Original Contributions

Stroke in Blacks

Richard F. Gillum, MD

In an attempt to answer unresolved questions and to suggest directions for future research concerning stroke in black populations, data from the National Center for Health Statistics were examined and published studies were reviewed. Stroke was the third leading cause of death among U.S. blacks in 1982, accounting for 18,698 deaths, 8.25% of the total. Black men aged 35-74 years were 2.5 times and black women 2.4 times as likely as whites to die of stroke. A long-term decline in stroke mortality rates continued through 1982, with the declines since 1968 probably due to improved hypertension control. Data on morbidity trends are lacking. About 7% of black men and 11% of black women in the U.S. noninstitutionalized population aged 65 and over reported having had a stroke in 1977, black women having the highest prevalence of any group. In several studies, black women had higher incidence rates of stroke than white women in each age group. Black men had higher incidence rates than whites up to age 75 years. Survivorship and outcome following stroke may have been poorer in blacks than in whites. Advanced age and elevated blood pressure were the only putative risk factors for stroke for which published data were adequate to firmly establish the association in blacks. Thus, data are needed to examine trends in stroke incidence and survivorship in blacks and to assess the relation of many variables to the risk of stroke. (Stroke 1988;19:1-9)

Stroke is the third leading cause of death in U.S. blacks. It has long been recognized that U.S. blacks suffer mortality and morbidity from stroke at rates far in excess of those of whites; stroke death rates of U.S. blacks have been among the highest in the world. Despite these facts, many questions remain regarding the etiology of stroke in blacks and the basis for racial differences in stroke occurrence. This report examines data from the National Center for Health Statistics and reviews epidemiologic studies of stroke in black populations in an attempt to answer these questions and to suggest directions for future research.

Mortality

Rates and Trends

Figure 1 shows age- and sex-specific cerebrovascular disease (CVD) mortality rates for U.S. blacks and whites for 1979-1982. The rubric used was 430-438 of the ninth revision of the International Classification of Diseases. The third leading cause of death, CVD accounted for 18,698 deaths in blacks in 1982, 8.25% of the total. Age-adjusted CVD mortality rates for persons aged 35-74 years declined from 1979 to 1982 as follows: for black men (BM) 12.0%, for white men (WM) 14.9%, for black women (BW) 12.5%, and for white women (WW) 13.4% (Table 1). Age-adjusted CVD mortality rates at ages 75 and over also declined: for BM 9.4%, for WM 14.6%, for BW 8.5%, and for WW 13.1%. Age- and sex-specific race ratios (B/W) shown in Table 1 changed little over the period and were inversely related to age. A crossover in mortality rates occurred in the age 85 and over group, with white rates exceeding black rates. The decline in CVD mortality rates was similar for blacks and whites under 75 years of age but was greater in whites >75 years old. Both the absolute and relative rates of decline for 1979-1982 were less than those reported for 1972-1975 for each age, sex, and race group, suggesting a slowing of the decline in CVD mortality rates. Long-term trends in CVD mortality prior to 1979 have been extensively discussed elsewhere together with problems in the interpretation of vital statistics data. Most authors have cited improvement in hypertension detection and control as the chief explanation for the decline in CVD mortality in all race and sex groups. Relative improvements in hypertension control and stroke mortality in blacks and whites was consistent with this hypothesis.

Geographic Variation

In 1959-1961, the lowest mortality rates for blacks and other nonwhites were recorded in the middle Atlantic and New England regions of the United States, the highest in the south Atlantic or east-south central regions for both sexes; this pattern was similar to that for whites. Stroke mortality rates were higher in nonmetropolitan than in metropolitan counties for blacks and whites. In 1965-1972 this pattern was little changed despite downward national trends. Substantial within-state variation in stroke mortality rates for blacks probably existed during the 1960s and...
Although reliable stroke mortality rates are largely lacking for black populations outside the United States, available data indicate high rates for blacks in Africa, the Caribbean, and Latin America (Figure 2). However, rates from developing countries must be interpreted with caution because of possible inaccuracies in death certification and population enumeration.

One study attempted to explain geographic variation in CVD mortality rates on the basis of prevalence of stroke risk factors compared with population survey results in three cities, one with a high, one with an intermediate, and one with a low mortality rate. There was an increasing prevalence of hypertension in black women and white men and an increasing glucose intolerance and history of diabetes with increasing stroke mortality in all race and sex groups; there was no difference in prevalence of other stroke risk factors. Another study attempted to link ecologic stress to CVD mortality. However, the interpretation of such ecologic correlations is difficult because of the possibility of spurious associations.

