Cerebrovascular Disease in African Americans

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It was an honor to be selected as the first lecturer for the American Heart Association (AHA) Presidential Symposium in conjunction with the 23rd International Joint Conference on Stroke and Cerebral Circulation. I wish to thank Dr Martha Hill, the AHA President, for the invitation to participate. Dr Hill has had a longstanding interest in cardiovascular health issues in the African American community. I also wish to thank Drs Edward Cooper and Jacqueline Washington, who served as panel discussants for the symposium. Since 1981, I have been carrying out epidemiological studies of stroke in African Americans. The studies have included both observational ones and clinical trials. At the present time, we are completing a secondary stroke prevention trial: the African American Antiplatelet Stroke Prevention Study (AAASPS). I now provide an overview of cerebrovascular disease in African Americans. I begin my discussion with a brief review of the constructs race and ethnicity.

Race and Ethnicity

Williams has critically examined the scientific consensus on the conceptualization of race.1 The United States government recognizes four racial groups—white, black, Asian or Pacific Islander, and American Indian or Alaskan Native—and one ethnic category, Hispanic. The distinction between race and ethnicity may be obscured, however, as some Hispanics may prefer to refer to themselves as a racial category.1 In the social science literature, the early definitions of race used the term to capture “physical” or “biological” characteristics that differentiated human populations. The term was then extended to encompass biological and social interaction. More recent definitions of race have discredited the early definition that included physical or biological characteristics because in general, phenotypic characteristics do not correlate well with biochemical or other genetic characteristics, and there may be more genetic variation within a race than between them.1,2 More recently, race has been defined as a sociopolitical construct with important cultural and ethnic components.

For health research, some have suggested the use of the term ethnicity instead of race.3–5 Ethnic groups share a common ancestry, history, or culture. Ethnicity highlights cultural and social characteristics rather than biological ones.1 Williams argues, however, that although race is not a useful biological category, it has traditionally been an important social one.1 In Williams’ framework for studying the relationship between race and health, he indicates that race is a complex construct that encompasses a number of interrelated factors such as biological and geographic origins, culture, economics, political and legal factors, and racism. Williams further argues that racial categories remain important because they define social, economic, and political disadvantages that impact on health status, and in the United States, race in health should be studied in a manner to uncover unmeasured biological, socioeconomic, and sociocultural factors that may affect well-being.1 Thus, political-economic and ideological structures maintain race as an important health variable.6,7

The distinction between race and ethnicity is somewhat blurred and is dependent on the specific definitions that are used to define these constructs. Some have used the label “race/ethnicity” or “racial/ethnic” group to acknowledge the different uses of these terms and the difficulties in distinguishing a specific group as culturally or biologically distinct.8 In this review, I will use the designation “race” and subscribe to Williams’ use of the construct.1 I will also use the terms “African American” and “black” interchangeably in regard to US studies, because African Americans are the predominant black group in the United States (an estimated 10% to 12% of the population).

Epidemiology of Stroke in African Americans

Mortality

Excess mortality is a pervasive theme in the African American community. African Americans are more likely to die of more chronic diseases, occupational injuries, homicides, and violent crimes and have disproportionate infant mortality.9–11 It is not surprising that African Americans have a substantially lower life expectancy than their white counterparts (Table 1).12 Whereas in most societies women outlive men by about 15 years, in the United States, life expectancy for black men is similar to that of those who live in some of the less-developed regions of the world.13 Possible explanations for disproportionate mortality among African Americans is...
discussed in the context of stroke mortality in a subsequent section of this article.

In the United States, of the three leading causes of adult death—heart disease, cancer, and stroke—the disparity in the ratio of black to white mortality is greatest for stroke. African American men and women have almost twice the rate of death due to stroke as their white counterparts (Table 2). Furthermore, the rate ratio for this disparity is most prominent at relatively younger ages (Table 3). For example, black men aged 45 to 59 years are about four times more likely to die of stroke than white men of the same age. By age 75 years or older, however, this ratio falls to about 1.26.

