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THE ASSOCIATION BETWEEN BIRTHPLACE AND MORTALITY FROM CARDIOVASCULAR CAUSES AMONG BLACK AND WHITE RESIDENTS OF NEW YORK CITY

JING FANG, M.D., SHANTHA MADHAVAN, DR.P.H., AND MICHAEL H. ALDERMAN, M.D.

ABSTRACT

Background Life expectancy is shorter and mortality from cardiovascular disease higher among blacks than among whites in the United States. We studied whether place of birth was associated with mortality from cardiovascular causes among non-Hispanic black and white residents of New York City.

Methods We linked mortality records from 1988 through 1992 with 1990 U.S. Census data for New York City. Mortality data for blacks born in the U.S. South and Northeast and in the Caribbean were compared with those for whites born in the Northeast.

Results Among blacks, the rates of overall mortality and mortality from cardiovascular causes exceeded those among whites. Among persons born in the Northeast, the rates of death from cardiovascular disease for white men (285 per 100,000), as compared with black men (299), and for white women (155), as compared with black women (165), were similar. However, Southern-born black men and women both had mortality from cardiovascular disease that was substantially higher than that of their counterparts born in the Northeast, and Caribbean-born blacks had rates substantially lower than their Northeastern-born counterparts. The differences among the groups in the rates of death from coronary heart disease were greater than those for death due to stroke or hypertension. In each category defined by age and sex, Caribbean-born blacks had significantly lower rates of death from coronary heart disease than did whites. Black men who were 25 to 44 years of age and were born in the South had a rate of death from coronary heart disease that was 30 percent higher than that of Northeastern-born blacks, and four times that of Caribbean-born blacks of the same sex and age.

Conclusions The higher rate of mortality from cardiovascular causes among blacks, as compared with whites, in New York City masks substantial variation among blacks based on their place of birth. (N Engl J Med 1996;335:1545-51.)

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LIFE expectancy is shorter, and mortality rates greater, for black than for white Americans.¹ Recently, these two discrepancies have widened.² Cardiovascular disease, the leading cause of death for all Americans, is the most important single determinant of these disturbing trends.^{3,4}

Although the relative contribution of genetic and environmental factors to this mortality pattern remains unknown, clues can be found in observational studies of defined populations. For example, there are marked regional differences in mortality from cardiovascular disease within and among countries.⁵⁻⁹ Moreover, migrants often carry patterns of disease from their countries of origin to their countries of destination.¹⁰ At the same time, changes in the incidence of disease in migrating populations provide the best evidence of the impact of the environment on patterns of disease.

To determine the enduring impact of birthplace on mortality from cardiovascular disease in residents of New York City, we examined rates of death from cardiovascular disease for the years 1988 through 1992 for blacks from the southern United States, blacks born in the Caribbean area, and Northeastern-born blacks and whites, and we compared each of these groups with the total U.S. population. We found that the variation in mortality from cardiovascular disease within the black population according to birthplace far exceeds the interracial differences between blacks and whites.

From the Department of Epidemiology and Social Medicine, Albert Einstein College of Medicine, 1300 Morris Park Ave., Bronx, NY 10461, where reprint requests should be addressed to Dr. Fang.

METHODS

Sources of Data

This analysis is based on New York City mortality records for the five-year period from 1988 through 1992 and on 1990 U.S. Census data.

Death Records

Computer tapes with information on the registration of deaths were provided to us by the New York City Health Department, to which all births and deaths in the city are reported.¹¹ Information identifying individual persons was eliminated to preserve confidentiality. The records of deaths included the person's borough and ZIP Code of residence, age, sex, educational attainment, race, ancestry, and birthplace. These characteristics were recorded by funeral directors, usually on the basis of information obtained from a relative of the deceased person. Underlying causes of death were coded by a physician according to the *International Classification of Diseases, 9th Revision (ICD-9)*. The major categories in our analysis were death from all causes, death from cardiovascular disease (ICD-9 codes 390 to 459), death from coronary heart disease (codes 410 to 414), death from stroke (codes 430 to 438), and death from hypertensive disease (codes 401 to 404).

Census Data

The 1990 U.S. Census Public Use Microdata Samples (PUMS)¹² data were obtained from the Department of Data Service of the City University of New York. The PUMS tapes, the largest available census data base, contain data on about a 5 percent sample of the total census population. A weighting value was assigned by the Census Bureau to each case in this sample. On the basis of these weights, the characteristics of the PUMS sample were extrapolated to the total population.¹³ The variables, as constructed from data reported by the respondents themselves, included borough of residence, race, ethnic group, age, sex, birthplace, education, years of residence in the United States (for foreign-born respondents), and employment status.