Pathology

In addition to differences in the prevalence of hypertension, differing susceptibility of various arterial beds to atherosclerosis has been suggested as a possible explanation for the increased stroke mortality rate in blacks. Unfortunately, population-based anatomic data are not available. However, several autopsy series reported more atherosclerosis in the intracranial and as much as or more in the cervical arteries in American blacks than in whites. A recent review of autopsy and angiography series of patients with occlusive CVD concluded that the available data, while incomplete, suggest that the blacks studied had a disproportionately high occurrence of intracranial occlusions. Unlike Japanese, who may also have a predisposition for intracranial occlusions, blacks studied recently in the United States had high rates of ischemic heart disease mortality and morbidity and atherosclerotic lesions of coronary arteries.

Prevalence

Few population-based estimates of prevalence for blacks are available from studies that used neurologic
examinations and strict criteria as well as self-reports for ascertainment of stroke. However, both types of study have reported higher prevalence in blacks than in whites. In a 1950s Baltimore study, blacks had higher CVD prevalence (320 per 10,000) than whites (240 per 10,000). In the Evans County cohort study, the age-adjusted prevalence rates per thousand (with number of cases in parentheses) at the second examination (1967–1969) were for BM 58.6 (18), for WM 53.2 (28), for BW 48.4 (18), and for WW 15.0 (10) for persons aged 35 years and older. In a probability sample of the Chicago population aged 65–74 on public assistance in 1965–1970, prevalence of completed stroke at baseline examination was for BM 134, for WM 104, for BW 127, and for WW 79 per thousand. Prevalence was higher in blacks than in whites in Birmingham, Alabama. Age-adjusted prevalence of stroke among 10,940 hypertensives at the time of randomization into the Hypertension Detection and Follow-up Program (HDFP) clinical trial was twice as high in black as in white men and about 50% higher in black than in white women. In Copiah County, Mississippi, age-adjusted point prevalence as of January 1, 1978, was for BM 1341, for WM 1124, for BW 1228, and for WW 767 per 100,000 for definite and possible stroke confirmed by examination. In 1977, national prevalence rates of self-reported stroke at ages 45–64 were highest in black men followed by black women, white men, and white women. At ages 65 and older, rates were highest in black women followed by white men, black men, and white women. About 4% of black men and 3% of black women aged 45–64 had a stroke history. These rates rose to 7 and 11% at age 65 and older. Blacks reported having their initial strokes at younger ages than whites. In 1972, prevalence rates for ages 45–64 were white 1.0%, other races 2.5%; for ages 65 and older white 4.7%, other races 6.0%. However, since self-reported rates are subject to various types of bias that may differ by race and sex, the results of these surveys must be interpreted with caution. The general pattern of an increased prevalence of stroke in blacks compared with whites was doubtless accurate although temporal trends in prevalence cannot safely be inferred from self-reported data, as discussed elsewhere. Unfortunately, the sample size of the Health Examination Survey (1960–1962) was not sufficiently large to estimate stroke prevalence. Only 25 cases of definite stroke (history plus paralytic residuals on examination) were found in the sample of 6,672 persons. Of these 25 cases, only four were found among the 827 blacks aged 18–79 years. The first and second National Health and Nutrition Examination Surveys were also unable to provide stroke prevalence rates because of small sample sizes.

**Incidence**

**Cohort Studies**

The 7-year follow-up of a biracial cohort in Evans County, Georgia, revealed age-adjusted incidence rates of stroke as follows (age adjusted using the 1950 U.S. population as standard with number of cases in parentheses): for BM 5.8 (24), for WM 4.7 (35), for BW 5.8 (23), and for WW 1.2 (12) per 1,000 per year for persons aged 15–74 years at entry. Rates generally increased with age in all groups. Three-year incidence of stroke was determined in a sample of persons aged 65–74 years at entry receiving old age assistance in Cook County, Illinois, in 1965 (number of cases in parentheses): BM 82 (51), WM 50 (26), BW 94 (73), and WW 62 (37) per 1,000. Subjects were screened at 6-month intervals and were examined by a neurologist if neurologic symptoms were found. The incidence of transient ischemic attacks was not reported by race in the latter study but was reportedly almost twice as great in whites as in blacks in the Evans County study. Blacks had higher incidence of stroke than whites in Birmingham, Alabama. These studies from the 1960s are the only population-based cohort studies of stroke incidence in U.S. blacks that I found in the literature. However, they were consistent with one another and with studies that used other methodologies in reporting higher incidence of stroke among blacks.

