Prevalence of Stroke Survivors in Rural South Africa
Results From the Southern Africa Stroke Prevention Initiative (SASPI)
Agincourt Field Site

The SASPI Project Team

Background and Purpose—The importance of stroke in low-income regions such as sub-Saharan Africa has recently been emphasized. However, little is known about the burden of stroke in sub-Saharan Africa. We investigated the prevalence of stroke survivors in the Agincourt Health and Population Unit, a demographic surveillance site in the rural northeast of South Africa.

Methods—Census workers asked household informants 2 screening questions for stroke during the annual census. If either question was answered positively, a clinician visited individuals aged ≥15 years to confirm the likely diagnosis of stroke. We performed a detailed assessment and defined stroke according to the World Health Organization criteria.

Results—A total of 42 378 individuals were aged ≥15 years. There were 982 positive responses to the questionnaire, and we examined 724 individuals (74%). We identified 103 strokes (crude prevalence, 243/100 000). After adjustment for those we did not examine, the prevalence was 300/100 000 (95% CI, 250 to 357). Sixty-six percent of stroke survivors needed help with at least 1 activity of daily living (Segi age-standardized prevalence, 200/100 000).

Conclusions—Stroke prevalence in rural South Africa is higher than previously documented in Africa but lower than in high-income countries. However, the prevalence of stroke survivors requiring help with at least 1 activity of daily living is already at high-income country levels. South Africa suffers from a huge burden of HIV/AIDS and diseases of poverty and violence and now faces the challenge of adapting its health systems to face the coming epidemic of vascular disease. (Stroke. 2004;35:627-632.)

Key Words: cause of death ■ censuses ■ epidemiology ■ population surveillance ■ prevalence ■ rural population ■ South Africa ■ stroke

Although stroke has been recognized as an important cause of death and disability in high-income countries for many years, its importance in low-income countries has only recently been emphasized.1–3 However, little is known about the burden and nature of stroke in low-income countries, particularly in sub-Saharan Africa.4,5 The Agincourt Health and Population Unit (AHPU) of the University of the Witwatersrand, located in a deprived rural area of South Africa, has been monitoring the causes of death, births, and inward and outward migration by means of a health and demographic surveillance system in a population of approximately 70 000 people since 1992.6 In this area, the very high stroke mortality7 prompted us to set up the Southern African Stroke Prevention Initiative (SASPI), a multidisciplinary study aiming to understand and address the burden and nature of stroke in rural sub-Saharan Africa. In this article we report the prevalence of stroke in this population.

Subjects and Methods

Ethics
Ethics committee approval was granted by both the London School of Hygiene and Tropical Medicine (755) and the University of the Witwatersrand (M02-04-63).

Setting and Population
The Agincourt subdistrict of Limpopo Province, in the northeast of South Africa, was formerly part of the homeland of Gazankulu. The population is Shangaan, although Mozambican refugees who settled in the area after the 1980s civil war in Mozambique, who are also Shangaan speaking and culturally affiliated with the South African population, make up approximately one third of the population. There are limited amenities. Although electricity is recently available in most villages, it does not reach all households, and access to clean water is severely restricted. As part of the legacy of the apartheid system, there is considerable labor migration, especially among men. Some migrant workers return home only at Christmas and Easter, while others return more frequently. Migrants are included in the annual census because they would consider “home” to be the AHPU...
villages, and almost all of them maintain a household in the area. If they become ill and unable to work, they usually return home.

Case Finding
Each year, the AHPU performs a door-to-door census survey of all the households in the 21 villages in the area using an interview questionnaire administered by trained census workers. In 2001, we added 2 of the 3 screening questions from a recent stroke prevalence study in Tanzania. The fieldworker questioned each household informant, named every individual in the household, and asked the following: “Has (person) ever had weakness down 1 side of the body?” and “Has (person) ever had a stroke?” The census workers, an experienced team of trained local fieldworkers, received specific training on stroke, including information on its causes and manifestations, as well as instruction and practice in using the questions in the vernacular. After a pilot study in 20 households revealed that a significant number of birth trauma–related neurological conditions and cerebral palsy were being screened as positive, we decided to limit the questions to those aged ≥15 years. The census ran between August and November 2001, and the date chosen for point prevalence was the day before the census started, July 31, 2001. If either screening question was answered positively, a neurologist experienced in stroke medicine (M.D.C.) or 1 of 2 clinicians trained in stroke assessment (B.C., C.D.), accompanied by an interpreter, visited the relevant individual in his or her home between January and October 2002. We obtained informed consent before taking a detailed history and examining the individual. We held regular meetings to discuss and agree on the diagnosis in all cases. When there was diagnostic doubt, M.D.C. visited and assessed individuals and made a final diagnosis.