Matching Variables

Information on age, sex, race, ethnic group, birthplace, and education was available in both the death records and the census data. A person's year of immigration and employment status were not available in the death records. Of these several variables, four (age, sex, race, and birthplace) were recorded in the same format in both files.

Birthplace was defined in the following manner. First, persons born in the United States were separated from those born elsewhere. Those born in the United States were then subdivided according to four regions.¹⁴ The South comprised the states of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia and the District of Columbia. The Northeast comprised Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Because there were few black migrants to New York from the Midwest and West (1.5 percent), persons born in these areas, black or white, were not included in the final analysis. Only whites born in the Northeast were studied.

The category of foreign-born blacks included only migrants from the Caribbean islands and excluded a small number of blacks born elsewhere. Of the foreign-born blacks, 86 percent were from Barbados, Grenada, Haiti, Jamaica, and Trinidad and Tobago.

With both the data sources,¹⁴ we considered as whites those who either defined their race (or whose race was listed on the death records) as white or identified themselves as (for example) Canadian, German, Italian, Lebanese, Near Eastern, Arab, or Polish. We considered as blacks those who indicated their race (or whose race was listed on the death records) as black, Negro, or African American or whose background, region, or nation of

origin was identified as (for example) black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian.

The definition of Hispanic origin was similar in the two data files. However, the variable representing Hispanic origin in the two data sets differed. In the census data, Hispanics were defined as such in a single variable that captured the response to questions about place of origin. Respondents who had cited Mexico, Puerto Rico, or Cuba, as well as those who indicated that they were of other Spanish or Hispanic origin, were defined as Hispanics. In the death records, Hispanic status was defined through a variable called ancestry and included persons (even those born in the United States) whose ancestry was Mexican, Puerto Rican, or Cuban and those whose ancestors came from other Hispanic countries.¹¹ We therefore excluded both persons of Hispanic origin in the census data and those of Hispanic ancestry in the death records, so that only data on non-Hispanic blacks and non-Hispanic whites remained.

Educational attainment was classified into 17 categories in the census file and 5 categories in the death records. More than 10 percent of the information on education was missing from the death records, so education was not included in our analysis of mortality.

Statistical Analysis

Mortality rates were computed according to race, sex, and birthplace for residents of New York City, as well as for the United States as a whole. The measures of mortality according to sex that we used in the analysis were age-adjusted death rates according to cause of death, standardized mortality ratios (with the mortality rate of Northeastern-born whites as the reference category), and excess deaths of blacks (as compared with Northeastern-born whites). These measures were estimated for each region of birth. Initially, five-year mortality rates (for 1988 to 1992) per 100,000 persons were computed by dividing the number of deaths (from the death records) in the five years by the population in 1990 as recorded in the census and then multiplying by 100,000. To estimate an average annual mortality rate, the five-year rate was divided by 5 and expressed as a rate per 100,000 per year.

For each of the sexes and causes of death, age-adjusted mortality rates according to birthplace (and for the United States as a whole) were calculated by the direct-standardization method¹⁵ with the U.S. population in 1940¹⁶ as the standard and with 10-year age categories, to permit comparison with data on the national population. In addition, the 1990 population of New York City was used as a standard to make it possible to perform an analysis according to five-year age groups; this was done within each of three broader age strata (25 to 44 years, 45 to 64, and 65 and above) to estimate age-adjusted mortality rates.

With the sex-specific death rates of Northeastern-born whites as the reference category, standardized mortality ratios for blacks according to birthplace were computed for each sex by the indirect method of standardization¹⁵ for those 25 to 64 years of age. To calculate the standardized mortality ratios according to birthplace, the total number of observed deaths due to each cause in the five-year period was divided by the total expected number of deaths, a figure based on the population of each age group and the death rates of that age group in the reference category. The 95 percent confidence intervals for the standardized mortality ratios were calculated. We calculated annual excess deaths as the difference between the total number of observed deaths and the expected number of deaths for the five years from 1988 through 1992 (again with the sex-specific death rates of Northeastern-born whites as the reference category), divided by 5 and expressed as an annual rate per 100,000 persons.

