent the total population at risk for CHD mortality over the study period.) To calculate person-years for 1985–1995, we obtained the intercensal population estimates for each year for each race-gender group for each county and summed these over the 11-year period for each category of urbanicity in each region. While a large number of counties were rural, major metropolitan areas had the highest concentrations of person-years and CHD deaths. Small urban and rural counties outside the South together accounted for only approximately 1% of the African American population, and there were very few CHD deaths among African Americans in these areas over the study period. Consequently, we did not analyze premature CHD mortality trends for African American men and women living in small urban and rural counties in the non-South, reducing the total number of geo-demographic groups analyzed from 32 to 28.

Mortality rates. After grouping counties by region and urbanicity, we summed death counts and population counts across counties within each of the eight resulting geographic areas by year of death, gender, race, and five-year age group. We computed five-year-age-group-specific CHD mortality rates for each year for each of the 28 geo-demographic groups using Census Bureau intercensal population estimates as denominators and then calculated age-adjusted annual CHD mortality rates using the 1980 US population as the standard for age-adjustment.[28] We also calculated and graphed three-year running average rates of CHD mortality for each of the 28 geo-demographic groups.

Mortality trends. To quantify mortality trends over the study period, we fitted separate linear regression models

Table 1. Study population: adults ages 35–64 years, by region and urbanicity, United States, 1985–1995

Variable	Region: Non-South (excluding Alaska)				Region: South[a]			
	Major metropolitan	Lesser metropolitan	Small urban	Rural	Major metropolitan	Lesser metropolitan	Small urban	Rural
Number of counties	183	250	155	1100	117	266	88	920
Population distribution, 1990[b] (percent)								
Black women	41.7	6.6	0.5	0.3	20.7	18.1	3.1	9.1
Black men	40.5	7.4	0.7	0.7	20.7	17.9	3.0	9.1
White women	36.3	18.1	4.5	8.1	11.3	13.0	2.1	6.7
White men	36.2	18.1	4.5	8.3	11.4	12.7	2.1	6.7
Total person-years, 1985–1995[c]								
Black women	22,321,825	3,576,515	250,608	184,612	11,231,938	9,895,283	1,688,554	4,993,664
Black men	8,056,616	3,324,542	343,051	299,912	9,350,972	8,134,286	1,382,712	4,156,852
White women	146,677,818	73,369,305	18,175,193	32,901,669	45,746,313	52,650,524	8,418,870	27,501,692
White men	141,499,436	70,906,870	17,806,084	32,573,431	44,628,887	49,961,658	8,057,296	26,491,546
Total CHD deaths, 1985–1995[d]								
Black women	27,575	3,954	251	225	12,472	11,443	2,170	7,070
Black men	46,257	7,137	549	484	21,135	19,281	3,615	11,384
White women	78,706	37,911	9,850	18,467	21,843	28,594	5,239	19,592
White men	233,519	115,294	29,808	57,693	70,005	89,708	16,209	59,952

NOTE: Percentages may not add to 100% due to rounding errors.

[a]The South consists of: Alabama, Arkansas, Delaware, District of Columbia Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

[b]Source of data: Reference 68

[c]Source of intercensal population estimates: Reference 28

[d]Underlying cause coded on death certificate as 402 (hypertensive heart disease), 410–414 (coronary heart disease), or 429.2 (cardiovascular disease, unspecified) as defined in the International Classification of Disease, Ninth Revision[24]

CHD = coronary heart disease

to log-transformed age-adjusted rates for each geodemographic group. Specifically, we used the following model:

$$y = \alpha + \beta (x)$$

where $y = \ln(\text{age-adjusted rate})$

$x = \text{year}$

$100(e^{\beta} - 1) = \text{the average annual percent change in mortality.}$

The use of a log-linear model allowed us to compare the relative change in mortality over time for populations with markedly disparate absolute rates. In addition, linear regression of the log-transformed rates assumed constant proportional change over time rather than constant absolute change over time. This has been shown to be a more appropriate model for examining temporal trends in mortality.[29] We calculated 95% confidence limits for average annual percent changes using the standard errors from the regression models.

Socioeconomic resources. We looked at data on socioeconomic resources in order to characterize the social environment of each geographic area defined by region and urbanicity. Social environments include "socioeconomic factors (for example, employment, education), physical surroundings (for example, neighborhood and work conditions), social relations (for example,

within a community or workplace) and power arrangements (for example, political empowerment, individual and community control and influence)."[30]

We derived data on socioeconomic resources for counties from the *County and City Data Book* (1994 edition), compiled by the Bureau of the Census, and from the *Area Resource File* (1996 edition), compiled by the Bureau of Health Professions, Health Resources and Services Administration, US Department of Health and Human Services. The variables analyzed were annual per capita income, percent of population living in poverty, percent of employed workers who were in white collar occupations, percent of the civilian labor force that was unemployed, percent of adults ages 25 years and older with college educations, percent of adults ages 25 years and older with less than nine years of education, percent of households with no phone, annual per capita bank deposits, annual per capita retail expenditures.