In this remote region there are no reliable means of postal or other communication, and therefore we had to visit the households. If the relevant individual was not available, we tried to arrange a future visit through other household members or neighbors. If initially unsuccessful, we made at least 2 additional attempts on different occasions to visit any individual who, on the basis of the census questions, might have had a stroke.

Clinical Assessment
We defined stroke according to the World Health Organization (WHO) criteria as “rapidly developing signs of focal (or global) disturbance of cerebral function, leading to death or lasting longer than 24 hours, with no apparent cause other than vascular.” We excluded people with transient ischemic attacks. CT and MR scanning are far from readily available, and the diagnosis of stroke was therefore made clinically. In making the diagnosis, we emphasized the sudden onset of focal neurological symptoms and lack of progression of the illness to avoid including infective processes or space-occupying lesions that mimic stroke. If the person had suffered multiple events, we focused on the person’s first-ever-in-a-lifetime event. We defined an individual as “needing help with at least 1 activity of daily living” if he or she needed assistance with any of the following: washing, dressing, bathing, feeding, transfer, or toileting.

We asked individuals found to have had a stroke about their demographic details, symptoms at onset and since the stroke, space-occupying lesions that mimic stroke. If the person had suffered multiple events, we focused on the person’s first-ever-in-a-lifetime event. We defined an individual as “needing help with at least 1 activity of daily living” if he or she needed assistance with any of the following: washing, dressing, bathing, feeding, transfer, or toileting.

We measured the blood pressure with the patient in the sitting position after 5 minutes of rest with the appropriate cuff size using an OMRON 705CP or OMRON M5-I blood pressure monitor. We defined hypertension as systolic blood pressure >139 mm Hg or diastolic blood pressure >89 mm Hg, using the mean of 2 measurements, or if the stroke survivor was taking antihypertensive treatment. We defined “any evidence of hypertension” as all hypertensive individuals plus those with evidence of hypertensive end-organ damage or previous antihypertensive treatment. We defined diabetes as a history of diabetes mellitus or treatment with oral hypoglycemic agents or insulin. We did not perform ECGs, and we diagnosed angina and myocardial infarction on history and atrial fibrillation on history or on examination of the pulse and auscultation of the heart. Peripheral vascular disease was defined as a history of calf claudication or absent foot pulses on examination.

HIV infection has reached epidemic proportions in South Africa, and HIV infection is associated with stroke. Although no blood tests were done, at the end of the clinical examination the clinician documented whether he or she had any reason to suspect that the individual was infected with HIV.

When appropriate, we referred individuals to local clinics or hospitals with suggestions for secondary stroke prevention or management of other specific conditions.

Data Analysis
We calculated the age-specific prevalence of stroke survivors both according to the number of stroke survivors identified and with an adjustment factor to allow for the likely number of strokes among the individuals who screened positively but whom we were not able to examine. For this calculation, we assumed that the prevalence of stroke survivors in each 10-year age and sex stratum was the same among those examined and those not examined. We then calculated...
age-standardized prevalence in 10-year sex-specific bands using the Segi standard population to enable comparison with published work and with the new WHO standard population\textsuperscript{15} to permit comparison with future work in this area. We used STATA software for the analyses, including calculation of the CIs for age-standardized prevalence\textsuperscript{16}. We calculated the 95% CIs for crude stroke prevalence using Confidence Interval Analysis\textsuperscript{17} software.

### Results

Figure 1 shows the screening process, the numbers of individuals examined, and their diagnoses of both stroke and other conditions.

**Response Rates**

The population of the Agincourt subdistrict under health and demographic surveillance was 68 525 in 2001. Of these, 42 378 were aged \( \geq 15 \) years. There were 982 positive responses to the screening questionnaire, and 724 (74\%) of these individuals were examined (Table 1). Reasons for failure to examine were that people had moved away (\( n = 39 \)), died (\( n = 37 \)), or refused (\( n = 2 \)). In addition, we were unable to locate 1 person, 101 were migrant workers, and we were unable to make contact with 73 despite at least 3 attempts. In 5 cases the reason for failure to examine was not recorded.