RESULTS

Demographic Characteristics

Most of the whites in our final sample (73.1 percent) were born in the Northeast (Table 1). This was

also true, but less so, for blacks (54.1 percent). Nearly 20 percent of black subjects came from the South, and 17 percent from the Caribbean region. Blacks from the South were older on average, and this group included comparatively more old people, and fewer young people; blacks born in the Northeast were the youngest group, and black Caribbean migrants were intermediate in age (mean age, 51.1, 23.2, and 37.7 years, respectively). The proportion of Northeastern-born blacks and whites who were male was the same (46.9 percent), but there were fewer males among blacks born in the South (38.1 percent) and the Caribbean (43.3 percent). In general, the educational attainment of whites and the proportion employed exceeded the levels among blacks. More Caribbean migrants than blacks born in the South had graduated from high school (77.9 percent vs. 64.5 percent).

As noted above, five Caribbean countries — Barbados, Grenada, Haiti, Jamaica, and Trinidad and Tobago — were the birthplace of 86 percent of the black Caribbean migrants. The demographic characteristics of the migrants from these five islands were generally similar and did not differ importantly from those of the remaining 14 percent of black Caribbean migrants. The average length of stay in the United States for the black Caribbean migrants was 13.9 years.

Mortality Rates

The age-adjusted death rates per 100,000 New York City residents exceeded those for the country as a whole (878.9 vs. 680.2 for males and 456.8 vs. 387.9 for females). Moreover, within the city, the overall mortality rates for blacks substantially exceeded those for whites among both males (1224.8 vs. 721.4) and females (593.7 vs. 393.1). Black males born in the South had a higher rate of death from all causes (1382.7) than did blacks born in the Northeast (1221.8) and a much higher rate than did

black Caribbean migrants (762.3). The same pattern held for females (Southern-born blacks, 647.0; Northeastern-born blacks, 552.5; and Caribbean-born blacks, 386.7).

Cardiovascular disease was the leading cause of death for both black and white New Yorkers, accounting for 34.1 percent and 51.8 percent of all deaths, respectively. Overall, the age-adjusted total rate of death from cardiovascular disease per 100,000 population (with the 1940 U.S. population used as the standard) was 264.9 for blacks and 209.9 for whites. Among males, this rate was sharply higher for Southern-born blacks than for other blacks or Northeastern-born whites (Fig. 1). The pattern among females was similar. All four regional groups had higher rates than did the U.S. population as a whole (251.8 for males and 143.0 for females in the United States as a whole) (data not shown). All the groups of black males had higher death rates from stroke than New York City whites, but Southern-born black males had higher rates than other blacks. This was also true for females. The relative disadvantage of Southern-born black males persisted in their rate of death from coronary heart disease (207.9 per 100,000), but this rate was similar to that among Northeastern-born whites (203.7 per 100,000). By contrast, Southern-born black females had a higher rate of death from coronary heart disease (137.0 per 100,000) than did Northeastern-born white females (109.1). Blacks, both male and female, born in the Caribbean and the Northeast had lower rates of death from coronary heart disease than did their Northeastern-born white counterparts.

The relative differences in mortality according to birthplace between the groups (Table 2) were greatest among the young (25 to 44 years old) and the middle-aged (45 to 64 years old). Again, blacks generally had higher death rates than whites. The differ-

TABLE 1. CHARACTERISTICS OF NON-HISPANIC BLACKS AND WHITES IN NEW YORK CITY ACCORDING TO BIRTHPLACE.*

| CHARACTERISTIC | BLACKS | | | WHITES BORN IN NORTHEAST |
|------------------------------------|----------------|------------------|----------------|--------------------------|
| | SOUTH | NORTHEAST | CARIBBEAN | |
| Population — no. (%)† | 366,853 (19.7) | 1,008,677 (54.1) | 309,380 (16.6) | 2,315,288 (73.1) |
| Mean age (±SD) — yr | 51.1±17.2 | 23.2±17.7 | 37.7±17.9 | 39.6±23.1 |
| Age at 1990 Census — % | | | | |
| <25 yr | 6.0 | 59.2 | 23.5 | 28.0 |
| 25 to 64 yr | 70.1 | 37.7 | 68.0 | 53.1 |
| ≥65 yr | 23.9 | 3.1 | 8.5 | 18.9 |
| Male sex — % | 38.1 | 46.9 | 43.3 | 46.9 |
| At least high-school education — % | 64.5 | 74.6 | 77.9 | 85.6 |
| Unemployed — % | 19.2 | 19.7 | 10.1 | 12.3 |

*Data are from the 1990 U.S. Census.

†Numbers in parentheses represent the percentages of the total population in each racial group that was born in the region shown.