We chose measures of labor market opportunity (unemployment, white collar employment), social capital (adult educational attainment), economic resources (per capita income, percent of persons living in poverty, retail expenditures) and concentration of wealth (bank deposits, households with no phone). For each socioeconomic variable analyzed, we calculated weighted averages of county data to yield a single measure for each geographic area defined by region and urbanicity.

For each socioeconomic variable analyzed, we calculated weighted averages of county data to yield a single measure for each geographic area defined by region and urbanicity. For example, to calculate the average percent of households with no phones in the 920 rural counties in the South, we first calculated the percent of households with no phones in each of the 920 counties. Then we calculated a weighted average of the individual county values. The weighting factor was the total number of households in each county. The formula for the weighted average is:

$$y = (a_1x_1 + a_2x_2 + a_3x_3 + \ldots + a_ix_i) / (a_1 + a_2 + a_3 + \ldots + a_i),$$

where

- y = the weighted average of county percent of household with no phone
- a_i = the total number of households in county i
- x_i = the percent of households in county i with no phone
- i = the total number of counties in a particular category of region and urbanicity.

We calculated weighted averages for socioeconomic variables for each geographic area defined by region and urbanicity similarly. For annual per capita income, percent of persons living in poverty, annual bank deposits per capita, and annual retail expenditures per capita, the weighting factor was total county population. For percent of employed workers in white collar occupations, the weighting factor was the county civilian labor force, which consists of civilians 16 years and older who are employed, or unemployed and actively seeking work. For percent of adults ages 25 years and older with a college education and percent of adults ages 25 years and older with less than nine years of education, the weighting factor was the total number of adults ages 25 years and older in each county.

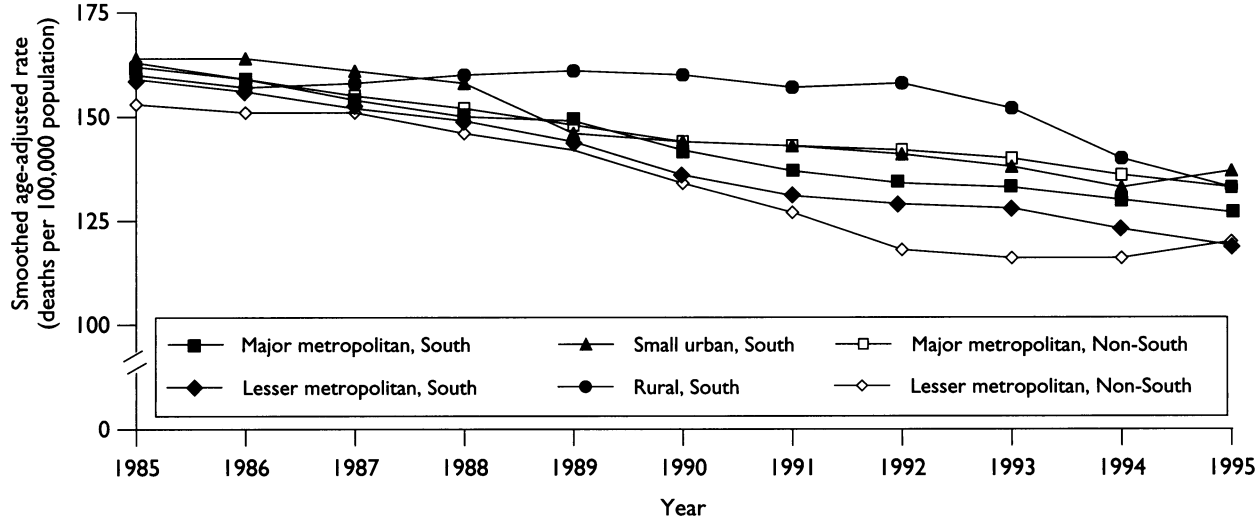
RESULTS

We found differences by both region and urbanicity in rates of premature CHD mortality for men and women in both racial groups during the study period (Figures 1–4). For all four race-gender groups, CHD mortality was highest in the rural South. As has been observed in numerous previous studies, we found that African Americans had markedly higher premature CHD mortality rates than whites in all geographic areas. In both racial categories, women experienced lower rates of CHD mortality than men.

