Racial Variations in Ischemic Stroke-Related Physical and Functional Impairments

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Background and Purpose: We sought to determine whether there are racial differences in physical and functional impairments resulting from an initial ischemic stroke.

Methods: We conducted a prospective, county-wide, multisite cohort study including a university hospital, a community hospital, and a Veterans Affairs hospital. The study population was an inception cohort of 145 patients hospitalized for ischemic stroke. Physical and functional impairments were measured using a modified form of the Fugl-Meyer test and the Barthel Index, respectively. Nurses trained to use these tests made assessments at admission and 5, 30, 90, and 180 days after admission. Patient and disease-specific data along with treatment data and vital status were collected.

Results: Forty-one patients (28%) were black. Compared with whites, black stroke patients were more likely to be widowed (51% versus 26%) and hypertensive (83% versus 63%) but less likely to be male (42% versus 69%) and alert on admission (66% versus 76%). There were no racial differences in mortality. Physical impairment was significantly more severe in black than in white patients at admission, and although physical impairment improved, it remained significantly worse in blacks. Functional impairment was also greater in black patients initially but was similar to that in white patients 90 days after the event. Multivariable analyses confirmed these findings.

Conclusions: These results indicate that blacks may have greater residual physical deficits from stroke than whites. (Stroke 1991;22:1497-1501)

Racial differences in the incidence of stroke and stroke-related mortality are well documented.1 Black populations, particularly rural black populations, have higher incidence and mortality rates for stroke and experience stroke earlier in life than whites.2-4 Yet, racial differences in stroke morbidity, such as cognitive and physical impairments, and their subsequent effect on rehabilitation and productive life are poorly described.

The few available studies report minor racial differences in clinically documentable impairments resulting from stroke and in the prognosis of stroke patients.5-9 No significant racial differences were found in either 1- or 4-year survival after ischemic stroke.5-7 However, hospitalized black patients had a significantly better 1-year survival for hemorrhagic stroke.7 One year after the event, the rate of recurrent stroke or death was similar for white and black ischemic stroke patients (35% and 31%, respectively), although Hispanics had a significantly lower rate (21%).8 There were no black/white differences in the capacity to perform activities of daily living (ADL) at discharge or 12 months after discharge among hospitalized North Carolina stroke patients.9 There are no reports of black/white differences in stroke-related physical impairments.

Subjects and Methods

This study was part of a county-wide cohort analysis designed to investigate the importance of serum glucose levels on stroke outcome. The subjects constitute an inception cohort of patients who were admitted with a new ischemic stroke event between January 1987 and October 1989 at Duke University Medical Center, Durham County General Hospital, or the Durham Veterans Affairs Medical Center. Any hospital admission for stroke in the county occurs at one of these three hospitals.
There were 990 patients who presented with a presumptive diagnosis of atherothrombotic stroke, of which 34% were black. To be included in the study, patients had to 1) give informed consent to participate either personally or by proxy through a responsible family member, 2) be over 40 years of age, 3) reside within 100 miles of Duke University Medical Center, 4) be hospitalized within 24 hours after the onset of neurological symptoms, 5) have a measurable deficit on admission, 6) have no preexisting stroke deficit, 7) have a deficit persisting for more than 24 hours, and 8) lack any medical condition for which death was likely within 6 months. Patients with hemorrhagic strokes as determined by computed tomography were excluded from the study. Patients also were excluded if they had risk factors for embolic stroke, including cardiomyopathy, anterior myocardial infarction during the previous 6 months, new atrial fibrillation, or a prosthetic heart valve. The intent was to exclude patients at especially high risk of early recurrence of stroke. To improve patient accrual, the eligibility criteria were relaxed to include patients with a previous minor stroke when any preceding neurological deficit would not interfere with measurement of the clinical course of the new deficit.

The major outcomes of the study included all-cause mortality, physical function, and capacity to perform ADL. The Barthel Index was used to determine disability in performing ADL; physical function was assessed using a modified version of the Fugl-Meyer test. The Barthel Index is a valid and reliable measure of ADL disability and is widely used in stroke research. For purposes of this study, the Fugl-Meyer test score was expressed as a percentage: the total number of points scored divided by the maximum number of points possible, multiplied by 100%. Because some points were unmeasurable due to disabilities incurred prior to the stroke (e.g., amputation) or limitations in cognitive function (e.g., sensory aphasia), the Fugl-Meyer test was modified to reflect the maximum number of points applicable to the patient and is referred to as the modified Fugl-Meyer test.