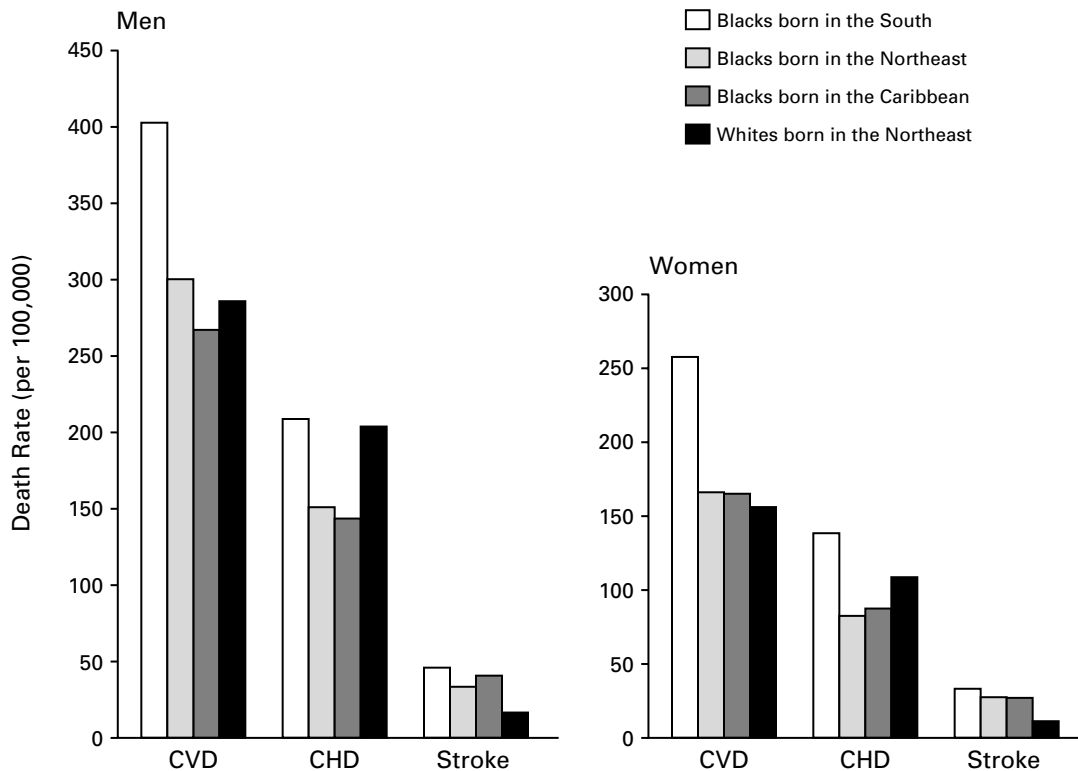


Figure 1. Age-Adjusted Annual Rates of Death from Selected Cardiovascular Diseases in Non-Hispanic Blacks and Whites in New York City from 1988 through 1992, According to Birthplace.

Mortality rates were adjusted for age in 10-year age categories, with the U.S. population in 1940 used as the standard. CVD denotes cardiovascular disease, and CHD coronary heart disease.

ences within the black population were also greatest among those under 65 years of age. Southern-born blacks, both young and middle-aged and both male and female, had higher rates of death from all causes (as well as from selected cardiovascular causes) than the other black groups. The difference in mortality between Southern-born and Caribbean-born blacks was particularly marked.

Young black men born in the South had an age-adjusted rate of death from coronary heart disease (30.1 per 100,000) that was 30 percent higher than that of young Northeastern-born black men (23.1), and more than four times as high as that of young Caribbean-born black men (7.4). These relative differences were somewhat diminished in middle-aged subjects, but even in this group, Southern-born blacks still had a rate of death from coronary heart disease more than twice that of Caribbean-born blacks (406.5 vs. 165.2 per 100,000). In the oldest group (65 years of age or older), the death rate from coronary heart disease among Caribbean-born blacks (2149.1 per 100,000) became roughly equal to that among Southern-born blacks (2117.5 per 100,000). Caribbean-born black men had lower rates of death from coronary heart disease than Northeastern-born

whites in all age groups. On the other hand, in all age groups and both sexes, deaths due to hypertensive disease and stroke were higher among Caribbean-born blacks than among Northeastern-born whites (Table 2).