In the United States, excess stroke mortality has been substantial for both African Americans and whites in the southeastern portion of the country, an area known as the Stroke Belt. Stroke mortality is not uniform in this region. The highest rates appear along the coastal plain of Georgia and the Carolinas in an area dubbed the stroke “buckle.” Recent study suggests a shift of the Stroke Belt to the lower Mississippi River Valley. Overall, although stroke mortality rates may have fallen recently in this region, there still remains substantial excess stroke mortality. The reason for this geographically based excess remains uncertain. Howard has suggested that death certificate coding practices, the proportion of African Americans in the region, regional case fatality, and socioeconomic factors are variables that are unlikely to explain the excess. Cardiovascular, genetic, or environmental factors may explain the disproportion, at least in part, and should be considered the focus of future study in this region.

In the United States, secular trends have shown a deceleration of stroke mortality decline for African Americans and whites that spans the 1980s and 1990s when compared with the late 1960s and early 1970s. This slowing of the absolute rate of decline in stroke mortality has been substantial for African American women. The reason for the deceleration is not known. It may relate to an increase in the prevalence of cardiovascular diseases or risk factors such as heart failure, atrial fibrillation, diabetes mellitus, and obesity or a drop-off in control of hypertension.

In addition, African Americans may have higher mortality rates for intracerebral hemorrhage and cerebral infarction. Case fatality rates may be higher in young blacks for intracerebral hemorrhage. However, limited data permit no final conclusions to be drawn about overall case fatality by race for intracerebral hemorrhage and cerebral infarction.

### Incidence and Prevalence

The incidence of stroke has been approximately twice as high for African American men and women when compared with white Americans (Table 4). This disparity is most pronounced at younger ages.

The substantially higher stroke incidence rates in African Americans have led to a revised estimate of the annual number of strokes that occur in the United States. The estimated number has been revised upward from 500,000 to 550,000 to over 730,000. Furthermore, since 1990 the gap has widened for excess incident stroke among African American men and women who are Medicare beneficiaries when compared with their white counterparts. There is a paucity of recent studies of stroke prevalence. The prevalence of stroke may be higher for African Americans, and African American women may have the highest prevalence of stroke.

### Racial Differences in Stroke Subtype

African Americans have a higher incidence of cerebral infarction, subarachnoid hemorrhage, and intracerebral hemorrhage. Again, these rates generally are disproportionately higher for African Americans at relatively younger ages. Broderick and colleagues showed that African Americans who were up to 75 years had about twice the risk of

### TABLE 1. Comparative Life Expectancy in the United States

<table>
<thead>
<tr>
<th></th>
<th>White women</th>
<th>Black women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>79.6 y</td>
<td>73.8 y</td>
</tr>
<tr>
<td>Men</td>
<td>72.9 y</td>
<td>64.6 y</td>
</tr>
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</table>

### TABLE 2. Comparative Black:White Mortality for Cardiovascular Disease

<table>
<thead>
<tr>
<th>Condition</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>1.38</td>
<td>1.64</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>1.05</td>
<td>1.34</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.97</td>
<td>1.76</td>
</tr>
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### TABLE 3. Rate Ratio for Stroke Mortality in Texas 1988–1992

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Men*</th>
<th>Women*</th>
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</thead>
<tbody>
<tr>
<td>45–59</td>
<td>4.06</td>
<td>3.22</td>
</tr>
<tr>
<td>60–74</td>
<td>2.57</td>
<td>2.31</td>
</tr>
<tr>
<td>≥75</td>
<td>1.26</td>
<td>1.10</td>
</tr>
</tbody>
</table>

*Ratio compares African American men and women, respectively, with their white counterparts. Reprinted with permission.

### TABLE 4. Stroke Incidence Rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Incidence Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Alabama25</td>
<td>208/100 000 blacks*</td>
</tr>
<tr>
<td></td>
<td>109/100 000 whites*</td>
</tr>
<tr>
<td>Lehigh Valley26</td>
<td>2.43 black:white standard morbidity ratio</td>
</tr>
<tr>
<td></td>
<td>4.50 black:white standard morbidity ratio for age &lt;65 y</td>
</tr>
<tr>
<td>Northern Kentucky28</td>
<td>351/100 000 black men*</td>
</tr>
<tr>
<td></td>
<td>716/100 000 black women*</td>
</tr>
<tr>
<td></td>
<td>326/100 000 white women*</td>
</tr>
<tr>
<td>Greater Cincinnati/Northern Kentucky28</td>
<td>288/100 000 African Americans (first-ever stroke)†</td>
</tr>
<tr>
<td>Northern Kentucky28</td>
<td>233/100 000 blacks*</td>
</tr>
<tr>
<td></td>
<td>93/100 000 whites*</td>
</tr>
</tbody>
</table>