Physical and functional impairments were assessed by a study nurse or physician’s assistant trained in using the Fugl-Meyer and Barthel instruments through review of a videotape plus up to five sessions with a physical therapist experienced in the use of these scales. Assessments were made within 24 hours after admission and 5, 30, 90, and 180 days after admission. The evaluators obtained physical and ADL data from the patients with ischemic stroke by interview and physical examination in the hospital and, after discharge, at the patient’s home. No patient was lost to follow-up. At each assessment, 87% or more of living patients were evaluated. Only 11% of patients who survived at least 180 days after the stroke had fewer than three assessments. Patients with missing data for physical function and ADL status did not differ significantly from those with complete data.

The demographic variables considered were age, sex, marital status, and residence. Marital status was categorized as never married, currently married, and widowed, separated, or divorced; almost all patients in the latter category were widowed. Residence was dichotomized as rural or urban, based on size of the community of residence. Almost all patients with urban residence were from cities with at least 100,000 population. Most patients with rural residence came from communities of less than 25,000 population.

Clinical characteristics were described by a set of dichotomous variables and included hypertension, diabetes mellitus, cigarette smoking status, history of transient ischemic attack (TIA), previous stroke, and cardiac disease. Level of consciousness was assessed using the Oxbury scale of the four categories alert, disoriented, lethargic, and stuporous/comatose. Presence of hypertension was based on a history of the condition. Presence of diabetes mellitus was based on a history of diabetes or a glycosylated hemoglobin level of 8% or greater on admission. Cardiac disease was deemed present if the patient had a history of heart disease or had cardiomegaly on a chest roentgenogram. The primary deficit was categorized as upper extremity motor only, lower extremity motor only, upper and lower extremity motor, and nonmotor only (e.g., visual or speech deficit). Nonmotor deficits could be present when the primary deficit was motor.

Statistical analysis involved summarizing the data within racial categories by means (±SDs) and proportions. The Kruskal-Wallis test and the χ² statistic, with correction for continuity when appropriate, were used to determine the statistical significance of differences between the races for continuous and categorical variables, respectively. Survival patterns were estimated using the Kaplan-Meier technique, and racial differences were evaluated using the log-rank test. Logistic regression and least-squares regression were used to determine the association of race with 30-day (all-cause) mortality and physical and functional impairment at 180 days poststroke, controlling for potential confounding factors.

Results

Of 146 patients with ischemic stroke, 41 (28%) were black and 104 (72%) were white. The one native American was excluded from the analysis. There were no important racial differences in reasons for exclusion from the study population except for prior neurological deficit; 43% of black and 26% of white patients were excluded for this reason. White and black patients were remarkably similar in the presence of significant comorbidity (8% and 6%, respectively), admission later than 24 hours after onset (38% and 40%), age under 40 years (6% and 4%), residence more than 100 miles from the hospital.
There was no racial difference in either the crude or age- and sex-adjusted survival of the patients. Mortality was low, with only 20 white patients (19.2%) and seven black patients (17.1%) dying within 2 years after stroke onset. Most deaths occurred within 180 days after admission, with a range of 3–696 days. The probability of dying within 30 days after the acute event was 12% in whites and 16% in blacks. Death among black patients occurred earlier, with six of the seven deaths occurring within 90 days after admission while only 10 of the 20 deaths among white patients occurred during this period.

The medical management of the black and white stroke patients was similar. Black patients were not significantly more likely to be admitted to the neurology service than white patients. The use of angiography did not differ by the patient’s race. The type of pharmacological therapy instituted, such as the use of heparin or heparinoid, was similar as well.

There were no significant racial differences in the distribution of the primary motor or nonmotor sequelae of the incident stroke event. Concomitant upper and lower extremity motor deficits (with or without nonmotor deficits) predominated for blacks (68%) and whites (59%). Approximately 13% of the patients in each racial group had only nonmotor deficits, such as speech and visual problems. Only four patients had a definite or probable brain stem stroke; three were white and one was black.