Among African Americans, the lowest rates of premature CHD mortality occurred in lesser metropolitan areas outside the South (Figures 1 and 2), and both men and women experienced generally higher rates in rural and small urban counties in the South than in other areas. African Americans in major metropolitan areas outside the South also experienced relatively high rates of premature CHD mortality. Geographic disparities increased over the study period for African Americans; in 1995, the excess in mortality for the rural South in relation to the lesser metropolitan non-South was 36% for black men and 26% for black women (not shown; calculated based on the ratio of log-linear regression-estimated rates).

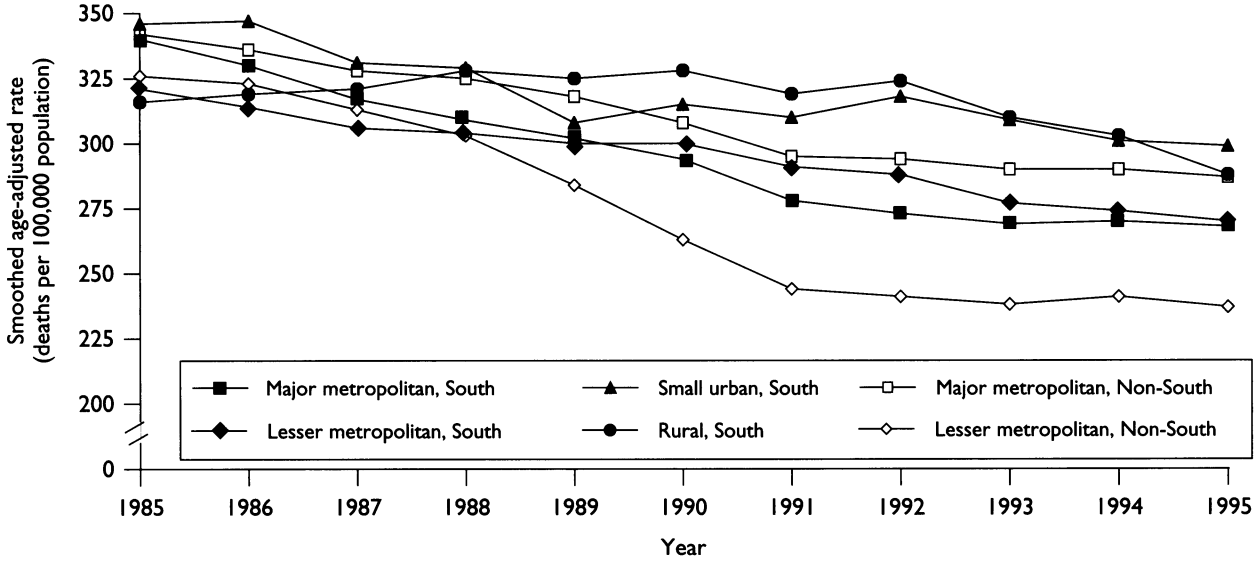
For white men and women, we observed pronounced regional disparities, while differences by urbanicity were only noticeable in the South (Figures 3 and 4). With the exception of white women living in major metropolitan areas, people in the South experienced higher rates of premature CHD mortality than people outside the South for each level of urbanicity. In the South, there was a monotonic rural-urban gradient in premature CHD mortality for both white men and women, with the highest rates in rural counties and the lowest rates in major metropolitan counties. In 1995,

Figure 1. Coronary heart disease mortality, black women ages 35–64, by urbanicity and region, 1985–1995



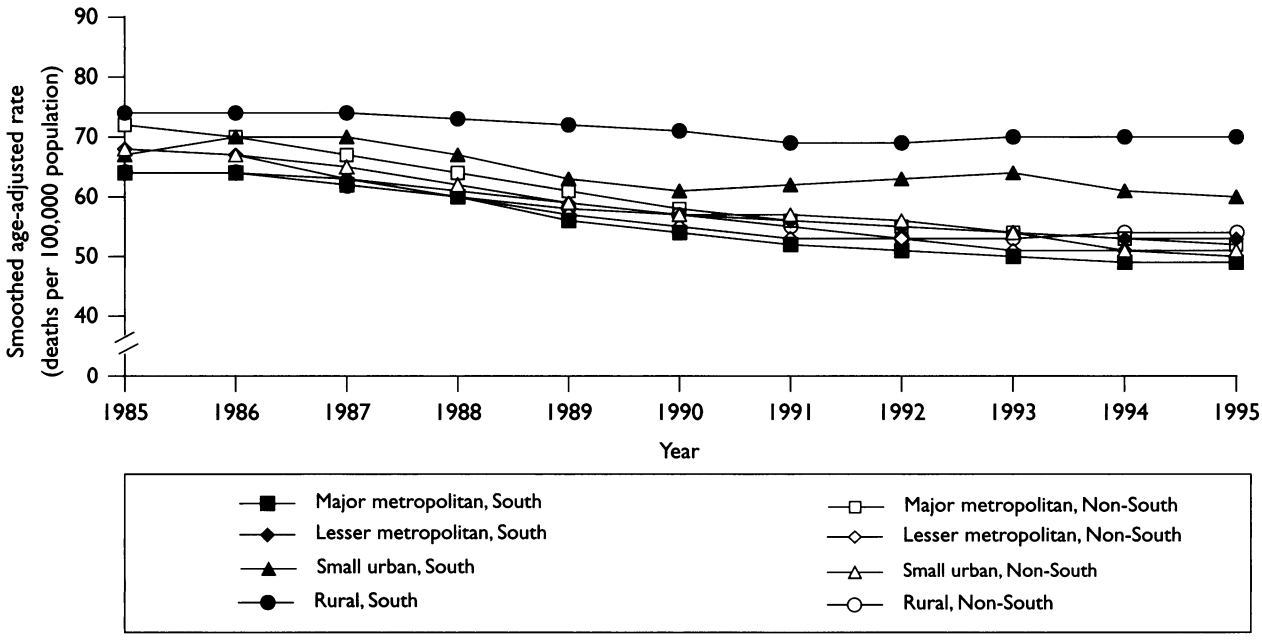
NOTE: Smoothed rates were calculated based on three-year running averages of annual age-adjusted rates.