Standardized Mortality Ratios and Annual Excess Deaths

Southern-born black men 25 to 64 years of age had higher rates of death from all causes and higher rates of death from each of the categories of cardiovascular disease than did Northeastern-born white men (Table 3). Black men born in the Northeast had higher rates of death from all causes and from total cardiovascular disease, stroke, and hypertension than did whites born in the Northeast, but the rates of death from coronary heart disease were similar in the two groups. Caribbean-born black men had a mortality rate from all causes similar to that of Northeastern-born whites, but a higher mortality rate from stroke and hypertensive disease. All these patterns (for death from coronary heart disease, all causes, stroke, and hypertensive disease) were also found among Southern-born black, Northeastern-born black, and Northeastern-born white women. Caribbean-born black men, however, had a sharply lower mortality

TABLE 2. AGE-ADJUSTED RATES OF DEATH FROM SELECTED CARDIOVASCULAR CAUSES AMONG NON-HISPANIC BLACKS AND WHITES IN NEW YORK CITY FROM 1988 THROUGH 1992, ACCORDING TO BIRTHPLACE.*

| AGE GROUP AND CAUSE OF DEATH | BLACKS | | | WHITES BORN IN NORTHEAST |
|------------------------------|----------------|-----------|-----------|-----------------------------|
| | SOUTH | NORTHEAST | CARIBBEAN | |
| | deaths/100,000 | | | |
| Men | | | | |
| 25–44 yr | | | | |
| All causes | 1313.1 | 1259.6 | 479.3 | 393.0 |
| Cardiovascular disease | 106.5 | 99.0 | 38.2 | 38.8 |
| Coronary heart disease | 30.1 | 23.1 | 7.4 | 16.8 |
| Hypertension | 16.0 | 14.6 | 4.5 | 3.6 |
| Stroke | 15.5 | 15.2 | 8.0 | 3.8 |
| 45–64 yr | | | | |
| All causes | 2415.5 | 2106.4 | 914.3 | 1227.3 |
| Cardiovascular disease | 835.6 | 653.8 | 347.7 | 493.1 |
| Coronary heart disease | 406.5 | 318.9 | 165.2 | 339.8 |
| Hypertension | 94.2 | 73.2 | 33.1 | 19.0 |
| Stroke | 102.9 | 74.0 | 64.4 | 25.3 |
| ≥65 yr | | | | |
| All causes | 7662.8 | 5290.4 | 7092.0 | 5727.6 |
| Cardiovascular disease | 3525.8 | 2495.9 | 3646.6 | 3194.2 |
| Coronary heart disease | 2117.5 | 1467.5 | 2149.1 | 2429.8 |
| Hypertension | 220.0 | 140.6 | 184.1 | 164.5 |
| Stroke | 321.0 | 248.7 | 452.6 | 57.4 |
| Women | | | | |
| 25–44 yr | | | | |
| All causes | 369.4 | 320.7 | 157.4 | 127.6 |
| Cardiovascular disease | 50.4 | 56.8 | 20.0 | 14.6 |
| Coronary heart disease | 12.4 | 10.1 | 3.2 | 5.1 |
| Hypertension | 10.9 | 10.3 | 3.2 | 0.8 |
| Stroke | 14.9 | 13.0 | 3.7 | 2.3 |
| 45–64 yr | | | | |
| All causes | 1141.6 | 953.8 | 588.4 | 664.1 |
| Cardiovascular disease | 456.6 | 322.1 | 221.2 | 202.3 |
| Coronary heart disease | 223.8 | 151.5 | 105.3 | 133.1 |
| Hypertension | 51.5 | 40.4 | 28.6 | 8.2 |
| Stroke | 65.8 | 41.5 | 38.6 | 16.9 |
| ≥65 yr | | | | |
| All causes | 5222.2 | 2803.4 | 3991.1 | 3715.3 |
| Cardiovascular disease | 2936.8 | 1579.1 | 2344.8 | 2158.5 |
| Coronary heart disease | 1815.0 | 981.0 | 1409.2 | 1620.8 |
| Hypertension | 178.6 | 115.3 | 143.0 | 45.6 |
| Stroke | 319.2 | 141.3 | 349.8 | 146.8 |

*Death rates are expressed per 100,000 population per year, with adjustment for age according to five-year age groups, with the total population of New York City in 1990 used as the standard.

rate from total cardiovascular disease and from coronary heart disease than did Northeastern-born whites. Caribbean-born black women had rates of death from all causes, total cardiovascular disease, and coronary heart disease that were similar to those of Northeastern-born white women.

The excess deaths among black as compared with white New Yorkers were largely due to the presence of Southern-born blacks. As compared with Northeastern-born whites, only Southern-born blacks had excess deaths from coronary heart disease. Strikingly, in spite of their excess deaths from all causes and from total cardiovascular disease, Northeastern-born blacks had no excess deaths from coronary heart disease. As a group, Caribbean-born black men actually

had fewer deaths from cardiovascular disease overall — particularly deaths from coronary heart disease — than did men from any other region. It should also be noted that nearly half the excess deaths among Southern-born black women were accounted for by cardiovascular disease. By contrast, less than 10 percent of the excess deaths among Northeastern-born black men were due to cardiovascular disease.