The evolution of physical and functional recovery differed for black and white patients (Figure 1). Black stroke patients were admitted to the hospital with a lower, albeit statistically similar, score on the modified Fugl-Meyer test. However, white patients showed recovery from their physical deficits by 5 days after admission while scores on the modified Fugl-Meyer test in black patients continued to decline; the 5-day racial difference in physical impairment was significant ($p=0.03$). The racial disparity in physical impairment was greatest 30 days after admission when, on average, black patients had only two thirds of normal physical function compared with 95% of normal function in whites ($p=0.002$). By 90 days after admission, the median score on the modified Fugl-Meyer test was at least 90% of normal among black and white patients.

From multiple regression analysis, the significant predictors of physical impairment at 180 days poststroke were score on the modified Fugl-Meyer test on admission ($p=0.0001$), alert level of consciousness on admission ($p=0.002$), and race ($p=0.03$). The regression-adjusted, average score on the modified Fugl-Meyer test at 180 days poststroke was 9.5% lower for black than for white patients, a clinically meaningful difference.

A similar racial pattern is found for the evolution of impairment in ADL (Figure 1). Initially, the median Barthel Index score for black patients was only half that for white patients. By 30 days after admission white patients had essentially recovered their capacity for ADL while black patients had

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**TABLE 1. Demographic and Clinical Characteristics of Ischemic Stroke Patients by Race**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Black (n=41)</th>
<th>White (n=104)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age on admission (yr)</td>
<td>62.5</td>
<td>65.7</td>
<td>0.013</td>
</tr>
<tr>
<td>≤54</td>
<td>12.2</td>
<td>22.1</td>
<td>0.063</td>
</tr>
<tr>
<td>55–64</td>
<td>36.6</td>
<td>56.7</td>
<td>0.881</td>
</tr>
<tr>
<td>65–74</td>
<td>41.5</td>
<td>19.2</td>
<td>0.055</td>
</tr>
<tr>
<td>≥75</td>
<td>9.8</td>
<td>32.7</td>
<td>0.063</td>
</tr>
<tr>
<td>Male sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>71.1</td>
<td>64.4</td>
<td>0.001</td>
</tr>
<tr>
<td>Never married</td>
<td>2.9</td>
<td>62.5</td>
<td>1.000</td>
</tr>
<tr>
<td>Widowed/separated/divorced</td>
<td>26.0</td>
<td>50.5</td>
<td>0.090</td>
</tr>
<tr>
<td>Urban residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>82.9</td>
<td>62.5</td>
<td>0.029</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>39.0</td>
<td>22.1</td>
<td>0.063</td>
</tr>
<tr>
<td>Smoker</td>
<td>53.7</td>
<td>56.7</td>
<td>0.881</td>
</tr>
<tr>
<td>Previous transient ischemic attack</td>
<td>9.8</td>
<td>26.0</td>
<td>0.055</td>
</tr>
<tr>
<td>Previous stroke</td>
<td>14.6</td>
<td>19.2</td>
<td>0.682</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>65.9</td>
<td>64.4</td>
<td>1.000</td>
</tr>
<tr>
<td>Level of consciousness on admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alert</td>
<td>76.0</td>
<td>76.0</td>
<td>0.394</td>
</tr>
<tr>
<td>Disoriented</td>
<td>10.6</td>
<td>10.6</td>
<td>0.001</td>
</tr>
<tr>
<td>Lethargic</td>
<td>8.6</td>
<td>8.6</td>
<td>0.001</td>
</tr>
<tr>
<td>Stuporous/comatose</td>
<td>4.8</td>
<td>4.8</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Data are %. Cardiac disease is defined as history of heart disease or cardiomegaly on chest roentgenogram.

(10% and 6%), and lack of a persisting deficit (16% and 12%). Approximately 10% of black patients and 7% of white patients were excluded because of intracerebral hemorrhage.