*Age-adjusted rates; †age- and sex-adjusted rates.
subarachnoid hemorrhage and 2.3 times the risk of intracerebral hemorrhage when compared with whites. For African Americans over 75 years of age, however, the odds ratio for intracerebral hemorrhage was only 0.23. In the Kaiser Permanente study, the risk of hospitalization for subarachnoid hemorrhage was about 2.5 times higher and that of intracerebral hemorrhage 2.3 times higher for African Americans than whites.34

Ischemic stroke subtypes may also differ by race.35 African Americans may be at higher risk for lacunar infarction and large-artery intracranial occlusive disease, whereas whites may be more prone to cerebral embolism, transient ischemic attack, and possibly extracranial occlusive disease.24,25,36,37 Debate has occurred concerning the possible racial propensity for intracranial or extracranial occlusive disease.35 Data to support the belief that racial differences exist in the anatomic distribution of occlusive cerebral vascular disease originate from a variety of types of studies such as autopsy, angiography, noninvasive blood flow, and clinical trials.36,38–43 Much of this data, however, emanates from referral centers or select populations that may not be representative of the community at large.35 Thus, it may be premature to conclude that there are clear-cut racial differences in the distribution of occlusive cerebral vascular disease. The weight of the available data suggests that African Americans are more likely to have symptomatic intracranial occlusive disease,44 whereas the results are mixed with regard to a racial propensity for symptomatic or asymptomatic extracranial occlusive disease. Several studies suggest that intimal-medial thickness may be greater at some asymptomatic extracranial sites in African Americans but at other sites in whites.45–48

The precise explanation for racial differences in the frequency of stroke subtype and the possible differences in the anatomic distribution of occlusive cerebral vascular disease is not known. It is presumed to be due to differences in the frequency, severity, and control of major cardiovascular risk factors such as hypertension.37,49

**Risk Factors**

Well-documented cardiovascular disease risk factors such as hypertension, diabetes mellitus, smoking, and obesity and the sequelae of these risk factors, end-stage renal disease, left ventricular hypertrophy, and congestive heart failure, generally are more prevalent in African Americans,50–52 These risk factors, however, may not be as prevalent in rural or urban Africans. Cooper and colleagues53 described the distribution of blood pressures, hypertension prevalence, and associated factors among populations of West African origin and the black African diaspora. These included peoples of Nigeria, Cameroon, Jamaica, St Lucia, Barbados, and the United States. The gradient of hypertension prevalence rose from 16% in West Africa to 26% in the Caribbean to 33% in the United States. Hypertension prevalence increased with age, and the epidemiological curve was two times as steep in the United States as in Africa. Furthermore, hypertension prevalence varied consistently with obesity and sodium and potassium intake for each region. The findings suggest that social conditions may be important determinants of hypertension.

Gillum54 has traced the epidemiological changes in the patterns of cardiovascular disease associated with the African diaspora. This study included comparisons of black societies of precolonial Africa, traditional African societies, modern black populations in the West Indies, rural and inner-city black populations of the United States, and affluent suburban or urban US blacks. Gillum concluded that social influences that related to acculturation, urbanization, and affluence were important determinants of cardiovascular disease because these factors were associated with saturated dietary fat intake, salt intake, and smoking, for example, and their occurrence paralleled that of hypertensive and atherosclerotic cardiovascular diseases. Substantial efforts to control certain of these potentially modifiable behaviors associated with poor cardiovascular health could lead to less cardiovascular disease in high-risk groups.55