**Community Surveillance Studies**

Several studies have reported higher rates of hospitalization for acute stroke in blacks than in whites. In a defined population in south Alabama in 1980, age-adjusted rates per 100,000 for initial strokes were higher in black men (172) than in white men (139) and higher in black women (236) than in white women (88) based on 108 cases in blacks and 53 cases in whites.

The National Hospital Discharge Survey found 1981 age-adjusted discharge rates for first-listed CVD to be 30% higher in U.S. blacks (652 per 100,000) than in whites (483 per 100,000) aged 35–74 years. Rates for blacks and whites over 75 were 3540 and 3438 per 100,000, respectively, in 1981, the only year for which race-specific rates were available (Figure 3). In this survey, discharge diagnoses were not validated, and data on race were missing from the discharge face sheet in >10% of cases. Missing race data were imputed only in 1981, although data have been collected on an annual basis since 1965. Because of the large percent of imputed data, rates for blacks and whites must be compared with caution. The validity of hospital surveys is limited by the finding that a substantial percent of stroke survivors were never hospitalized in
Table 1. Cerebrovascular Disease Mortality Rates by Age, Sex, and Race, 1979–1982

<table>
<thead>
<tr>
<th>Age</th>
<th>1979</th>
<th>1980</th>
<th>1981</th>
<th>1982</th>
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<tr>
<td>Black</td>
<td>171.6</td>
<td>165.0</td>
<td>157.1</td>
<td>151.0</td>
<td>20.6</td>
<td>12.0</td>
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<tr>
<td>White</td>
<td>70.7</td>
<td>67.9</td>
<td>64.1</td>
<td>60.2</td>
<td>10.5</td>
<td>14.9</td>
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<tr>
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<td>2.45</td>
<td>2.51</td>
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<tr>
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<td>1161.9</td>
<td>1249.7</td>
<td>1134.5</td>
<td>1052.5</td>
<td>109.4</td>
<td>9.4</td>
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<tr>
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<td>1064.0</td>
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<td>1.07</td>
<td>1.07</td>
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ICD 430–438; rate per 100,000 population. B/W, black: white ratio.

some areas.44 Thus, there are no satisfactory national data published on stroke incidence in blacks.54,55 Both national and local data on trends in stroke incidence or hospitalization in blacks are lacking.52–57 Further, little firm epidemiologic data was found on the relative incidence of cerebral infarction and intracerebral hemorrhage in black compared with white populations. In most studies, diagnostic data or number of cases were too limited for such comparisons. Several studies found a lower incidence of transient cerebral ischemia in blacks. Estimates of incidence from Africa came from a stroke register operated from 1973 to 1975 in Ibadan, Nigeria; comparisons with U.S. data are problematic.58

Survivorship

Case Fatality

No population-based case fatality data for blacks were found for cases subjected to diagnostic validation. Neither the population-based study in south Alabama50 nor the National Survey of Stroke55 reported race-specific case fatality rates. Among patients discharged from U.S. hospitals in 1981 with the diagnosis of CVD, hospital case fatality rates for persons aged 45–64 were for BM 19.1%, for WM 6.5%, for BW 14.8%, and for WW 9.1%; for persons aged 65 and over, for BM 13.3%, for WM 11.6%, for BW 14.1%, and for WW 11.1%.52,53 However, these rates for
blacks must be viewed with caution due to the small number of fatal cases in the sample. Blacks admitted to 208 hospitals participating in the Professional Activities Survey (PAS) during 1970 and 1971 had slightly higher age-specific hospital mortality in Michigan and much higher mortality in North Carolina than did whites in each respective state. Hospital mortality in North Carolina was higher than that in Michigan for each race. Only 68% of North Carolina and 75% of Michigan hospitals participated in PAS. In a series of 527 black stroke patients admitted to Harlem Hospital in New York, hospital fatality was 41%; half of the deaths occurred within 9 days of admission, similar to results from an earlier report. These limited data permit no firm conclusions to be drawn about relative case fatality in blacks compared with whites in the United States; they do, however, suggest that at least in some areas blacks suffering from stroke may have a less favorable acute prognosis than whites. No data on trends in case fatality for blacks were found.

### Long-term Survivorship

No population-based studies of long-term survival after stroke in blacks were found. Data from several hospital series indicate possibly poorer survivorship and functional recovery in blacks.

