Stroke Incidence, Prognosis, 30-Day, and 1-Year Case Fatality Rates in Matão, Brazil
A Population-Based Prospective Study

Cesar Minelli, MD, PhD; Lee Fu Fen, MD; Denise P. Camara Minelli, RN

Background and Purpose—Stroke is the main cause of death in Brazil and no prospective population-based study has been conducted in the country. The purpose of this study was to determine the incidence of stroke, stroke subtypes, case fatality, and prognosis after 1 year of follow-up in the city of Matão, Brazil.

Methods—Using overlapping methods of case ascertainment, all stroke cases that occurred in the city of Matão (population, 75 053) from November 1, 2003 to October 31, 2004 were followed-up at 1 month and 1 year after the episode. Standard criteria for population-based stroke studies were followed.

Results—Of 141 suspect stroke cases identified, 81 were first-ever-in-a-lifetime strokes. All patients underwent a CT scan. The crude annual incidence rate per 100 000 per year was 108 (95% CI, 85.7–134.1) and the rate adjusted for sex and age to the Segi population was 137 (95% CI, 112.0 to 166.4) per 100 000 inhabitants per year. Ischemic stroke occurred in 69 (85.2%) subjects, intracerebral hemorrhage in 11 (13.6%), and subarachnoid hemorrhage in 1 (1.2%). The 30-day case fatality rate was 18.5 and the 1-year case fatality rate was 30.9%. After 1 year of follow-up, 43% of the patients were independent in activities of daily living, 49.4% had independent gait, and 15.9% had a recurrent stroke.

Conclusions—The present results are similar to those obtained in other stroke population-based studies. Future studies in Matão will provide the opportunity to discover ways to decrease the stroke burden in Brazil. (Stroke. 2007;38:2906-2911.)

Key Words: epidemiology ■ incidence ■ outcome ■ stroke

Two-thirds of strokes occur in developing countries, but little is known about stroke epidemiology in Brazil, the largest Latin American country. The few epidemiologic studies conducted in South America have revealed an incidence ranging from 35 to 183 per 100 000 inhabitants, with a higher prevalence of cerebral hemorrhage and small vessel disease.

Although a decline of stroke mortality rates has been described in Brazil, stroke still is the main cause of death in the country and presents the highest mortality on the American continent for both sexes. Because of the population aging process, the incidence of stroke is expected to increase.

Few epidemiologic stroke studies have been conducted in Brazil and none followed current recommendations. The present prospective population-based study reports the incidence of first-ever-in-a-lifetime stroke, stroke subtypes, prognosis, and 30-day and 1-year case fatality rates in Matão, São Paulo state, Brazil.

Subjects and Methods

Study Design
A prospective population-based study was performed from November 1, 2003 to October 31, 2004, to determine the incidence and outcome of stroke in Matão according to most of the methodological criteria recommended.

Site of Investigation
Matão is a city located in São Paulo state, the wealthiest state in Brazil, in the Brazilian southwest, 300 km northwest of the state capital. The Brazilian census is undertaken every 10 years and the last census was in 2000, showing a population of 169 799 170 inhabitants and a gross domestic product per capita of $8140 (US dollars). The estimated Brazilian population for 2004 was 179 108 134 people. When compared with the European and North American population, the Brazilian population is younger and its overall life expectancy of 71.9 years is lower.

According to the 2000 Brazilian census, the Matão population was 71 753 and the annual estimated population growth rate in Matão for the 2000 to 2006 period was 1.4%. In 2004, the estimated Matão population was 75 053 inhabitants, with no difference in sex distribution. The economy is mainly based on agricultural and industrial activities and on general services. Ethnicity is diverse, but most people are of white ethnicity, descendants of European immigrants. The population is urban and stable, with a low rate of interurban migration. Approximately 95% of all dwellings have piped water, a sewage network, and electricity.

There is only 1 hospital in the city, Carlos Fernando Malzoni Hospital, which serves the whole Matão population and 2 other small...
tours. This is a general secondary level public hospital, a reference for public and private patients, with 190 beds, including 10 beds in the intensive care unit and a radiology service with CT scan, the only one in the city. The emergency department attends to 5000 to 6000 people monthly; including emergency and urgency cases. Ninety-seven percent of the Matão population uses this service as the first aid center in the city. The emergency department and intensive care unit take care of acute stroke patients according to a written protocol that includes hospitalization and a brain CT scan applied as soon as possible to all patients with suspected stroke. Although it is not a rule in Brazil, in Matão all acute or suspect stroke cases are hospitalized, even patients with mild stroke and those of advanced age. There are 2 other private first attendance facilities in the city, but all suspected stroke cases are referred to the hospital for investigation. The only nursing home in the city refers the suspected stroke cases to the hospital.