### Prevalence of Stroke

We identified a total of 103 cases of stroke, including 6 Mozambican refugees, giving a crude prevalence of 243/100 000 aged \( \geq 15 \) years (Table 1) (300/100 000 after adjustment for the individuals who screened positive but whom we did not examine). The crude male/female ratio was 1/1.8. There was a steep age gradient (Figure 2). Table 2 shows, after adjustment for those we did not examine, the age-standardized prevalence using both the Segi (290/100 000) and the new WHO (330/100 000) standard populations. After age standardization, the male/female ratio was approximately 1. Sixty-eight stroke survivors (66\%) seen needed help with at least 1 activity of daily living, giving a Segi age-standardized prevalence of 200/100 000 aged \( \geq 15 \) years (Table 2) when adjusted for those whom we did not examine.

### Characteristics of Stroke Survivors

In the 103 stroke survivors examined, hypertension was very frequent, occurring in 71\% of cases, while 84\% had “any

---

**TABLE 1. Prevalence of Positive Answers to the 2 Screening Questions, and Prevalence of Stroke Survivors by Sex and Age**

<table>
<thead>
<tr>
<th>Sex /Age</th>
<th>Population 15 years</th>
<th>No. of Positive Respondents (Prevalence per 100 000)</th>
<th>No. (%) of Positive Respondents Examined</th>
<th>No. of Stroke Survivors Diagnosed</th>
<th>Prevalence of Stroke Survivors (95% CI) per 100 000</th>
<th>Adjusted for Proportion Not Examined per 100 000*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population ( \geq 15 ) years</td>
<td>42 378</td>
<td>982 (2317)</td>
<td>724 (74)</td>
<td>103</td>
<td>243 (198 to 295)</td>
<td>300 (250 to 357)</td>
</tr>
<tr>
<td>Male</td>
<td>20 042</td>
<td>339 (1691)</td>
<td>213 (63)</td>
<td>37</td>
<td>185 (130 to 255)</td>
<td>246 (181 to 323)</td>
</tr>
<tr>
<td>Female</td>
<td>22 336</td>
<td>643 (2879)</td>
<td>511 (79)</td>
<td>66</td>
<td>296 (229 to 376)</td>
<td>348 (276 to 436)</td>
</tr>
<tr>
<td>Age 15–24</td>
<td>15 358</td>
<td>41 (267)</td>
<td>32 (78)</td>
<td>2</td>
<td>13 (2 to 47)</td>
<td>16 (2 to 47)</td>
</tr>
<tr>
<td>Age 25–34</td>
<td>10 315</td>
<td>88 (853)</td>
<td>50 (57)</td>
<td>6</td>
<td>58 (21 to 127)</td>
<td>83 (34 to 153)</td>
</tr>
<tr>
<td>Age 35–44</td>
<td>6855</td>
<td>137 (1999)</td>
<td>75 (55)</td>
<td>8</td>
<td>117 (50 to 230)</td>
<td>170 (80 to 287)</td>
</tr>
<tr>
<td>Age 45–54</td>
<td>4340</td>
<td>203 (4677)</td>
<td>155 (76)</td>
<td>21</td>
<td>484 (300 to 740)</td>
<td>598 (373 to 850)</td>
</tr>
<tr>
<td>Age 55–64</td>
<td>2497</td>
<td>198 (7930)</td>
<td>150 (76)</td>
<td>19</td>
<td>761 (458 to 1188)</td>
<td>945 (584 to 1382)</td>
</tr>
<tr>
<td>Age 65–74</td>
<td>1925</td>
<td>166 (8623)</td>
<td>136 (82)</td>
<td>22</td>
<td>1143 (716 to 1730)</td>
<td>1349 (882 to 1979)</td>
</tr>
<tr>
<td>Age 75–84</td>
<td>901</td>
<td>131 (14 539)</td>
<td>112 (85)</td>
<td>22</td>
<td>2442 (1530 to 3697)</td>
<td>2766 (1796 to 4096)</td>
</tr>
<tr>
<td>Age ( \geq 85 )</td>
<td>187</td>
<td>18 (9626)</td>
<td>14 (78)</td>
<td>3</td>
<td>1604 (331 to 4688)</td>
<td>1961 (583 to 5477)</td>
</tr>
</tbody>
</table>

*Calculated using the same proportion of stroke survivors diagnosed among those examined for each 10-year age-sex stratum.
evidence of hypertension.” By contrast, only 12 people were diabetic, 11 gave a history of angina, and none had had a myocardial infarction. Seven had clinical evidence of peripheral vascular disease, and 4 had carotid bruits. Nine were current smokers. In 4 women the stroke occurred during pregnancy or the puerperal period, while 2 women were using oral contraceptives at the time of stroke. Although no serology was available, HIV infection was clinically suspected in only 2 stroke patients, one aged 26 years and the other 42 years, and in both there was no other detectable cause for their stroke.