Figure 2. Coronary heart disease mortality, black men ages 35–64, by urbanicity and region, 1985–1995



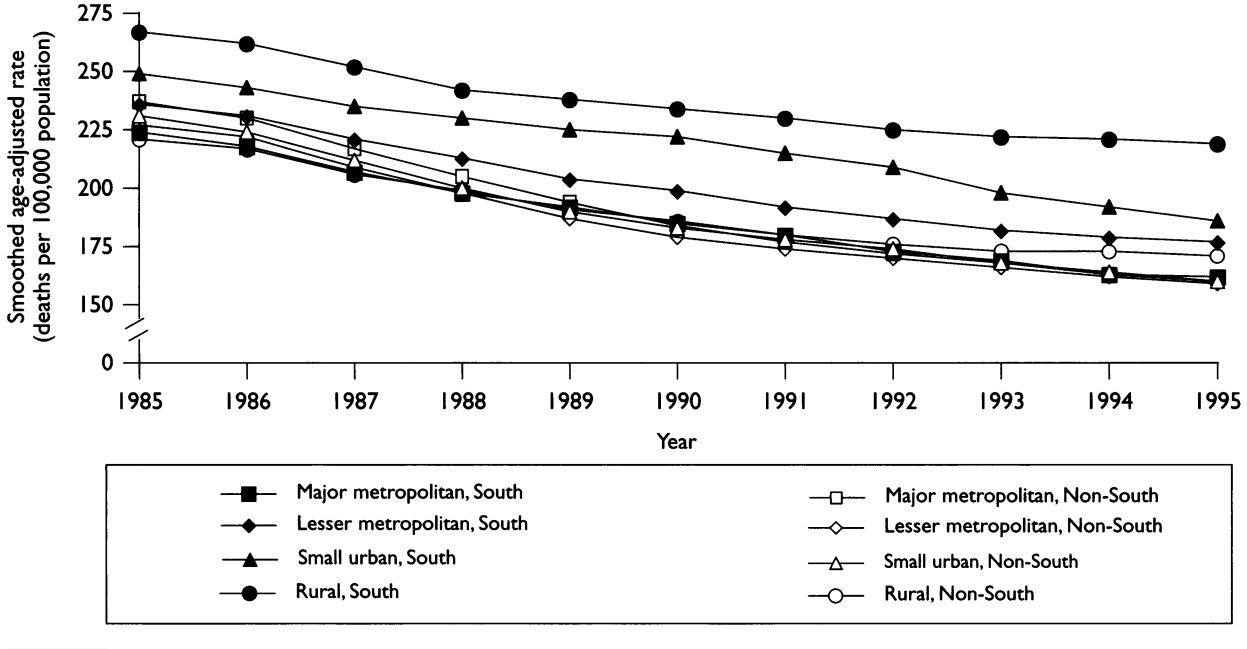
NOTE: Smoothed rates were calculated based on three-year running averages of annual age-adjusted rates.

Figure 3. Coronary heart disease mortality, white women ages 35–64, by urbanicity and region, 1985–1995



NOTE: Smoothed rates were calculated based on three-year running averages of annual age-adjusted rates.