### Risk Factors

#### Blood Pressure

Only 2 prospective cohort studies were found that estimated relative risk for stroke associated with elevated blood pressure in blacks. In the Evans County cohort study, 87-month incidence of stroke was higher in persons with severe hypertension (blood pressure ≥180/110 mm Hg) than in those with normal or borderline blood pressure (≤159/94 mm Hg). Approximate age-adjusted relative risks were for WM 3, for WM 6, and for WM 9. This single study suggests substantial differences in the magnitude of relative risk associated with a given elevation in blood pressure between blacks and whites. However, much more data is required to confirm the existence of the differences and their magnitude. For this, a large population-based prospective follow-up study of stroke incidence in blacks is needed.

The 5-year mortality follow-up study of 23,490 black and 325,384 white male volunteers screened in 1973-1975 for eligibility for the Multiple Risk Factor Intervention Trial (MRFIT) yielded useful information on risk factors for stroke mortality. At the time of screening, black men aged 35-57 years had higher (3.3 mm Hg) diastolic blood pressure, lower total serum cholesterol (3.9 mg/dl), and higher percent smokers (50 vs. 35.9%) compared with their white counterparts. Black-to-white crude ratios of 5-year death rates were for all causes 1.38, for cardiovascular disease 1.26, for coronary heart disease 1.28, and for CVD 2.6. Black men had higher age-adjusted CVD mortality rates than whites after controlling for diastolic blood pressure at screening, especially among hypertensives. There was a significant difference in logistic multiple regression coefficients between blacks and whites; a 10 mm Hg increase of diastolic blood pressure increased risk of death from CVD by 86% for black men and by 45% for white men. This difference seemed to explain part of the black-white difference. After adjusting for age and the three risk factors, relative risks for black versus white men were 2.8 among hypertensives and 1.8 among normotensives; i.e., risk factor levels at screening did not entirely explain the racial difference in stroke mortality. However, the number of deaths among black men was small (n = 30), and these results require confirmation. In the 1977 Health Interview Survey, relative risks of stroke associated with hypertension varied greatly by race, age, and sex but showed no consistent racial pattern.
The epidemiology of hypertension in black populations has been well documented elsewhere.\textsuperscript{7,18,67-69} Prevalence, incidence, and blood pressure levels were higher in blacks than in whites. Only about half of U.S. blacks or whites recognized high blood pressure as a cause of stroke, and only about one fifth recognized hypertension control as a way to prevent stroke in 1973 and 1979.\textsuperscript{70} In the 1985 Health Interview Survey, 79% of blacks and 77% of whites correctly identified hypertension as the most significant cause of stroke.\textsuperscript{71} In a 1985 Chicago survey, 74% of black men and 81% of black women identified high blood pressure as the chief risk factor for stroke.\textsuperscript{72} Despite the marked improvements of the past 2 decades, the still unsatisfactory rates for hypertension among black men suggest that considerable work is still needed to control hypertension in black communities.\textsuperscript{71,87}

**Diabetes**

No published prospective follow-up data were found relating diabetes to the risk of stroke in blacks; even estimates of relative risks were lacking from cross-sectional or retrospective studies.\textsuperscript{50,60,74} In the 1977 Health Interview Study, relative risks of history of stroke associated with history of diabetes were higher in whites than in blacks among women aged 45–64 years and among men aged 45 years and older and were similar in whites and blacks among women aged 65 years and older (National Center for Health Statistics, unpublished data). Estimated relative risks (odds ratios) in blacks aged 45–64 years were 0.9 for men and 1.5 for women; for blacks aged 65 years and older odds ratios were 1.7 for men and 2.7 for women. Estimated relative risks in whites aged 45–64 years were 3.5 for men and women; for whites aged 65 years or older estimated relative risks were 2.5 for men and 2.8 for women. However, these results must be interpreted with caution due to the small number of blacks with stroke in the sample and due to large potential biases associated with self-reported cross-sectional data, with exclusion of fatal cases, and with exclusion of the institutionalized population.

The epidemiology of diabetes in blacks has been reviewed elsewhere.\textsuperscript{67,75} Earlier data from various sources were conflicting concerning the relative prevalence of diabetes or glucose intolerance in blacks compared with whites. Recent national data indicated a higher prevalence of diagnosed and undiagnosed diabetes in blacks than in whites.\textsuperscript{73-78} Further, the relation of the fourfold increase in the rate of black Americans with known diabetes between 1963 and 1985 to trends in stroke and ischemic heart disease mortality requires study.\textsuperscript{79}

**Prior Heart Disease and Electrocardiographic Abnormalities**

Published data on the relative risk of stroke associated with prior heart disease in blacks are few. Antecedent electrocardiographic abnormalities were associated
Stroke in Blacks

with only slightly increased risk of stroke in blacks in the Evans County study.  
Approximate age-adjusted relative risks were for BM 1.3, for WM 1.9, for BW 1.3, and for WW 1.3. This and mortality analyses using multiple-cause data suggest a different mode of action for this risk factor in blacks than in whites, perhaps related to greater prevalence of hypertension and greater susceptibility to the effects of hypertension in blacks.  
Further data on the relative risk associated with clinically manifest vascular disease is needed for blacks. Prevalence of heart disease and electrocardiographic abnormalities was higher in blacks than in whites in the United States.  
I found no data on the association of atrial fibrillation with stroke in blacks.