DISCUSSION

Mortality rates in New York City differ substantially according to race and sex. The disadvantage of blacks as compared with whites is well known. What has not previously been noted, however, is the striking heterogeneity of mortality rates within the black

TABLE 3. STANDARDIZED MORTALITY RATIOS AND ANNUAL EXCESS DEATHS DUE TO SELECTED CARDIOVASCULAR CAUSES AMONG NON-HISPANIC BLACKS 25 TO 64 YEARS OF AGE IN NEW YORK CITY FROM 1988 THROUGH 1992, ACCORDING TO BIRTHPLACE.*

| CAUSE OF DEATH | SOUTH | | NORTHEAST | | CARIBBEAN | |
|------------------------|------------------|----------------------|-------------------|----------------------|------------------|----------------------|
| | SMR (95% CI) | ANNUAL EXCESS DEATHS | SMR (95% CI) | ANNUAL EXCESS DEATHS | SMR (95% CI) | ANNUAL EXCESS DEATHS |
| Men | | | | | | |
| All causes | 2.17 (2.07–2.27) | 893 | 2.46 (2.36–2.56) | 813 | 0.92 (0.85–1.00) | 0 |
| Cardiovascular disease | 1.75 (1.60–1.90) | 196 | 1.56 (1.40–1.74) | 75 | 0.74 (0.62–0.88) | –48 |
| Coronary heart disease | 1.21 (1.07–1.37) | 37 | 0.99 (0.84–1.17) | 0 | 0.48 (0.36–0.63) | –63 |
| Stroke | 4.09 (3.18–5.12) | 44 | 3.20 (2.29–4.21) | 18 | 2.32 (1.42–3.52) | 14 |
| Hypertension | 4.89 (3.77–6.31) | 43 | 3.95 (2.91–5.36) | 20 | 1.90 (1.17–2.79) | 6 |
| Women | | | | | | |
| All causes | 1.81 (1.71–1.91) | 370 | 2.26 (2.13–2.39) | 319 | 0.96 (0.86–1.07) | 0 |
| Cardiovascular disease | 2.28 (2.09–2.51) | 164 | 1.96 (1.72–2.22) | 57 | 1.10 (0.89–1.34) | 0 |
| Coronary heart disease | 1.65 (1.43–1.89) | 53 | 1.19 (0.96–1.22) | 0 | 0.75 (0.54–1.02) | 0 |
| Stroke | 4.15 (3.17–5.11) | 35 | 3.32 (2.42–4.67) | 13 | 2.09 (1.11–3.22) | 8 |
| Hypertension | 6.42 (5.13–8.75) | 29 | 6.74 (5.20–10.20) | 15 | 3.47 (2.03–5.75) | 8 |

*In the calculation of standardized mortality ratios (SMRs), the sex-specific mortality rates of Northeastern-born whites were used as the reference category. CI denotes confidence interval. Annual excess deaths are expressed per 100,000 population per year. Negative numbers indicate that there were fewer deaths in the category shown than among whites from the Northeast.

population that is revealed through simple stratification by birthplace. In fact, the apparent interracial differences actually obscure larger variations within the black population.

New Yorkers have higher annual death rates per 100,000 than the country as a whole. Cardiovascular disease is the leading cause of death for both blacks and whites. Our data reveal that Southern-born blacks were at greater risk of death from cardiovascular causes than Northeastern-born blacks, and at vastly greater risk than Caribbean-born blacks. In fact, the black-white differences in mortality are largely accounted for by mortality among Southern-born blacks. The disadvantage of Southern-born blacks, as compared with Northeastern- and Caribbean-born blacks, was observed in the rates of death from all types of cardiovascular disease.

These findings also revealed the dissociation of the mortality patterns related to coronary heart disease from those related to hypertensive disease and stroke. Mortality from hypertensive disease and stroke was high among all blacks, perhaps mediated by a higher prevalence of high blood pressure among blacks.¹⁷ The association of coronary heart disease with high blood pressure, however, is less marked than that for hypertensive disease and stroke, and the development of coronary heart disease may therefore reflect the influence of other factors. The observed differences in mortality from cardiovascular disease according to birthplace may be due to genetic or environmental influences (or both).