Despite the excess stroke burden in African Americans, there has been a relative paucity of research on cardiovascular risk factors for stroke in this group.56 For example, modifiable cardiovascular risk factors may not have a uniform impact among different race-ethnic groups. In the Northern Manhattan Stroke Study, diabetes mellitus and hypertension had the highest etiologic fraction (attributable risk) among blacks and Hispanics, whereas atrial fibrillation had the highest etiologic fraction among whites.57 Thus, the number of strokes attributable to hypertension and diabetes was higher in blacks and Hispanics, while the number attributable to atrial fibrillation was higher in whites. Furthermore, in the same study, homocysteine levels were elevated in blacks compared with whites and were related to environmentally modifiable conditions such as diet, alcohol intake, and physical activity.58 These latter observations further emphasize the potential importance of modifiable stroke risk that may be linked to social influences. Patent foramen ovale, on the other hand, was more frequent in white and Hispanic case subjects than in controls compared with black cases and controls.59 The protective effects of serum potassium on ischemic stroke risk, however, were similar for men, women, and all three race-ethnic groups.60 Finally, the role of factors such as alcohol consumption, blood lipids, physical inactivity, genetic and coagulation factors, hormonal replacement therapy, markers of inflammation, stress, and racism needs to be better defined.50,51

**Explanations for Excess Stroke in African Americans**

Why is there excess stroke mortality and risk in African Americans? Several explanations have been proposed50,51: (1) higher prevalence of cardiovascular risk factors, (2) greater severity of risk factors or greater sensitivity to the risk factors, and (3) lack of access to care.

**Risk Factor Prevalence**

As previously mentioned, African Americans have a disproportionate burden of many of the traditional and modifiable cardiovascular disease risk factors.55 This seems to be a logical explanation for the excess of stroke. Although cardiovascular disease risk factors are important, they may not account for all of the variance for stroke risk. Kittner and
colleagues studied the contribution of hypertension and diabetes mellitus to stroke incidence in the 10-year follow-up of respondents from the First National Health and Nutrition Survey. Despite higher mean blood pressures and a higher prevalence of diabetes mellitus among blacks, these factors explained only about 50% of the excess stroke risk among black women.

If traditional cardiovascular disease risk factors such as hypertension and diabetes mellitus do not fully account for the disproportionate stroke burden in African Americans, what other conventional factors might play a role? Socioeconomic status (SES) is one such factor. Commonly used measures, indexes, and ecological measures of social class include education, income, occupation, employment status, indexes of social class (eg, occupational prestige), measures of living conditions (eg, ownership of a house, automobile, etc), area-based measures (eg, census tracts, block groups), life-span measures, and measures of income inequality. The primary measures of SES have been education, occupation, and income. SES has been linked to cardiovascular disease risk factors and may be viewed as an independent risk factor for cardiovascular disease, with some reservation related to possible confounding.

SES has been a predictor of all-cause mortality or coronary disease mortality. Geronimus and colleagues studied mortality among blacks in selected areas of New York, Detroit, Los Angeles, and Alabama and among whites in areas of New York City, metropolitan Detroit, Kentucky, and Alabama by analyzing death certificates of subjects between 15 and 64 years of age. The comparison areas were chosen as those of poverty and higher income. In the poverty-stricken areas there was excessive mortality, especially among blacks. The standardized mortality ratios for men and women, respectively, were 4.11 and 3.38 in Harlem, 2.92 and 2.60 in Watts, 2.79 and 2.58 in central Detroit, and 1.81 and 1.89 in the Black Belt of Alabama. In general, poor whites had mortality ratios below the national average for blacks, whereas higher-income blacks in Queens/Bronx had the lowest black mortality ratios (men, 1.18; women, 1.08) and ratios that were lower than those of poor whites. Fang and colleagues and Schneider and colleagues noted that higher rates of cardiovascular disease mortality in blacks may be masked by variation in their place of birth. In general, southern-born blacks who migrate have the highest mortality rates.

Howard and colleagues analyzed data from the US National Longitudinal Mortality Study for persons 45 years and older (73,400 white men, 87,528 white women, 6,522 black men, and 8,816 black women) to estimate excess black stroke mortality in relation to the SES measures of education and income. They concluded that SES explained <25% of excess stroke mortality among men aged 45 to 65 years, and there was a small impact in women. Although SES may be important in stroke mortality risk, little of the black excess stroke mortality for women and only 20% in men was attributed to this factor. The findings suggested that other explanatory factors need to be elucidated. Guralnick and Leveille have suggested, however, that the interrelationships between race and SES may be too complex to unravel with traditional adjustments for current income and education. Specific methodology for the measurement of SES and its application may affect conclusions about the role of SES in explaining differences in health outcomes.