Figure 4. Coronary heart disease mortality, white men ages 35–64, by urbanicity and region, 1985–1995



NOTE: Smoothed rates were calculated based on three-year running averages of annual age-adjusted rates.

the excess in premature CHD mortality for the rural South in relation to the major metropolitan South was 37% for white men and 45% for white women (not shown; calculated based on the ratio of log-linear regression-estimated rates). Outside the South, the rural-urban gradient in CHD mortality was negligible by 1995, with all areas outside the South experiencing CHD mortality rates similar to those of the lesser and major metropolitan counties in the South.

Rates of decline. While premature CHD mortality declined among all geo-demographic groups between 1985 and 1995, there were important disparities between groups in the rates of decline. For African American men and women, the slowest rates of decline occurred in the rural South: the average annual percent change was -1.6% per year for black women and -0.7% per year for black men (Figure 5). Faster rates of decline occurred in lesser and major metropolitan areas of the South. Overall, the fastest rates of decline in premature CHD mortality among African Americans occurred in lesser metropolitan counties outside the South: the average annual percent change was -3.3% per year for black women and -3.9% per year for black men.

We observed regional disparities and clear gradients by urbanicity in rates of decline of premature CHD mortality for both white men and women (Figure 6). In both the South and non-South, the rates of decline were fastest in major metropolitan counties and slowest in rural areas. In addition, counties in the South experienced slower rates of decline than counties outside the South for each category of urbanicity. For both white men and women, the slowest rates of decline in premature CHD morality were found in the rural South: 0.9% per year for white women and 2.1% per year for white men. The fastest rates of decline occurred in major metropolitan areas outside the South: 3.0% per year for white women and 4.2% per year for white men.

Figure 5. Declines in coronary heart disease mortality for black men and women ages 35–64, by urbanicity and region, 1985–1995

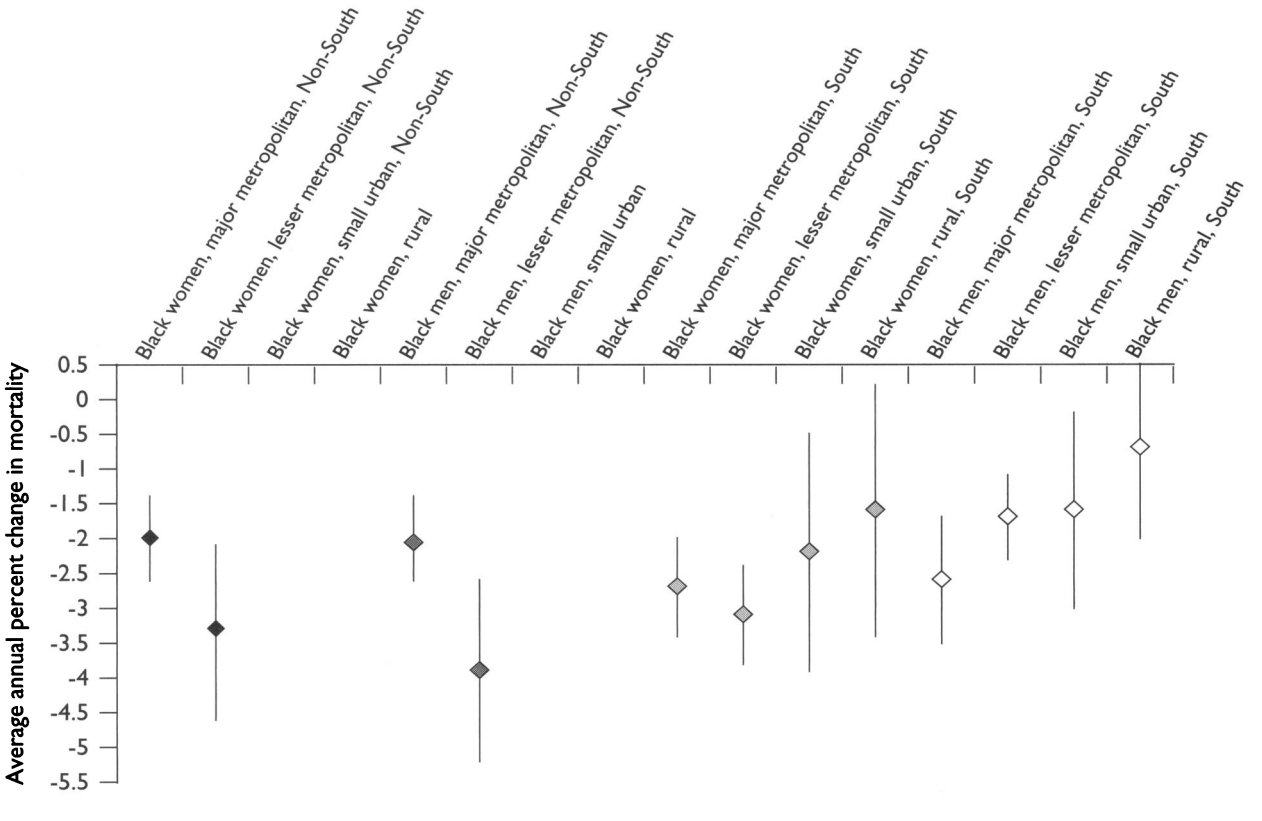


Figure 6. Declines in coronary heart disease mortality for white men and women ages 35–64, by urbanicity and region, 1985–1995