Comparison of the demographic and clinical characteristics of the patients showed several important racial differences (Table 1). Black patients tended to be younger, having a mean±SD age of 65.7±8.1 years versus 68.5±10.8 years in white patients, but this was not a significant difference. A greater proportion of black patients were from urban communities. Black stroke patients were significantly less likely to be male and to have a living spouse than their white counterparts. Hypertension was significantly more prevalent in black than in white stroke patients. There also was a tendency for diabetes mellitus to be more prevalent ($p=0.063$) but a history of TIA to be less prevalent ($p=0.055$) in black patients. Black and white patients were similar in the prevalence of other risk factors. Race was not associated with the level of consciousness on admission to the hospital, although fewer black stroke patients were alert (66% versus 76%).
improved, but only to about two thirds of their normal level. Within the next 60 days, black stroke patients recovered their ADL capacity to a level similar to that of white patients. Multiple regression analysis showed that only the initial Barthel Index score \( (p=0.0001) \) and an alert level of consciousness on admission \( (p=0.006) \) were significant predictors of ADL capacity at 180 days poststroke.

To examine whether the relation between race and functional recovery was confounded by the higher early mortality among black patients, the evolution of physical and functional recovery was reexamined in the subset of patients who survived at least 180 days. The racial differences in recovery were more pronounced in this patient subgroup. The median level of physical impairment was significantly greater in black than in white stroke patients 30, 90, and 180 days after the event. Similarly, functional impairment was significantly greater in black patients at all times. Multivariable assessment of significant predictors of physical and functional impairment at 180 days indicated that race was an important independent predictor only of physical impairment \( (p=0.045) \). The adjusted 180-day postevent score on the modified Fugl-Meyer test for black patients was approximately 9% lower than that for whites, indicating greater physical impairment from stroke of a clinically important degree.

**Discussion**

It has been known for some time that the incidence of stroke and its related mortality is higher in black than in white populations. Studies of hospitalized stroke patients show that race does not affect mortality when there is adjustment for severity of the illness and other predictors of stroke outcome. Few studies have examined racial differences in residual physical or functional impairments associated with stroke. The one study that examined the effects on ADL of stroke by race found no black/white differences. There are no published reports on racial differences in stroke-related physical impairment.

This study provides additional evidence of some similarities between races in the clinical course of ischemic stroke. There were no significant racial differences in either the level or the pattern of mortality, although black patients tended to die earlier after stroke. Likewise, the pattern of recovery of ADL capacity showed no persistent racial difference with adjustment for severity of the stroke. That is, black stroke patients had greater functional impairment initially and improved more slowly, but they approximated the ADL capacity of white patients within 3–6 months after the acute event. The initial racial difference appeared to be associated with the initial stroke severity.

However, physical impairment from ischemic stroke was greater in black than in white individuals, the initial difference persisted over time, and the difference was independent of stroke severity. Racial differences in sociodemographic characteristics or comorbidity, such as diabetes mellitus, were not significant predictors of the 180-day score on the modified Fugl-Meyer test. Management of stroke therapy did not differ by the patient’s race.

The importance of location of the stroke on the distribution and extent of physical impairment remains unclear. Racial differences in location of the stroke were not assessed in this study but can be expected to follow the pattern previously reported. Stroke in black patients more often involves the smaller intracranial arteries whereas in whites lesions of extracranial vessels and the larger intracranial arteries are more characteristic of the disease. Differences in risk factor profiles are believed to account for the racial variations in stroke pathology. No
significant racial differences were found in the distribution of affected extremities. Investigators may wish to examine further the association between location of the stroke and physical impairment.

A limitation of our study is the small sample size. Because there were only 41 black stroke patients, concerns about statistical power prevented some subgroup analyses, such as analysis of impairments by race–sex groups. Low statistical power may also explain our inability to detect racial differences in functional impairment. Another limitation of our findings is the nature of the patient population. Because we studied only patients without significant previous deficits, we cannot comment on racial differences in the outcomes of patients with recurrent stroke.

The available evidence indicates that the natural history of ischemic stroke is similar in black and white patients with the exception of physical recovery. An apparent racial difference in functional impairment appears to be attributable to severity of the stroke at admission as reflected by the level of consciousness. The higher mortality from stroke in black populations appears to be more a function of their higher stroke incidence rate than either more aggressive disease or poorer medical care. This suggests that greater efforts at stroke prevention should be directed at black populations.

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References


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