Earlier studies in the United States have reported the overall black-to-white ratio of mortality from coronary disease among men to be 0.9.^{18,19} However,

this ratio decreases with advancing age (35 to 44 years, 1.6; 45 to 54 years, 1.2; 55 to 64 years, 1.0; 65 to 74 years, 0.9; 75 to 84 years, 0.8).²⁰ Our data show that even the youngest Caribbean-born blacks of both sexes had rates of death from coronary heart disease well below — and Southern-born blacks rates well above — those of whites born in the Northeast. It is well established that rates of mortality from stroke, hypertensive heart disease, and ischemic heart disease are higher in the south central and southern Atlantic states for both sexes and all races, particularly blacks.^{6,7,9,21} Similarly, in England and Wales, Caribbean-born immigrants were observed to have significantly lower rates of death from coronary heart disease and higher mortality from cerebrovascular disease than native-born whites.^{22,23}

The relative genetic and environmental contributions to the observed mortality rates cannot be assessed with the available data. Genetic heterogeneity may help explain the observed phenomena. However, the extent of gene mixing in these populations is unknown. In fact, it has been suggested that some specific phenomena related to cardiovascular disease may be genetically determined in the Caribbean area.²⁴

It is also possible that some of the regional and racial differences reflect sociocultural factors: selective migration, health and medical care practices, and socioeconomic status.² It has been suggested that the increased mortality from cardiovascular causes in the South, as compared with other regions, may reflect more common and more severe hypertension, lower rates of blood-pressure control, more smoking and obesity, and lower socioeconomic status, as well as regional differences in diet, lifestyle,

and the composition of soil and water.^{9,25} It has also been suggested that the Caribbean diet, with its low amounts of fat and moderate consumption of alcohol, may help explain the relatively favorable outcome of coronary heart disease in Caribbean-born men.²⁶ Other low-risk characteristics of Caribbean blacks include infrequent obesity, low levels of low-density lipoprotein cholesterol, and high levels of high-density lipoprotein cholesterol.²⁶

Migration has been repeatedly demonstrated to alter a population's pattern of disease and mortality. Generally, migrants have mortality rates intermediate between those of their region of adoption and region of origin.^{8,10,27} For example, Southern-born blacks who migrate to other regions in the United States have mortality rates higher than those of blacks native to their adopted region⁵ but below those of the South. Comparable data on Caribbean migrants are not available.

Information on the duration of residence in New York City was not available for any of our study subjects. However, census data revealed that, on average, Caribbean migrants had been in this country for 13 years, and most migration from the South occurred before 1960.²⁸ The possibility that Southern-born blacks had lived longer in New York suggests the interesting hypothesis that the risk of cardiovascular disease increases with longer exposure to New York City. On the other hand, protective factors associated with Caribbean migrants could, if identified, provide clues to interventions that might favorably influence the cardiovascular health of both blacks and whites.

This study is limited by its reliance on death certificates and census data. Both sources of data are known for their inaccuracies.^{29,30} There is, however, no reason to believe that there was systematic bias in the identification of birthplaces in both types of files. The undercounting of migrants in the census data would increase the mortality rates of the Caribbean-born and thus would tend only to diminish, not heighten, any observed differences in mortality.

In summary, mortality from all causes and from cardiovascular disease among blacks in New York City exceeds that of whites. This excess mortality is most pronounced among young and middle-aged men and is largely a reflection of the excess mortality of Southern-born blacks. There were substantial differences in death rates among blacks according to birthplace. If the favorable survival patterns of Caribbean migrants were conferred on other blacks, the current interracial pattern would be reversed, and mortality from cardiovascular disease among blacks would be well below that among whites.