Transient Cerebral Ischemia

I found few prospective studies that published data on transient cerebral ischemia or asymptomatic carotid bruits as a risk factor for stroke in blacks.  
In a multicenter study of patients treated for transient cerebral ischemia over a 21-month interval, race was not significantly associated with mortality.  
In Evans County, 4.8% of blacks and 4.2% of whites free of stroke or ischemic heart disease had cervical bruits; 5 of 29 blacks and 5 of 43 whites with asymptomatic bruits had a stroke during a 6-year follow-up. Age-adjusted incidence rates for transient cerebral ischemia were higher in whites than in blacks in Evans County in another report (number of cases in parentheses): BM 7.91 (3), WM 15.9 (11), BW 7.8 (4), and WW 11.5 (10) per 1,000.  
However, these data must be interpreted with caution since cases associated with stroke or death were excluded and numbers were small. A study of elderly welfare recipients in Cook County, Illinois, reported a greater prevalence in blacks than in whites: BM 118, WM 92, BW 153, and WW 138 per 1,000.  
In a three-city survey, blacks reported a similar prevalence of symptoms suggestive of transient ischemic attacks at age 35–54 years compared with whites.  
In 1981, U.S. blacks had similar rates of cerebral arteriography but much lower rates of carotid vascular surgery compared with whites according to data from the National Hospital Discharge Survey.  
No data were available to evaluate whether these findings were due to bias, confounding, different disease patterns, or to differences in care resulting from other patient or physician factors in blacks compared with whites. Data are needed to establish the appropriate management of transient cerebral ischemia and asymptomatic carotid lesions in blacks.

Other Risk Factors

Age was associated with increased stroke mortality and morbidity in all studies.  
Male sex was associated with higher stroke mortality under age 75 (Table 1) but was inconsistently associated with morbidity.  
Sickle cell disease was a risk factor for stroke, as was prior stroke. More data are needed on the efficacy of treatment of hypertension in black and white stroke survivors. Stroke incidence was reduced 21% in patients of all races in stepped-care compared with referred-care in the HDFP subgroup with end organ damage including stroke.  
Other potential risk factors have not been systematically studied in black populations. Serum cholesterol was not related to stroke incidence in blacks or whites in the Evans County cohort or to stroke mortality in the MRFIT follow-up study.  
Lean black men had a lower risk of stroke than obese black men, but no such relation was found in black women in the Evans County cohort.  
Obesity was associated with increased risk of stroke in whites. The relation of high hematocrit to stroke in blacks could not be adequately assessed in the Evans County cohort due to small numbers of exposed persons although a positive association was suggested. The MRFIT follow-up data suggested a positive relation of cigarette smoking to stroke mortality in blacks, but conclusive data were lacking.  
No data were found on high low density lipoprotein cholesterol levels, low high density lipoprotein cholesterol levels, high alcohol consumption, physical inactivity, high leukocyte count, high fibrinogen, low potassium intake, positive family history, or oral contraceptive use and CVD in blacks. Low socioeconomic status in the United States has been related to increased hypertension prevalence, blood pressure levels, and stroke mortality in blacks and whites.  
Stroke mortality rates in North Carolina blacks were not clearly related to income; rather, mortality rates appeared to be related to various indicators of social instability or social disorganization. I found no reports relating season or climate to stroke occurrence in blacks. In blacks, advanced age and elevated blood pressure were the only risk factors for stroke whose status was firmly established by published data. More data are needed to assess other likely risk factors and to determine whether racial differences in stroke may be explained by risk factor differences.

Conclusions

Improved data are needed on levels and trends in stroke prevalence, incidence, and survivorship in blacks. Further research should be directed to racial variations in the susceptibility of various vascular beds to hypertension and arteriosclerosis and to the relative importance of blood pressure, diabetes, and other putative risk factors.

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Gillum Stroke in Blacks


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70. The Public and High Blood Pressure: Six-Year Followup Survey of Public Knowledge and Reported Behavior. Bethesda, Md, National Heart, Lung, and Blood Institute, 1979


Key Words: cerebrovascular disorders • blacks • risk factors • epidemiologic methods
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