Kaplan and Keil acknowledge that SES as an independent risk factor for disease or mortality may simply imply our lack of knowledge about the behavioral, social, psychological, and biological pathways by which SES affects cardiovascular disease. Lantz and colleagues have shown that the risk of mortality is still significantly elevated for lower and middle-income groups even when age, sex, race, urbanicity, and education are controlled, and when four behavioral risk factors (cigarette smoking, alcohol intake, physical inactivity, and relative body weight) are taken into account. Thus, the authors concluded that socioeconomic differences in mortality were attributable to a wider array of factors and might persist even with improved health behaviors among the disadvantaged.

What then are these additional factors? In a companion editorial to the article of Lantz et al., recommended that the search for mediators of the impact of lower SES on health be expanded to include psychosocial factors such as hostility, depression, and social isolation, as well as a host of biological and behavioral factors. Williams emphasized the potential importance of early life experiences in the later development of at-risk psychosocial, behavioral, and biological characteristics. When considering SES and its nuances in cardiovascular disease, Cooper has cautioned that racial or ethnic comparison studies may be substantially confounded because factors such as SES may significantly differ for specific racial or ethnic groups and may not be comparable. Cooper advocates an approach to define the causal pathway by study of genes, environment, and appropriate interactions.

Thus, SES is likely to be an important determinant of excess stroke burden in African Americans, but its conceptualization and application to cardiovascular disease studies need to be refined. Early life exposures may be crucial for the development of at-risk behaviors and profiles. Furthermore, in lower SES groups conventional risk factors may appear earlier in life, and exposure periods to risk factors may be extended.

Severity of Risk Factors

With regard to severity of risk factors and possible sensitivity to risk factors (whereby one would be more likely to develop disease, experience more severe disease, or die), there is evidence to suggest that African American adults have higher blood pressure and that African American children may also have higher blood pressure. The mechanism whereby this occurs, however, is not well defined. Although much has been said about salt sensitivity in African Americans and the occurrence of a volume type of hypertension, we still need to clarify the mechanism(s) for hypertension in blacks. Furthermore, there is a relative paucity of information about the mechanism(s) of possible selective sensitivity of target end organs to cardiovascular risk factors by race. With concerted efforts, however, treatment of major cardiovascular risk factors can be accomplished successfully in both blacks and whites with subsequent reduction in mortality.
Access to Care

Traditionally, African Americans have had less access to medical care.88,89 This is reflected in the distribution of healthcare insurance90; discrimination against minorities in various aspects of medicine91,92; utilization of procedures, treatments, and surgery93–104; participation in clinical trials105–107; and hospital care.108 Such inequalities have been present since the pre-Civil War era and have led to a deep mistrust of health institutions on the part of African Americans.107,109 Furthermore, beyond mistrust, African Americans face other barriers to healthcare participation such as economic factors; social isolation; lack of awareness of disease risk factors, warning signs, and treatment programs; and communication barriers.107,110

Of particular interest is the utilization of major diagnostic procedures and surgery in African Americans. For example, in a study of 12,402 patients (10.3% black) with coronary disease at Duke University, Peterson and colleagues105 reported that blacks were 13% less likely to undergo angioplasty and 32% less likely to undergo bypass surgery than whites. The difference was not explained by clinical features of the disease and was most pronounced for those predicted to benefit most from revascularization. Mort and colleagues97 reported that Massachusetts blacks had lower rates of abdominal aortic aneurysm repair, appendectomy, cardiac valve replacement, carotid endarterectomy, cholecystectomy, lumbar disk procedures, open reduction/internal fixation of the femur, and tonsillectomy but higher rates of hysterectomy and prostatectomy than whites. Racial variation was noted for low, moderate, and high discretion procedures, and it was suggested that race-related differences in access to care or in the way patients and physicians made clinical decisions could explain the findings. Gornick and colleagues106 reported that race and income had substantial effects on use of services among Medicare beneficiaries, but Medicare coverage alone was not sufficient to promote effective patterns of use of services. With regard to medical insurance, blacks in the United States are less likely to have private health insurance (63% versus 86%) and more likely to have Medicaid coverage (35% versus 11%) than whites.90

