Poststroke Survival for Black-Caribbean Populations in Barbados and South London

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Background and Purpose—There are variations in mortality rates for stroke in black communities, but the factors associated with survival remain unclear.

Methods—The authors studied population-based stroke registers with follow up in South London (270 participants, 1995 to 2002) and Barbados (578 participants, 2001 to 2003). Differences in sociodemographic factors, stroke risk factors and their management, case severity, and acute management between London and Barbados were studied. Survival analysis used Kaplan-Meier curves, log-rank test, and Cox proportional hazards model with stratification.

Results—There were 1411 person-years of follow-up. Patients in Barbados had poorer survival (log-rank test $P=0.037$), particularly those with a prestroke Barthel index scores between 15 and 20 (1-year survival, 56.4% versus 74.3%; $P=0.001$). This disadvantage remained significant (hazard ratio [HR], 1.99; 95% CI, 1.23 to 3.21, $P=0.005$) after adjustment for age and year of stroke and stratification for stroke subtype and socioeconomic status (SES). After stratification by SES, clinical stroke subtype, and Glasgow Coma Score, and adjustment for other potential confounders, additional factors reducing survival were untreated atrial fibrillation (AF; HR, 8.54; 95% CI, 2.14 to 34.08, $P=0.002$), incontinence after stroke (HR, 2.64; 95% CI, 1.79 to 3.89), and dysphagia (HR, 2.25; 95% CI, 1.57 to 3.24). Patients not admitted to the hospital had improved survival (HR, 0.35; 95% CI, 0.21 to 0.58). Interaction terms between location and Barthel score, location and AF, and location and transient ischemic attack were included in the final model to reflect the greater difference in survival with a high Barthel score of 15 or more, absence of untreated AF, and having untreated transient ischemic attack.

Conclusions—Black-Caribbean people with stroke living in Barbados have worse survival than similar patients in South London, particularly if they have good mobility before the stroke. Further exploration and refinement of measurement of confounding factors such as SES and poststroke management along with exploring the cultural/environmental differences between the communities is required to understand these stark differences. (Stroke. 2006;37:1991-1996.)

Key Words: ethnicity ■ stroke ■ survival

Blacks have higher stroke incidence rates than whites in the United Kingdom and the United States, and this represents a major public health issue with an approximate twofold increased risk compared with white groups regardless of the country or ethnicity of the black group.1–3 Incidence for blacks relative to whites appears to be highest for subarachnoid hemorrhage and intracerebral hemorrhage.4 However, stroke risk among the black populations of the Caribbean is lower than among African-origin populations in the United States and the United Kingdom.5,6

There are a limited number of mainly hospital-based studies that indicate increased stroke severity in black American groups.7,8 Overall population-based mortality rates, using routine statistics, show a consistent increased risk of death in black groups in the United States, and it is of interest to understand what drives this increased risk.4

We have reported independently that the risk of stroke is increased in blacks in South London compared with white groups.3 The risk of stroke in Barbados, using identical methodologies to South London, estimated the overall risk to be similar to the risk in white groups in Europe.5 In a study based in South London, we have found that blacks have a poststroke survival advantage over whites.9 Using the population-based stroke registers in South London and Barbados, the aims of this study are to estimate poststroke survival differences in Black-Caribbean populations in an
inner-city population in western Europe and in a developing island in the Caribbean and to identify factors associated with survival. Such analyses may, in conjunction with incidence studies, explain the differences in mortality rates between populations.

**Methods**

A population-based stroke register, recording first-ever strokes in patients of all age groups for a defined area of South London, the South London Stroke Register (SLSR), was set up in January 1995. \(^5\) First-in-a-lifetime strokes between January 1995 and December 2002 were selected for analysis. A similar register was set up in Barbados, the Barbados Register of Strokes (BROS), in October 2001 and registrations between October 2001 and October 2003 were used. \(^8\) Different timeframes were chosen to provide the study with adequate power to undertake the survival analyses. Both registers used identical methods and used multiple sources of notification both in the hospital (wards, imaging, pathology) and in the community (primary care, rehabilitation outpatients, death certificates).