REFERENCES

- Cooper RS. Health and the social status of blacks in the United States. *Ann Epidemiol* 1993;3:137-44.
- Mason JO. Understanding the disparities in morbidity and mortality among racial and ethnic groups in the United States. *Ann Epidemiol* 1993; 3:120-4.
- National Center for Health Statistics. Advance report of final mortality statistics, 1989. *Mon Vital Stat Rep* 1990;40(8):Suppl 2.
- Kochanek KD, Hudson BL. Advance report of final mortality statistics, 1992. *Mon Vital Stat Rep* 1995;43(6):Suppl.
- Greenberg M, Schneider D. Region of birth and mortality of blacks in the United States. *Int J Epidemiol* 1992;21:324-8.
- Miller JP, Perry HM Jr, Rossiter JE, Baty JD, Carmody SE, Sambhi MP. Regional differences in mortality during 15-year follow-up of 11,936 hypertensive veterans. *Hypertension* 1994;23:431-8.
- Perry HM Jr, Gillespie KN, Romeis JC, et al. Effects of 'stroke belt' residence, screening blood pressure and personal history risk factors on all-cause mortality among hypertensive veterans. *J Hypertens* 1994;12:315-21.
- Robertson TL, Kato H, Gordon T, et al. Epidemiologic studies of coronary heart disease and stroke in Japanese men living in Japan, Hawaii and California: coronary heart disease risk factors in Japan and Hawaii. *Am J Cardiol* 1977;39:244-9.
- Roccella EJ, Lenfant C. Regional and racial differences among stroke victims in the United States. *Clin Cardiol* 1989;12:Suppl 4:IV-18-IV-22.
- Gerber LM, Madhavan S. Epidemiology of coronary heart disease in migrant Chinese population. *Med Anthropol* 1980;4:307-20.
- National Center for Health Statistics. Demographic classification and coding instruction for death record, 1993: instruction manual. Part 4. Hyattsville, Md.: Centers for Disease Control and Prevention, 1993.
- 1990 Census of population and housing: public use microdata samples, United States. Washington, D.C.: Bureau of the Census, 1992 (machine-readable data files).
- 1990 Census of population and housing: public use microdata samples, United States: technical documentation. Washington, D.C.: Bureau of the Census, 1993.
- Bureau of the Census. 1990 Census of population: general population characteristics, United States. No. 1990 CP-1-1. Washington, D.C.: Government Printing Office, 1992.
- Kahn HA, Sempos CT. Statistical methods in epidemiology. Vol. 12 of Monographs in epidemiology and biostatistics. New York: Oxford University Press, 1989:87-126.
- National Center for Health Statistics. Vital statistics of the United States, 1990. Vol. 2. Mortality. Washington, D.C.: Government Printing Office, 1994. (DHHS publication no. (PHS) 95-1101.)
- Berenson GS, Webber LS, Srinivasan SR, Cresanta JL, Frank GC, Farris RP. Black-white contrasts as determinants of cardiovascular risk in childhood: precursors of coronary artery and primary hypertensive diseases. *Am Heart J* 1984;108:672-83.
- Tyroler HA, Knowles MG, Wing SB, et al. Ischemic heart disease risk factors and twenty-year mortality in middle-age Evans County black males. *Am Heart J* 1984;108:738-46.
- Keil JE, Sutherland SE, Knapp RG, Lackland DT, Gazes PC, Tyroler HA. Mortality rates and risk factors for coronary disease in black as compared with white men and women. *N Engl J Med* 1993;329:73-8.
- Gillum RF. Cardiovascular disease in the United States: an epidemiologic overview. In: Saunders E, Brest AN, eds. Cardiovascular disease in blacks. Vol. 21. No. 3 of Cardiovascular clinics. Philadelphia: F.A. Davis, 1991:3-16.
- Borhani NO. Changes and geographic distribution of mortality from cerebrovascular disease. *Am J Public Health* 1965;55:673-81.
- Balarajan R. Ethnic differences in mortality from ischemic heart disease and cerebrovascular disease in England and Wales. *BMJ* 1991;302:560-4.
- Cruickshank JK, Beevers DG, Osbourne VL, Haynes RA, Corlett JCR, Selby S. Heart attack, stroke, diabetes, and hypertension in West Indians, Asians, and Whites in Birmingham, England. *BMJ* 1980;281:1108.
- Browne CM, Solimen R, Arévalo R, et al. In Barbados the increase in blood pressure with age is inherited and associated with the "African" mtDNA genotype. *Circulation* 1996;93:623. abstract.
- Kurtzke JF. The geographic distribution of cardiovascular disease. New York: Springer-Verlag, 1969:29-46.
- Miller GJ, Kotecha S, Wilkinson WH, et al. Dietary and other characteristics relevant for coronary heart disease in men of Indian, West Indian and European descent in London. *Atherosclerosis* 1988;70:63-72.
- Gerber LM. The influence of environmental factors on mortality from coronary heart disease among Filipinos in Hawaii. *Hum Biol* 1980;52:269-78.
- Lemann N. The promised land: the great black migration and how it changed America. New York: Knopf, 1991.
- Beadenkopf WG, Abrams M, Daoud A, Marks RU. An assessment of certain medical aspects of death certificate data for epidemiologic study of arteriosclerotic heart disease. *J Chronic Dis* 1963;16:249-62.
- Guralnick L. Some problems in the use of multiple causes of death. *J Chronic Dis* 1966;19:979-90.