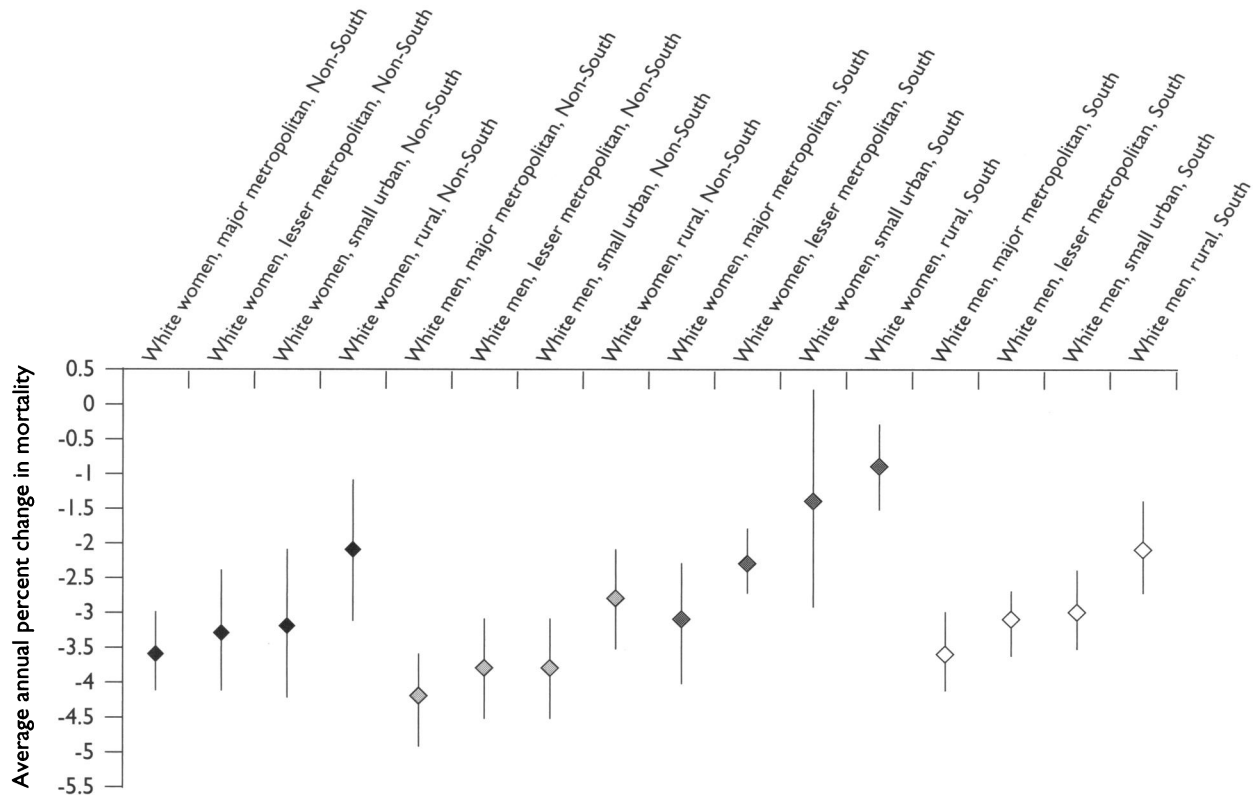


Figure 7. Excess in premature coronary heart disease mortality for African American men and women ages 35–64, compared with white men and women ages 35–64, by urbanicity and region, 1995