Ethical approval was obtained from the Guy’s and St. Thomas’ Hospital Trust, The King’s College Hospital, Queens Square, Westminster Hospital (London) and the Medical Research Ethics Committee of Barbados Ministry of Health (Barbados).

The World Health Organization (WHO) definition of stroke was used and transient ischemic attacks not included. \(^2\) Ethnicity was recorded at the initial assessment using self-definition of ethnic origin (1991 U.K. census question “What is your ethnic group?”) for SLSR patients, whereas patients or caregivers in BROS were asked to choose an ethnic group from: white, black, mixed, Asian, or other. The principal analyses were restricted to Black-Caribbeans, excluding those of mixed ethnicity. For SLSR, socioeconomic status (SES) was recorded using the UK Registrar General’s codes based on occupation \(^2\) and, for BROS, the national census questions. \(^5\) Socioeconomic categories were grouped into nonmanual (I, II, and III nonmanual), manual (III, IV, and V manual), and economically inactive.

**Clinical Variables**

Classification of the pathologic subtype (cerebral infarction, primary intracerebral hemorrhage, and subarachnoid hemorrhage) was based on results from at least one of the following: brain imaging, cerebrospinal fluid analysis, or necropsy examination. Cases without pathologic confirmation of stroke subtype were unclassified. The Oxford Community Stroke Project (OCSP) clinical classification of stroke was also used, cerebral infarction being categorized as total anterior cerebral infarction, partial anterior cerebral infarction, posterior cerebral infarction, and lacunar infarction. \(^10\) Cases with a recorded subtype (other than unclassified) were considered to have a confirmed diagnosis. All cases in SLSR and BROS were independently assessed by 2 physicians (A.R. or D.C., respectively, plus fieldworker physician), and details of their management and risk factors were recorded from the patients’ or caregivers’ histories, hospital records, and/or the records of their general practitioners. Case records were screened for any confirmed risk factor diagnosis.

Data collected on prestroke risk factors included current smoking status, high alcohol intake (\(\geq 14\) U per week for women, \(\geq 21\) U per week for men), hypertension (blood pressure \(>140/90\) mm Hg), atrial fibrillation (AF), diabetes, ischemic heart disease, and transient ischemic attack (TIA). \(^11\) Identical methods were used in both locations.

Risk factor management before stroke was analyzed by the prescription of appropriate drugs or not as diagnosed in general practice or the hospital and recorded in notes. Hypertension was subdivided into treatment by antihypertensives or not; AF was subdivided into no treatment, aspirin, other antiplatelets, or warfarin; a history of TIA or ischemic heart disease by treatment with aspirin or not; and diabetes by treatment with oral hypoglycemics/insulin or not. Prestroke case severity variables included urinary incontinence, living alone, and prior Barthel index (categorized as 0 to 14 or 15 to 20). A cutoff score of 15 was chosen to allow comparison of mild or no disability (15 to 20) with moderate/severe disability (<15). Case severity variables included urinary incontinence on admission, ability to swallow (dysphagia), Glasgow Coma Score (categorized as 0 to 8 or 9 to 15), and pathologic and clinical stroke subtype. A service provision variable categorized patients into those who were admitted to a stroke unit, to a general medical ward, and those who were treated in the community. Death data were from routine sources in government on each patient that died.

**Statistical Methods**

Survival time was measured from date of stroke to date of death. Patients with no record of death were censored at the end of March 2004. Univariate analyses using \(\chi^2\) tests were performed to examine differences resulting from location in sociodemographic factors, prior-to-stroke risk factors and their management, case severity, and service provision variables with age being compared using an unpaired \(t\) test. Survival after the initial stroke was examined using unadjusted Kaplan-Meier survival curves, \(^12\) with comparisons between the South London and Barbadian groups made using the log-rank test. To examine the impact of prestroke disability on survival differences between South London and Barbados, separate comparisons of the 2 locations were made for patients with a Barthel score of \(\geq 15\) and for those with a Barthel score of <15.