There is also a disparity in the use of carotid endarterectomy. In a Veterans Affairs study, Oddone and colleagues95 showed that blacks were substantially less likely to undergo carotid endarterectomy than whites (4.2% versus 93%). In this study of 35,922 veterans, blacks constituted 18.2% of the patients with a history of stroke or transient ischemic attack and 9.8% of those having cerebral angiography, yet only 4.2% of those undergoing carotid endarterectomy. Possible explanations for this disparity include less severe and frequent extracranial carotid occlusive disease, economic barriers, or aversion to invasive diagnostic procedures and high-risk surgeries.99

Access to medical care remains a logical candidate factor to explain excess stroke burden in African Americans, and access to medical care should be promoted at a national level. The provision of access to medical care, however, does not necessarily equate to lower morbidity and mortality, especially if services are not accessed in a meaningful way. The hierarchy of life’s needs for those of lower SES may preclude meaningful use of medical services. Because utilization of preventive services and treatments and maintenance of healthy lifestyles may equate to improvement in health outcomes,52 strategies to better engage those in need of these services should be developed.

Clinical Trials for Stroke Prevention

As noted previously, African Americans have been underrepresented in clinical trials.105–107 The US government has mandated diversity in study populations and the recruitment of women and minorities into studies sponsored by the National Institutes of Health. Since the enactment of this mandate, there has been greater representation of African Americans in clinical trials. Enrollment statistics for African Americans in select, recent stroke trials in which there were multiple test sites in the United States are listed in Table 5.111–117

To date, two clinical trials have focused primarily on stroke prevention in African Americans. The Stroke Prevention Trial in Sickle Cell Anemia (STOP) tested the hypothesis that periodic blood transfusions, with reduction of hemoglobin S concentration to <30% of the total hemoglobin concentration, could substantially lower the stroke risk compared with standard care.118 Children were eligible if there was no history of stroke and they had undergone 2 transcranial Doppler studies with time-averaged mean blood flow velocity in the internal carotid or middle cerebral artery of >200 cm/s. There were 10 cerebral infarcts and 1 intracerebral hemorrhage in the standard-care group (n=67) and only 1 cerebral infarct in the transfusion group (n=63). This represented a 92% difference in the risk of first stroke (P<0.001). This trial has led to the recommendation that children aged 2 to 16 years with sickle cell disease undergo transcranial Doppler examination every 6 months to identify candidates for transfusion therapy.

The other prevention study, the African American Antiplatelet Stroke Prevention Study (AAASPS), is presently ongoing; it is a double-blind, randomized, multicenter trial that is comparing the effectiveness and safety of ticlopidine hydrochloride (500

<table>
<thead>
<tr>
<th>Study</th>
<th>Total Patients, n</th>
<th>% Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ticlopidine Aspirin Stroke Study111</td>
<td>3069</td>
<td>16</td>
</tr>
<tr>
<td>Canadian American Ticlopidine Study112 (1989)</td>
<td>1053</td>
<td>28</td>
</tr>
<tr>
<td>North American Symptomatic Carotid Endarterectomy Trial (70–90% stenosis group)113 (1991)</td>
<td>659</td>
<td>3</td>
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<tr>
<td>NINDS rt-PA Study114 (1995)</td>
<td>624</td>
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<tr>
<td>Asymptomatic Carotid Atherosclerosis Study115 (1995)</td>
<td>1659</td>
<td>2</td>
</tr>
<tr>
<td>Clopidogrel vs Aspirin in Patients at Risk of Ischemic Events (CAPRIE)116 (1996)</td>
<td>6431</td>
<td>9</td>
</tr>
<tr>
<td>Clopidogrel vs Aspirin in Patients at Risk of Ischemic Events (CAPRIE)116 (Stroke subgroup)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American Antiplatelet Stroke Prevention Study (AAASPS)117 (ongoing, as of 10/19/98)</td>
<td>931</td>
<td>100</td>
</tr>
</tbody>
</table>
mg/d) and aspirin (650 mg/d) in the prevention of recurrent stroke, myocardial infarction, and vascular death in African Americans with noncardioembolic ischemic stroke within the past 90 days. Ticlopidine and aspirin were chosen as the interventions because the Ticlopidine Aspirin Stroke Study suggested that these agents were safe and effective in a substudy of nonwhites. AASPS is the first large-scale stroke prevention study that is targeted exclusively to the African American community. AASPS participating sites are located throughout the United States at centers that serve African American stroke patients. The recruitment goal is 1800 patients, and the follow-up period is 2 years.