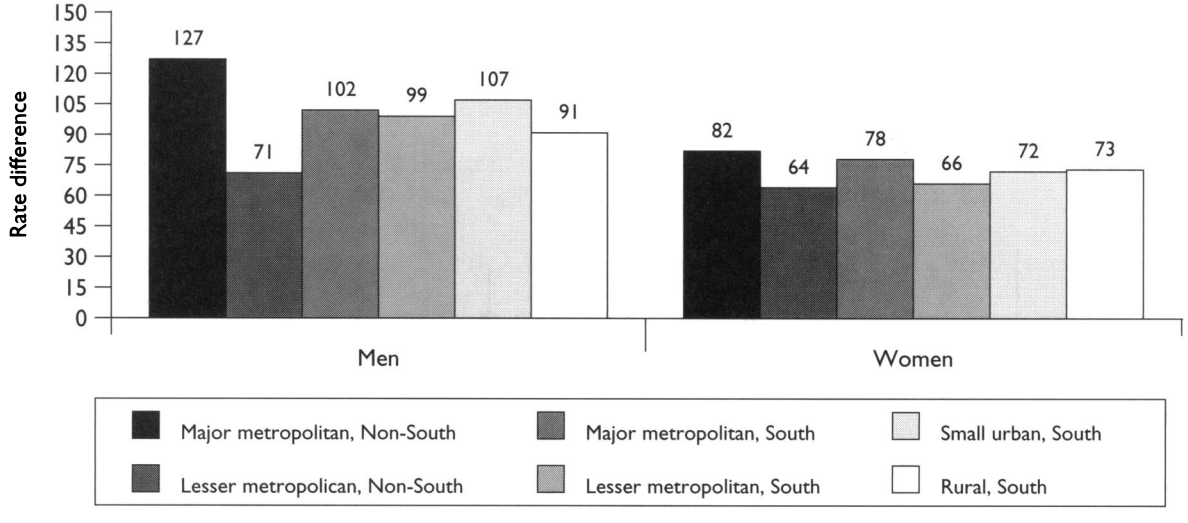


Table 2. Selected socioeconomic resources by urbanicity, non-South (excluding Alaska) and South, 1990

Variable	Region: Non-South (excluding Alaska)				Region: South[a]			
	Major metropolitan	Lesser metropolitan	Small urban	Rural	Major metropolitan	Lesser metropolitan	Small urban	Rural
Annual per capita income (dollars)	21,718	17,990	15,722	15,056	19,705	16,646	14,629	13,056
Percent of people living in poverty	11.2	11.6	13.8	14.0	12.3	15.2	18.6	22.0
Percent of employed workers in white collar occupations	63.3	57.1	50.8	44.0	63.4	57.5	50.0	41.3
Percent unemployed of civilians ≥16 years of age	6.3	6.2	6.7	6.6	5.6	6.2	7.0	7.6
Percent of adults >25 years of age with college education	24.1	19.6	16.4	12.6	24.0	19.0	14.9	10.0
Percent of adults >25 years of age with <9 years education	8.9	8.8	9.7	12.1	9.4	11.2	14.9	20.3
Percent of households with no phone	3.4	3.9	6.2	6.4	5.0	6.7	9.5	12.9
Annual bank deposits per capita (dollars)	12,348	9,162	8,280	9,631	8,968	8,911	7,762	8,012
Annual retail expenditures per capita (dollars)	6,697	6,691	5,939	4,761	7,159	6,494	5,777	4,198

[a]The South consists of: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

Racial disparities. We looked at the effects of region and urbanicity on differences in premature CHD mortality rates between African American and white adults (Figure 7). We calculated rate differences for 1995 using log-linear regression–estimated mortality rates. We found that racial disparities did not vary consistently by region or urbanicity among either men or women. However, for both men and women, the largest racial disparity in premature CHD mortality occurred in major metropolitan areas outside the South.

Socioeconomic resources. We also looked at levels of socioeconomic resources by region and urbanicity (Table 2). For both the South and the non-South, there was a straightforward rural-urban gradient for five of the nine variables, with rural counties having the least favorable profiles and major metropolitan areas having the most favorable profiles. In addition, local resources were more favorable outside the South than in the South at all levels of urbanicity.

DISCUSSION

For 1985–1995, we observed disparities by region and by urbanicity in both rates of CHD mortality and rates of decline in premature CHD mortality. Across all four race-gender groups, residents of the rural South experienced the highest rates and slowest declines in CHD mortality.

Our results confirm reports from several countries of a recent reversal of the urban excess in CHD mortality.[14,31] This reversal is consistent with the remarkable changes in population patterns of heart disease that have occurred over the course of the 20th century. Historically, heart disease incidence and mortality were positively associated with industrialization, societal wealth, and higher social class.[32] The US and Western Europe continue to experience dramatically higher levels of heart disease mortality than less industrialized nations.[33] However, the decline in heart disease mortality has been accompanied by a change in the character of heart disease from a

disease of affluence to a disease of disadvantage.[34]