During the study period, Matão had 65 physicians, 6 of them neurologists and 32 general practitioners. Most of the physicians work at Hospital Carlos Fernando Malzoni and are responsible for primary care in public and private offices.

Research Team
The research team consisted of 2 neurologists (C.M. and L.F.F.), 1 nurse coordinator (D.P.C.M.), and 4 nurses involved in patient care at the hospital. All patients were assessed by at least one of the neurologists of the research team.

Case Ascertainment
The following procedure was stipulated before the beginning of the study to determine all stroke cases in the city. The 4 neurologists that did not belong to the research team and all physicians were instructed to refer suspected acute stroke patients to the research team or to the hospital emergency department. The physicians and nurses of the hospital emergency department were instructed to contact the research team if any suspected stroke case appeared. The radiologists from the hospital radiology service were asked to inform the research team if a CT scan or carotid duplex studies were performed in any suspected case of stroke. The neurologists of the research team checked all radiology records in suspected cases of stroke. The hospital admission and discharge lists were checked weekly, searching for any suspected case. All death certificates from the study period were checked monthly to search for stroke patients who died in their homes and had not been referred to the hospital. The Brazilian death certificates are standardized throughout the country. Physicians are required to report the cause of death and to send it to a registry office within <24 hours. After the data are computerized, they are submitted to a central information system linked to the Brazilian Ministry of Health, which is responsible for their analysis.\(^\text{11}\)

All suspected stroke patients living in Matão at an address belonging to the city were included, regardless of age. The stroke criteria were those defined by the World Health Organization, “rapidly developing clinical symptoms and/or signs of focal and at time global loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin.”\(^\text{11}\) Although every stroke was recorded, only the first-ever-in-a-lifetime stroke was included in the analysis.

The exclusion criteria were patients not living in Matão, who did not fulfill the clinical criteria for stroke, with CT scan findings incompatible with a clinical suspicion of stroke and with clinical evidence of a previous stroke event.

Follow-Up
All included cases were followed-up prospectively by the research team during the first month and 1 year after the stroke event with hospital visits. Patients unable to attend the scheduled visits or who had moved to another city were contacted by telephone.

Classifications and Definitions
The subtypes of stroke were defined using universally accepted criteria:\(^\text{12}\): ischemic stroke and intracerebral hemorrhage on the basis of CT scan findings and subarachnoid hemorrhage on the basis of CT scan and cerebrospinal fluid findings. Undetermined strokes were defined if no CT scan or autopsy was performed. Ischemic stroke was subdivided into four subtypes according to the Oxfordshire Community Stroke Project classification on the basis of simple clinical criteria: total anterior circulation infarction, partial anterior circulation infarction, lacunar infarction, and posterior circulation infarction.\(^\text{14}\) For prognosis, the percentages of patients independent in activities of daily living, with independent gait and with recurrent strokes, were assessed. Independence in activities of daily living was defined if the patient reached 100 points on the Barthel scale,\(^\text{15}\) a widely accepted stroke measure of independence in activities of daily living. Independent gait was defined if the patient reached 15 points in the mobility subsection of the Barthel scale, which means that the patient is able to walk >50 meters with no one helping, but with a cane or walker being allowed. Recurrent stroke was defined as any new episode of focal cerebral dysfunction persisting >24 hours during the follow-up period.

Data Analysis
The age- and sex-specific annual incidence of first-ever-stroke per 100 000 inhabitants was estimated according to the official system of the Brazilian Ministry of Health stratification and is presented as 10-year age bands as follows: younger than 45, 45 to 54, 55 to 64, 65 to 74, and 75 years or older. This system includes people older than 80 years old but does not stratify them beyond this age. The incidence rate was calculated as the number of cases divided by the population at risk in the specific age bands, according to the 2004 estimated Matão population.\(^\text{10}\) Age- and sex-specific incidence rates were adjusted by the direct method to Segi and WHO standard populations.\(^\text{16}\) Inferential analyses were performed by the 2-sided Fischer exact test, with the level of significance set at 5%.

Ethics
The study was approved by the Research Ethics Committee of the University Hospital of Ribeirão Preto, process number 4089/2003. All patients or relatives, if the patient was incapacitated, gave written informed consent to participate in the study.