Discussion

Our study had an accurate denominator because it was based in a demographic surveillance site with rigorous annual census surveys. However, we were not able to examine every individual identified as having had a possible stroke from the screening questionnaire. We had to assume an equal stroke prevalence in those examined (74% of those screening positive were examined) and not examined and then adjust the crude prevalence figures accordingly. As would be the case in any location, diagnosing stroke sometimes long after the event and without the benefit of CT is difficult and can be inaccurate. However, in this study clinicians were skilled in diagnosing stroke and conducted detailed assessments. We do not know the sensitivity of the screening questions because we did not have the resources to study a group who did not report either 1-sided weakness or stroke. Many studies of stroke prevalence in high-income countries have used a screening postal or telephone questionnaire, but this was not possible in our population because there is no postal or reliable telephone service. Despite these shortcomings and given the challenging environment in which the study was conducted, we believe this study represents a reasonable starting point in estimating the burden and nature of stroke in rural sub-Saharan Africa.

The age-standardized prevalence of stroke in high-income countries in a recent review of studies since 1990 ranged from 461 to 733 per 100 000 for people aged ≥65 years. The largest of these came from Auckland, New Zealand, where it was estimated that approximately 461 per 100 000 people aged ≥15 years had made an incomplete recovery from a previous stroke, of whom 173 per 100 000 needed assistance with at least 1 self-care activity. While the age-standardized overall prevalence of stroke survivors adjusted for those we could not examine was much lower in our study (Table 3), the prevalence of survivors needing help with at least 1 activity of daily living (200/100 000) was higher and was even higher than in Tanzania. The proportion of stroke survivors who needed help with at least 1 activity of daily living was similar to that found in Tanzania (66% compared with 60%), both of which were much higher than in New Zealand (22%).

The lower prevalence of stroke in our population compared with Auckland and other high-income countries may reflect a lower incidence at this early stage of health transition or a higher case fatality. Both are plausible, but there are no reliable population-based data on either incidence or case-fatality in sub-Saharan Africa. Methodological differences must also account for some of the disparity. For example, in Auckland, prevalence was modeled from the results of 2 incidence studies and therefore would have included persons with very mild strokes who recovered completely. We must have missed some persons with mild strokes who had recovered and persons with strokes that did not cause hemiparesis. This would also have been a problem in the Tanzanian study, which used similar methodology to find strokes, but would not have occurred in Auckland because all incident strokes were included. The possibility that we missed some mild strokes is further suggested by the higher proportion of all identified persons with strokes who were dependent in our study, although the cultural interpretation of “needing help with everyday activities” must be highly variable. Another explanation is that inadequate care after stroke in our study area leaves more survivors disabled. Our higher prevalence of stroke than in rural Tanzania may be explained by a higher case fatality in Tanzania. Another possibility is that the rural South African population has been exposed to lifestyle risk factors for longer than the Tanzanians, is further along in regard to a health transition, and therefore has a higher stroke incidence. Only population-based incidence studies will clarify this question.

### Table 2. Age-Standardized Rates of Stroke Survivors and of Stroke Survivors “Needing Help With at Least 1 Activity of Daily Living” by Sex, Using Both the Segi and the New WHO Standard Populations*

<table>
<thead>
<tr>
<th>Population</th>
<th>Age-Standardized Using Segi Population (95% CI) per 100 000</th>
<th>Age-Standardized Using New WHO Population (95% CI) per 100 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>All stroke survivors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>281 (200 to 362)</td>
<td>324 (232 to 416)</td>
</tr>
<tr>
<td>Female</td>
<td>315 (243 to 387)</td>
<td>354 (275 to 434)</td>
</tr>
<tr>
<td>Total</td>
<td>290 (238 to 343)</td>
<td>330 (271 to 389)</td>
</tr>
<tr>
<td>Stroke survivors needing help with at least one activity of daily living</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>218 (145 to 291)</td>
<td>247 (165 to 328)</td>
</tr>
<tr>
<td>Female</td>
<td>188 (132 to 243)</td>
<td>221 (157 to 284)</td>
</tr>
<tr>
<td>Total</td>
<td>200 (156 to 244)</td>
<td>232 (182 to 282)</td>
</tr>
</tbody>
</table>