The social environments of rural, small urban, and metropolitan areas in the US differ from each other economically, socially, and culturally in complex ways,[2,11,16,35–44] that historically have had both beneficial and detrimental influences on the development and treatment of heart disease. In one early study, the transition from a rural to an urban way of life in the South was shown to have had negative health effects, leading to higher CHD mortality.[2,35] Family and community organization in rural areas has been shown to have important health benefits.[36–38] On the other hand, the lower standards of living and restricted social and economic opportunities in many rural areas contribute to higher prevalences of CHD risk factors such as poor diet, inadequate leisure-time physical activity, obesity, and cigarette smoking.[45] Research has shown that resources such as medical care and social services are more prevalent and accessible in urban areas than in rural areas.[21,46–49] In many rural communities, shortages of health professionals, lack of health insurance, transportation difficulties, and geographic distance all create barriers to accessing medical care, an important determinant of CHD case fatality rates.[49] Urban, and especially metropolitan, areas generally have higher levels of economic development and community resources, both of which have been shown to be related to lower levels of CHD mortality.[11,39]

In our analyses, we found a gradient in socioeconomic resources by level of urbanicity, with major metropolitan areas having the most favorable profiles. In addition, local resources were more available outside the South than in the South for most categories of urbanicity. Based on a presumption of a linear relationship between the quality of the social environment and CHD mortality rates and trends, we would have expected to observe the highest rates and slowest declines in the rural South and the lowest rates and fastest declines in major metropolitan areas outside the South. Our findings for white men and women fit this pattern quite well. Throughout the study period, CHD mortality among white men and women was highest in the rural South, higher in the South than in the non-South at every level of urbanicity, and higher in rural areas than in lesser and major metropolitan areas. Similarly, among African American men and women, premature CHD mortality was also highest in the rural South in most years, and in general higher in the South than in the non-South.

The rural South, as defined in this study, included non-metropolitan counties that included total urban populations of less than 20,000. We calculated that more than 9% of African American adults ages 35–64 and close to 7% of white adults ages 35–64 resided in the rural South in 1990. Our findings of persistent and widening disparities in premature CHD mortality for 1985–1995 between the rural South and other parts of the country are consistent with trends for earlier years.[16,17,19,20,22,50] The rural South consists in large part of four underdeveloped regions, namely Central Appalachia,[21,51] the so-called Black Belt,[52] the Mississippi Delta,[53] and the Lower Rio Grande Valley.[54] Characterized as "forgotten places" in a recent sociological study,[55] these four areas were underdeveloped through historical, political, and economic processes by which wealth generated in each region by the labor of its residents was exported outside the region instead of being reinvested internally to benefit local communities.[44]

An important unexpected finding of this study, given our theories about the influence of the social environment on CHD mortality, was that premature CHD mortality among black men and women was higher in major metropolitan areas outside the South than in most other geographic areas. Mortality declines among black men and women in these areas were also much slower than in most other geographic areas. What might account for these unexpectedly high rates and slow declines? One potential explanation is methodological—namely, that CHD mortality rates for major metropolitan areas outside the South may be overestimates because of incorrect population denominators for African Americans. Population undercounts by the Bureau of the Census have been confirmed for African Americans,[56] which would result in overestimated mortality rates, assuming that deaths were not undercounted and age at death was classified properly. The extent of these undercounts may have been greater in metropolitan areas, but there are no data available to address this question.

Explanations of the higher than expected rates of premature CHD mortality for African Americans in major metropolitan counties outside the South include stressors of urban life that are disproportionately experienced by African Americans, such as police surveillance, racial discrimination, and the high degree of racial residential segregation found in large Northeastern and Midwestern cities. An extensive sociological literature documents the detrimental effect of residential segregation on the well-being of African Americans and members of other racial/ethnic minority groups in the United States.[26,34,57–61] The health-related consequences of residential segregation for African Americans include limited availability of public and community services,

restricted labor market opportunities, high levels of exposure to air pollution and other environmental contaminants, and restricted access to medical care, public transportation, affordable food stores, exercise and recreation facilities, and other resources for healthy living.[62-65] Even though absolute levels of resources are generally higher for African Americans in metropolitan areas than in rural areas, racial inequality in access to resources may also be higher in metropolitan areas. Consistent with this possibility, we found that racial inequality in premature CHD mortality was greatest in major metropolitan areas outside the South for both men and women.

How can the relatively high rates and adverse trends in premature CHD mortality in the rural South and the unexpectedly high rates in major metropolitan areas outside the South for African Americans be ameliorated? Mainstream public health approaches to preventing heart disease focus on changing the "lifestyle" behaviors of individuals: dietary habits, leisure-time physical activity, and tobacco use.[66] However, the lifestyle approach to heart disease prevention has serious limitations for those people at highest risk, including rural residents and the working poor. In many parts of the rural South and in impoverished urban neighborhoods, economic insecurity is widespread, and safe and adequate housing, medical facilities, recreational and fitness facilities, affordable fresh produce and other low-fat foods, and safe, low-stress work environments are all scarce. Achieving lasting reductions in heart disease mortality in the South as well as in other regions will require public policies that enhance overall quality of life through improvements in local social environments.[67]

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