Results
The distribution of the study population compared with the 2004 estimated Brazilian population is presented in the Figure. Six percent of the Brazilian and Matão population is older than 65 years old. A total of 141 suspect strokes were identified. After clinical assessment by one of the neurologists, 9 patients were excluded after the detection of a transient ischemic attack in 5, focal epilepsy in 2, metabolic encephalopathy in 1, and benign paroxysmal vertigo in 1.
After exclusion of 14 patients (10.6%) from other cities and 37 (28.0%) with previous stroke events, the remaining 81 patients with first-ever-in-a-lifetime strokes formed the study group. Distribution according to the source of referral was as follows: 75 hospital admissions from the emergency department (92.5%), 3 (3.7%) general practitioners, and 2 (2.4%) hospital discharge list. All patients identified by death certificates had already been identified in the hospital. No autopsy was performed. All patients were admitted and hospitalized during the first 24 hours after the onset of stroke symptoms. All patients were assessed by 1 of the neurologist investigators within the first 48 hours, except 1 who was assessed 1 month after the stroke.

Among the 81 first-ever stroke patients, 51 (62.9%) were men and 30 (37.0%) were women. Mean age was 65.1±11.6 years for men and 65.3±12.1 years for women. The crude annual incidence for first-ever-in-a-lifetime stroke was 108 per 100,000 persons per year (95% CI, 85.7 to 134.1), with a rate of 136 (95% CI, 101.2 to 178.7) for men and 80 (95% CI, 53.9 to 114.1) for women. The rates adjusted for sex and age to the Segi and WHO populations were 137 (95% CI, 112.0 to 166.4; Table 1).

A CT scan was performed in all patients within 24 hours of stroke symptom onset. Based on the CT scan, ischemic stroke was identified in 69 (85.2%) subjects, intracerebral hemorrhage in 11 (13.6%), and subarachnoid hemorrhage in 1 (1.2%). The only case with subarachnoid hemorrhage was an 83-year-old man who died within the first 30 days after the stroke. No patient was classified as undetermined stroke. The pathologic classification by age bands and sex is shown in Table 2. According to the Oxfordshire Community Stroke Project Classification for ischemic stroke, lacunar infarction were observed in 28 (40.6%) patients, partial anterior circulation infarction in 23 (33.3%), total anterior circulation infarction in 13 (18.8%), posterior circulation infarction in 4 (5.8%), and undetermined in 1 (1.5%).

The overall 30-day case fatality rate was 18.5% (95% CI, 10.7 to 28.7%). Regarding stroke subtypes, the 30-day case fatality was 13% (95% CI, 6.1 to 23.3%) for ischemic stroke and 45.4% (95% CI, 16.7 to 76.2%) for hemorrhagic stroke (P=0.02). The overall 1-year case fatality rate was 30.9% (95% CI, 21.1 to 42.1%). Regarding stroke subtypes, the 1-year case fatality was 24.6% (95% CI, 23.7 to 47.2%) for ischemic stroke and 63.6% (95% CI, 30.7 to 89.0%) for hemorrhagic stroke (P=0.01).

Two patients were lost to follow-up. One year after the stroke, 43% of patients were independent in activities of daily living, 49.4% had independent gait, and 15.9% had a recurrent stroke.

**Discussion**

This is the first population-based prospective study done in Brazil. Of the 2 previous epidemiologic Brazilian studies, one was a retrospective population-based study and the other an institutional study. Our data can be comparable with other stroke incidence studies because we followed most of the standard criteria of an “ideal” stroke incidence investigation providing valid information about a disease with a high social impact in the country.

The present study has 2 limitations. First, it was impossible to measure stroke incidence in the age ranges between 75 and 85 years and older than 85 years. Although the population older than 80 years old was included, unfortunately the Brazilian public health system stops age stratification at age 80 years. Therefore, this observation should be considered when our adjusted stroke incidence is compared with other studies. Second, we could not follow-up the population for more than 1 year.

**Table 1. Age and Sex-Specific Incidence Rates for First-Ever-in-a-Lifetime Stroke per 100 000 Population in Matao City, Brazil**

<table>
<thead>
<tr>
<th>Age Group, y</th>
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<th>Female</th>
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<td>Cases, People/y</td>
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<td>45–54</td>
<td>7</td>
<td>176</td>
<td>71.0–363.4</td>
<td>2</td>
<td>53</td>
<td>6.4–191.6</td>
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<td>116</td>
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<td>55–64</td>
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<td>776</td>
<td>452.8–1240.0</td>
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<td>394</td>
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<td>612.7–1795.5</td>
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<td>718</td>
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<td>≥75</td>
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<td>744.8–2828.3</td>
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<td>694</td>
<td>255.0–1503.6</td>
<td>16</td>
<td>1059</td>
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<td>All ages</td>
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<td>136</td>
<td>101.2–178.7</td>
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<td>80</td>
<td>53.9–114.1</td>
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<td>85.7–134.1</td>
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<td>People/y indicates people per year exposed to a risk.</td>
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<td>*Segi world population.</td>
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<td>†WHO world population.</td>
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>1 year; therefore, the recommended 100,000 person-years of observation\textsuperscript{19} could not be reached.