*Using estimated prevalence of stroke survivors adjusted for proportion not examined.
survivors had hypertension, and 84% had vascular disease were all rare. However, 71% of stroke rosis; carotid bruits, ischemic heart disease, and peripheral large-artery disease, which is likely to be atheroscle-
disease and, unlike population-based studies from high-
tries, the cause of stroke and other vascular disease is more
Hypertension and stroke often herald the onset of vascular
economic surveillance site, followed by clinical assessment of everyone who gave a positive
The population of rural South Africa is undergoing a health transition from predominantly infectious diseases to noncom-
municable diseases, particularly vascular disease. Hypertension and stroke often herald the onset of vascular disease in the early stages of transition when stroke is mostly due to hypertension or embolism from rheumatic cardiac disease. Later in transition, typical of high-income countries, the cause of stroke and other vascular disease is more often atherosclerosis, and myocardial infarction becomes more common. We found little evidence of valvular heart disease and, unlike population-based studies from high-income countries, almost no evidence of extracranial large-artery disease, which is likely to be due to atherosclerosis; carotid bruits, ischemic heart disease, and peripheral vascular disease were all rare. However, 71% of stroke survivors had hypertension, and 84% had “any evidence of hypertension.” Only 9% were cigarette smokers. This suggests that the rural South African population is in early transition, with hypertension by far the most important modifiable cause of stroke. Coronary heart disease is rare in rural sub-Saharan Africa at present, although it will probably emerge in time. HIV infection did not appear to be a significant cause of stroke in our population.

Recent WHO reports have called for more resources to be spent on vascular risk factor reduction in low-income countries and for the development of new ways to provide preventive care. Our findings underscore the importance of this. Furthermore, the prevalence of survivors of stroke requiring help with activities of daily living was as high in rural South Africa as in New Zealand, and this has important implications for the South African health service. An even higher prevalence can be expected as rural South Africa goes through a health transition and as early treatment and rehabilitation improve. Research such as community-based stroke incidence studies with accurate case ascertainment, early brain imaging, detailed investigation of the nature of stroke, and long-term follow-up is needed to clarify the burden and nature of stroke in the region. Countries in sub-Saharan Africa, already suffering from a huge burden of HIV/AIDS and diseases of poverty and violence, face the challenge of preventing the coming epidemic of vascular disease and adapting their health systems to deal with the epidemic if prevention fails.

The sex ratio of the survivors whom we identified is different from that found in Tanzania and in New Zealand. Both of those studies found an overall male to female ratio of 1.4, declining to a ratio of 0.8 when only those survivors needing help with activities of daily living were considered (Table 3). By contrast, the overall sex ratio in our population was 0.9, and it increased to 1.2 when only those needing help were considered (Table 3). There is considerable labor migration, predominantly in men, but these migrant laborers are included in the local population denominator. They consider the region home, maintain their families by sending money home, and usually return to use local health resources when too ill to work. We had a higher rate of noncontact in men aged 25 to 44 years (49 men, 54%) than in any other age and sex group. However, we adjusted our figures for each 10-year age stratum and sex group to allow for those we had not examined, assuming the same proportion of stroke survivors as in those examined. Thus, we have assumed that there is the same proportion of stroke survivors in employed men as among predominantly unemployed men. As a result, we have probably overestimated rather than underestimated prevalence of stroke in men.

The SASPI Project Team for this study consisted of the following: University of Warwick, Warwick, UK: M. Thorogood (Principal Investigator, Professor of Epidemiology), G. Lewando-Hundt (Co-investigator, Professor of Health and Social Studies); University of Witswatersrand, Johannesburg, South Africa: S. Tollman (Coinves-
Acknowledgments

This study was supported by the Wellcome Trust (reference 064762/Z/01/Z). We are grateful to the many participants from the Agincourt area who gave their time. Dr Richard Walker gave invaluable advice on the use of screening questions. Dr Cathie Agincourt area who gave their time. Dr Richard Walker gave

References

Prevalence of Stroke Survivors in Rural South Africa: Results From the Southern Africa Stroke Prevention Initiative (SASPI) Agincourt Field Site
The SASPI Project Team

*Stroke*. 2004;35:627-632; originally published online February 12, 2004;
doi: 10.1161/01.STR.0000117096.61838.C7
*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2004 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/35/3/627

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org/subscriptions/