AASPS has recruited more African Americans than any other stroke trial (see Table 5). Furthermore, in preliminary study the proportion of baseline cardiovascular risk factors is substantially higher than in other stroke prevention studies. For example, the frequency of hypertension and diabetes mellitus was 84% and 40%, respectively.

AASPS will also help us to better understand approaches to recruitment of African Americans with stroke, the effectiveness and safety of secondary stroke preventatives in this group, and how to establish community networks in the pretrial planning and therapy phases in underserved populations. As we strive to establish the best means of treatment and prevention of stroke for this high-risk group, we find no evidence at the present time to suggest that any established acute, primary, or secondary stroke intervention or prevention should be withheld from African Americans.

Sequelae of Stroke
Vascular Dementia
Among groups at high risk for stroke, vascular causes of cognitive impairment may be important. This has been shown to be the case in some Asian populations and in the elderly, and it may also be the case for African Americans. Studies that include persons of different races have shown that dementia risk after stroke is higher in nonwhites.

In a risk-factor assessment study, we identified the following factors as possible risk factors for dementia after stroke in African Americans: history of myocardial infarction, recent cigarette smoking, lower educational attainment, and advanced age. Cardiovascular risk factors are believed to be predictors of cognitive impairment after stroke. In neuroimaging studies (cranial CT or MRI) of African Americans with dementia after stroke, we have identified the following radiological predictors of dementia: left cortical infarcts, diffuse enlargement of the left lateral ventricle, white matter lesions, nonlacunar infarcts, left subcortical infarcts, and atrophy (widenings) of the third ventricle. In another neuroimaging study, African Americans had a lower prevalence of white matter lesions by MRI of the brain but a higher prevalence of more severe white matter lesions when compared with whites.

Functional Outcome
Given the high stroke incidence and mortality rates for African Americans, one might expect poorer functional outcome after stroke. It was suggested that blacks were more seriously ill initially after stroke in the Joint Study of Extracranial Arterial Occlusion and in the Community Hospital-Based Stroke Programs. Although African Americans may be more likely to be obtunded or comatose after a stroke and may have a longer length of hospitalization, they may have a similar degree of functional impairment but more residual physical impairment several months after stroke. Further information in this area is needed to arrive at more definitive conclusions. Interestingly, stroke recurrence rates that may influence functional outcome may not differ for African Americans and whites in the United States.

Future Directions
African Americans continue to have epidemic rates of stroke. In this review we have explored possible reasons for this excess stroke burden. Although a higher prevalence of traditional cardiovascular risk factors may not explain fully the epidemiological pattern of elevated stroke risk in African Americans, these factors remain important because they are modifiable. A falloff in awareness, treatment, and control of these factors could be disastrous. The process to unravel the explanation(s) is further complicated by SES, which may play a role but may be associated with substantial confounding whereby specific racial or ethnic group intercomparisons may be invalid or difficult to interpret. Finally, access to medical preventative and treatment services traditionally has been lacking for African Americans. This may be an especially important factor in the early periods of life, as the risk factor is allowed to develop and may go untreated for long periods after which it may be too late to make a substantial preventative impact because target organ disease is too far advanced.

As we approach the next millennium, the challenges that Dr Cooper outlined remain. For example, we need to better understand the basic causes of hypertension in African Americans; the relationships of low birth weight, obesity, insulin resistance, and hypertension; and the possible role of less well-documented factors such as stress and coagulation abnormalities. All of these and the other important scientific questions that relate to African Americans and stroke must be answered within the context of a prevention gap that has developed between efficacy and effectiveness in practice, intention and action, and information and behavior. As Dr Hill emphasizes, we need to more fully integrate the social and behavioral sciences with the biomedical ones. In the example of African Americans and stroke, this may be pivotal to our understanding of excess stroke risk, since earlier life experiences and SES, for example, may set the stage for at-risk psychosocial, behavioral, and biological characteristics that serve to help bring together some of the missing links of heightened stroke risk in this group. Thoughtful prospective study of candidate genes, environmental exposures, and gene-environmental inter-
actions among African Americans of different SES in a specific community at large may be the appropriate focus of study. Such a comprehensive approach may not only identify important disease mechanisms and behaviors, but it may also resolve potential confounders that may plague intergroup comparisons.

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