Cox proportional hazards survival analysis was used to investigate the impact of location of care adjusting for potential confounding factors. Exploratory analyses of increasing complexity were used starting with a univariate comparison of South London and Barbados followed by a model that adjusted for age and year of stroke with stratification by SES and clinical stroke subtype. Next, all other sociodemographic variables were added, then all prior risk factors and their management, the baseline groups consisting of those without that diagnosis. Finally, all case severity variables and hospital admission were included with stratification by SES, subtype, and Glasgow Coma Score. This approach was used in preference to stepwise variable selection, because stepwise selection can be unstable; the addition or deletion of a small number of cases can alter the variables selected for the model. \(^13\)

Models involving stratification have the same estimated coefficients in each stratum but these estimates reflect the fact that the baseline hazard functions differ between strata. Modeling was not performed for each stratum separately.

The existence of variables with differing sizes of effect on survival in Barbados and South London was investigated by analyzing the 2 locations separately. Variables for which their statistical significance in the survival model differed in SLSR and BROS were considered as potentially interacting with location.

Assumptions for proportional hazards modeling were examined using Schoenfeld residuals with time-dependent covariates being considered if the proportionality assumption was not met. \(^14\)

**Results**

The SLSR registered 2321 patients with first in a lifetime stroke over 8 years. Four hundred fourteen (17.8%) were black and 112 (4.8%) of other ethnic origins with 74 (3.2%) of unknown ethnic origin. There were 270 Black-Caribbeans with a mean age at first stroke of 66.0 years (range, 27.8 to 95.6 years, standard deviation [SD] 13.7). There were 33 (12.2%) nonmanual, 193 (71.5%) manual, 32 (11.9%) of “other” employment categories, and 12 (4.4%) with no employment status ascertained. Overall, 175 (64.8%) were retired, 49 (18.1%) employed, and 10 (3.7%) unemployed before the stroke. All patients or their caregivers gave consent for inclusion in the study and there were no refusals.

The BROS registered 665 patients with first-in-a-lifetime stroke over 2 years. Two hundred eighty-two patients (42.4%) were males and 383 (57.6%) females; 30 (4.5%) were white, 578 (86.9%) were black (all Black-Caribbean), and 52 (7.8%) of
TABLE 1. Comparison of Risk Factors, Stroke Subtype and Case Severity Between SLSR and BROS

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All No./Total, %</th>
<th>BROS No./Total, %</th>
<th>SLSR No./Total, %</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>384/848, 45%</td>
<td>243/578, 42%</td>
<td>141/270, 52%</td>
<td>0.006</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>69.6 (15)</td>
<td>71.2 (15)</td>
<td>66.0 (14)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Living alone</td>
<td>203/771, 26%</td>
<td>123/558, 22%</td>
<td>80/213, 38%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Manual SES</td>
<td>395/848, 47%</td>
<td>202/578, 35%</td>
<td>193/270, 71%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prior Barthel &lt;15</td>
<td>75/830, 9%</td>
<td>57/567, 10%</td>
<td>18/263, 7%</td>
<td>0.13</td>
</tr>
<tr>
<td>Current smoker</td>
<td>109/801, 14%</td>
<td>45/559, 8%</td>
<td>64/242, 26%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High alcohol intake</td>
<td>43/761, 6%</td>
<td>24/536, 4%</td>
<td>19/225, 8%</td>
<td>0.03</td>
</tr>
<tr>
<td>IHD</td>
<td>94/831, 11%</td>
<td>55/572, 10%</td>
<td>39/259, 15%</td>
<td>0.02</td>
</tr>
<tr>
<td>Hypertension</td>
<td>597/829, 72%</td>
<td>401/573, 70%</td>
<td>196/256, 77%</td>
<td>0.05</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>64/815, 8%</td>
<td>49/562, 9%</td>
<td>15/253, 6%</td>
<td>0.17</td>
</tr>
<tr>
<td>Diabetes</td>
<td>296/830, 36%</td>
<td>200/573, 35%</td>
<td>96/257, 37%</td>
<td>0.50</td>
</tr>
<tr>
<td>TIA</td>
<td>77/823, 9%</td>
<td>46/569, 8%</td>
<td>31/254, 12%</td>
<td>0.06</td>
</tr>
<tr>
<td>Incontinence at time of stroke</td>
<td>450/827, 54%</td>
<td>352/574, 61%</td>
<td>98/253, 39%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Failed swallow test</td>
<td>243/808, 30%</td>
<td>154/564, 27%</td>
<td>89/244, 36%</td>
<td>0.009</td>
</tr>
<tr>
<td>Glasgow Coma Score &lt;8</td>
<td>124/386, 15%</td>
<td>85/577, 15%</td>
<td>39/259, 15%</td>
<td>0.90</td>
</tr>
<tr>
<td>Confirmed diagnosis</td>
<td>806/848, 95%</td>
<td>555/578, 96%</td>
<td>251/270, 93%</td>
<td>0.06</td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>670/839, 80%</td>
<td>480/577, 83%</td>
<td>190/262, 73%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TACI</td>
<td>110/839, 13%</td>
<td>68/577, 12%</td>
<td>42/262, 16%</td>
<td></td>
</tr>
<tr>
<td>PACI</td>
<td>175/839, 21%</td>
<td>127/577, 22%</td>
<td>48/262, 18%</td>
<td></td>
</tr>
<tr>
<td>POCI</td>
<td>55/839, 7%</td>
<td>30/577, 5%</td>
<td>25/262, 10%</td>
<td></td>
</tr>
<tr>
<td>LACI</td>
<td>330/839, 39%</td>
<td>255/577, 44%</td>
<td>75/262, 29%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PICH</td>
<td>99/839, 12%</td>
<td>63/577, 11%</td>
<td>36/262, 14%</td>
<td></td>
</tr>
<tr>
<td>SAH</td>
<td>37/839, 4%</td>
<td>12/577, 2%</td>
<td>25/262, 10%</td>
<td></td>
</tr>
<tr>
<td>Unclassified</td>
<td>33/839, 4%</td>
<td>22/577, 4%</td>
<td>11/262, 4%</td>
<td></td>
</tr>
<tr>
<td>No hospital admission</td>
<td>215/833, 26%</td>
<td>178/563, 32%</td>
<td>37/270, 14%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stroke unit admission</td>
<td>106/833, 13%</td>
<td>0/563, 0%</td>
<td>106/270, 39%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

IHD indicates ischemic heart disease; TACI, total anterior cerebral infarction; PACI, partial anterior cerebral infarction; POCI, posterior cerebral infarction; LACI, lacunar infarction; PICH, primary intracerebral hemorrhage; SAH, subarachnoid hemorrhage.

other ethnic origins with 5 (0.8%) of unknown ethnic origin. Of the Black-Caribbean patients, the mean age at first stroke was 71.2 years (range, 16.7 to 103.7 years, SD 14.9). There were 272 (47.1%) nonmanual, 202 (34.9%) manual, 24 (4.2%) from “other” employment categories, and 80 (13.8%) with no employment status ascertained. Overall, 350 (60.6%) were retired, 116 (20.1%) employed, and 11 (19.0%) unemployed before the stroke.

A comparison of sociodemographic factors, risk factors, and case severity is detailed in Table 1.

**Survival Analysis**

The 848 Black-Caribbean patients represented 1411 person-years of time poststroke, 516 person-years for the 578 Barbadians, and 895 for the 270 patients from South London. There were 356 deaths (228 BROS, 128 SLSR). Case fatality at 7 days was 26 (9.6%) for SLSR and 69 (11.9%) for BROS (P=0.321). At 3 months, this was 58 (21.5%) for SLSR and 201 (34.8%) for BROS (P<0.001).

Unadjusted Kaplan-Meier survival curves showed a survival difference between BROS and SLSR (Figure) with patients in Barbados having a clear disadvantage (log-rank test P=0.037). There was a nonsignificant short-term BROS disadvantage for those with a prior Barthel score of <15 (1-year survival, 23.5% versus 27.8%; P=0.719) but there was a clear difference in favor of patients living in South London for those with a Barthel score between 15 and 20 (1-year survival, 56.4% versus 74.3%; P<0.001).

The overall unadjusted survival difference in favor of South London remained significant (hazard ratio [HR], 1.99; 95% CI, 1.23 to 3.21; P=0.005) after adjustment for age and year of stroke and stratification for stroke subtype and SES. In models without interaction terms, residence in Barbados was a consistent indicator of worse survival at all stages of the proportional hazards modeling. At no stage did gender have an impact on survival. Because most (~90%) of the patients had a prior Barthel score of at least 15, the BROS disadvantage seen in the unadjusted survival analysis of this predominant subgroup was reflected in the overall BROS disadvantage observed in the multivariable models without interaction terms.

The variables included in the final proportional hazards survival model (built up from the stepwise addition of variables and interaction terms) are shown in Table 2. Residence in Barbados was not in itself of high significance (HR, 0.69; 95% CI, 0.25 to 1.93) but, adjusted for the interaction between location and prior Barthel score (HR, 2.79; 95% CI, 0.97 to 7.98), patients from BROS with a prior Barthel score...
of at least 15 were at a substantial survival disadvantage compared with those from SLSR. To confirm this reduced survival disadvantage for those with a lower Barthel score, a survival analysis was performed on those with a score of <15. However, this did not produce a usable model as a result of the large number of variables being applied to just 75 individuals.

A prior Barthel score of less than 15 was linked to poor survival (HR, 4.20; 95% CI, 1.67 to 10.53); those with untreated AF fared much worse compared with those without AF (HR, 8.54; 95% CI, 2.14 to 34.08) but other prior diagnoses, treated or untreated, had little impact on survival when compared with those without that diagnosis.

Incontinence after the stroke was linked to worse survival (HR, 2.64; 95% CI, 1.79 to 3.89) and dysphagia was associated with worse survival (HR, 2.25; 95% CI, 1.57 to 3.24). Nonadmitted patients had improved survival (HR, 0.35; 95% CI, 0.21 to 0.58).

There was a significant interaction between location and AF with a reduced survival disadvantage for Barbadians with untreated AF (HR, 0.06; 95% CI, 0.01 to 0.34). In contrast, the interaction between location and TIA indicated a greater survival disadvantage for Barbadians with untreated TIA (HR, 3.83; 95% CI, 1.00 to 14.72). The size of the survival disadvantage was unaffected by AF or TIA if it was treated. Adjustment for the year of the stroke had no impact on the results.

Discussion
This article focuses on ethnic differences in survival in South London and Barbados and the effect of sociodemographic, case severity, and acute clinical management factors stratified by SES on outcome for a disease of public health and clinical importance. Both SLSR and BROS are population-based and hence unbiased, well-phenotyped cohorts that have enabled the analyses to control for potential confounding factors and identify clinical and social factors that can be used when planning services and tailoring individual clinical management plans.

The use of SES as a stratification variable is an important decision because its effect as an independent factor cannot then be estimated. When an analysis using SES as an independent variable was undertaken, the effect of SES was not statistically significant and, furthermore, the coefficient values for the other variables were virtually unchanged. The potential for type II errors is a reasonable concern in which many variables are available for the modeling. However, in our model building, most variables did not have a substantial change in their effect with the addition of subsequent variables. This gives us confidence that our findings are genuine.

Wolfe et al report a survival advantage for blacks in South London, although this is for Black-Caribbean and Black-African groups together. There was the possibility that residual confounding may reduce the survival advantage, but of interest is the possibility of a healthy migrant effect explaining some of the observed difference in survival. Additionally, the role of poststroke care could shed light on those survival differences. These possible healthy migrant effects may be consistent with the findings of a difference in survival between those in Barbados and those in South London. Although we have not established the islands of origin of the SLSR stroke patients, it appears that there is an unexplained survival advantage in London after controlling for many factors, both sociodemographic and clinical. The ability to control for such detailed confounders is rare between countries, and there remain unexplainable survival differences.

An alternative explanation for the survival advantage of Black-Caribbeans in South London is the underascertainment of milder stroke cases in Barbados. This possibility might be construed from our article comparing the incidence of stroke in Black-Caribbeans in the 2 locations. Stroke incidence was found to be 25% higher in SLSR compared with BROS. Similar issues have been debated in the ERMANICA study in Martinique, French West Indies, where underascertainment of mild community cases of stroke was proposed as one of the reasons for a lower incidence rate than other studies in American blacks.

This phenomenon was also seen in the comparison of blacks and whites living in South London, with blacks having a higher stroke incidence. This suggests a possible underascertainment of milder strokes in whites. In a study of case ascertainment in SLSR, however, Tilling et al showed that ascertainment is good across SLSR and similar for blacks and whites and different levels of stroke severity. Further
but suggest a survival disadvantage in blacks.\textsuperscript{1,18} In the epidemiologic incidence and follow-up studies are equivocal Americans (61\%) compared with whites (46\%).\textsuperscript{19} The BROS/ Northern Manhattan population-based stroke study, unad-
justed Kaplan-Meier analysis show a nonsignificant 5-year underascertainment will not be a significant issue. fieldwork is required to assess the level of ascertainment in Barbados, although with multiple sources of notification and a significant out-of-hospital ascertainment, we feel confident underascertainment will not be a significant issue. A review of ethnic disparities in stroke epidemiology, acute care, and postoutcome in the United States indicated black Americans have more severe strokes and greater mortality.\textsuperscript{4} The review found less conclusive evidence for disparities in acute and postacute care. The findings from epidemiologic incidence and follow-up studies are equivocal but suggest a survival disadvantage in blacks.\textsuperscript{1,18} In the Northern Manhattan population-based stroke study, unad-
justed Kaplan-Meier analysis show a nonsignificant 5-year survival advantage in Caribbean Hispanics (67\%) and black Americans (61\%) compared with whites (46\%).\textsuperscript{19} The BROS/ SLSR comparison is the first direct comparison of stroke survival in blacks using population-based cohorts and would suggest that blacks in London have not only a survival advantage over whites,\textsuperscript{9} but also an apparent advantage over indigenous blacks in Barbados, even after adjustment for the younger average age of first stroke in South London.

The ERMANICA study in a neighboring Caribbean island reported 30-day case-fatality rates of 15.8\% for cerebral infarction and 37.3\% for intracerebral hemorrhage. This compares with 21.7\% and 51.8\% for BROS, indicating higher death rates in Barbados, although these figures have not been adjusted for age and sex.\textsuperscript{6}

The role of prior-to-stroke risk factors and their control on outcome may shed light on these survival findings because it is well documented that individual risk factors such as atrial fibrillation and diabetes\textsuperscript{20} are strong predictors of survival. There was a significant increased prevalence of smoking, drinking, and history of ischemic heart disease in the SLSR population with no particular risk factor being more prevalent in the BROS population to explain the survival differences. The risk factor data are derived from clinical notes, and these may not necessarily be complete in all cases in both settings and no formal assessment of validity was undertaken. As such, the risk factor data are not as systematically collected as other data variables.

Socioeconomic status has an independent effect on stroke incidence and survival,\textsuperscript{21} yet our ability to measure SES across cultures and countries is problematic and more subtle measures of deprivation may be required to reduce any residual confounding in such analyses. Barbados would appear to be a more affluent society given the higher proportion of people in non-
manual jobs, yet the WHO classifies Barbados as a developing country.\textsuperscript{22}

A counterintuitive finding of this study is that nonhospi-
talization, after adjustment for case severity, confers a post-
stroke survival advantage in both Barbados and South Lon-
don. For at least half the time of the study in London, access to stroke unit care was less than 50\% and there is no specialist stroke service in Barbados; the survival advantage seen in the stroke unit trialists analyses would not be expected given that admission was predominantly to general medical care.\textsuperscript{23} Kalra et al have shown that stroke unit care is more effective than mobile (domiciliary) stroke unit (team) care in South London and a systematic review has confirmed this.\textsuperscript{24,25} We have previously shown in South London that hospital admis-
sion is associated with poorer survival after adjustment for case severity.\textsuperscript{26} It would also be of interest to identify any differences in the cause of death after stroke in the two populations, which may shed further light on the differences.

The survival advantage of Black-Caribbeans in South London remains unexplained, and further exploration of socioeconomic and lifestyle factors and poststroke care are indicated.

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None.

References
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