Although 94.9\% of our patients were identified in the hospital, with our study consequently resembling an institutional investigation, we believe that all cases of first-ever-in-a-life-time strokes in the city were recorded. The city of Matão has some ideal conditions that make this study feasible and the data obtained reliable: only 1 well-structured public hospital with the only CT scan in the city, an emergency department that is reference for first aid care for almost the whole population, easy contact with the few neurologists and physicians, and the cultural custom to hospitalize every patient suspected of having a stroke regardless of stroke severity and age. This observation is corroborated by the finding that all patients with death certificates had already been identified in the hospital.

Another favorable point of our results was the significant percentage of patients with lacunar infarcts (40.6\%) and patients older than 80 years (19.7\%). This observation suggests that even patients with mild strokes and older patients were recorded. Most lacunar infarcts cause mild strokes that do not require hospitalization. Additionally, physicians tend not to hospitalize older patients.\textsuperscript{20} This practice can induce a bias observed in institutional studies that tend to include younger patients and more severe stroke cases.\textsuperscript{7}

Even though the Matão population cannot represent the whole Brazilian population in terms of lifestyles and genetic aspects, at least in age distribution the Matão population reflects the same proportion as seen in the country (Figure). Whereas only 6.0\% of the Brazilian population is older than 65 years, in other studies this percentage ranges from 13.1\% to 21\%.\textsuperscript{21–27} The fact that stroke is a disease that mainly affects elderly people can be one reason explaining the low overall crude incidence rate of 108 per 100,000 persons when compared with other series. A low overall crude incidence rate of 73.6 per 100,000 was also observed in a population-based study performed in Iquique, Chile,\textsuperscript{28} a South American country with a socioeconomic level similar to that of Brazil and with 5.5\% inhabitants older than 65 years. However, when we analyze our overall incidence rate adjusted to the Segi standard population (137/100,000), this number is within the range reported in 15 similar epidemiologic stroke studies reviewed.\textsuperscript{29}

CT scan was performed in all patients within the first 24 hours. Therefore, it was possible to accurately classify the stroke subtype in all patients. The distribution of ischemic stroke (85.2\%) is slightly over the range of 67\% to 81\% reported.\textsuperscript{29} Intracerebral (13.6\%) and subarachnoid hemorrhage (1.2\%) are also within the related range of 7\% to 20\% and 1\% to 7\%, respectively.\textsuperscript{29} We did not observe a high incidence of intracerebral hemorrhage as in other Latin American studies.\textsuperscript{3} Based on the Oxfordshire Community Stroke Project classification of ischemic stroke, we observed a percentage of lacunar infarct similar to that observed in Iquique,\textsuperscript{28} but higher than the 25\% rate observed in Oxfordshire.\textsuperscript{14} In addition to ethnic factors and dietary habits, the poor control of stroke risk factors, such as hypertension and diabetes, involved in the pathogenesis of small artery disease, could explain the high percentage of lacunar infarcts in our study and in the Chilean one.

| Table 2. Pathologic Classification by Sex of 81 First-Ever-in-a-Lifetime Strokes |
|---------------------------------|------------------|-----------------|------------------|------------------|
|                                 | Ischemic         | Intracerebral Hemorrhage |
|                                 | n    | Rate 95% CI | n    | Rate 95% CI |
| Men                            |      |             |      |             |
| ≤44                            | 2    | 6.8 0.8–24.6 | 0    | ... ...     |
| 45–54                          | 6    | 151.3 55.6–329.1 | 1    | 25.2 0.6–140.4 |
| 55–64                          | 14   | 639.3 349.9–1070.3 | 3    | 137.0 28.3–399.8 |
| 65–74                          | 12   | 874.0 452.4–1521.7 | 3    | 218.5 45.1–637.2 |
| ≥75                            | 9    | 1393.2 639.0–2626.2 | 0    | ... ...     |
| All                            | 43   | 114.6 82.9–154.3 | 7    | 18.7 7.5–38.4 |
| Women                          |      |             |      |             |
| ≤44                            | 2    | 6.9 0.8–24.8 | 0    | 0 ...     |
| 45–54                          | 2    | 53.1 6.4–191.6 | 0    | 0 ...     |
| 55–64                          | 8    | 350.1 151.3–688.7 | 1    | 43.8 1.1–243.6 |
| 65–74                          | 10   | 652.7 313.4–1197.1 | 1    | 65.3 1.7–363.1 |
| ≥75                            | 4    | 462.4 126.1–1179.7 | 2    | 231.2 28.0–832.7 |
| All                            | 26   | 69.3 49.3–101.5 | 4    | 10.7 2.9–27.3 |
| Total                          |      |             |      |             |
| ≤44                            | 4    | 6.8 1.9–17.5 | 0    | ... ...     |
| 45–54                          | 8    | 103.5 44.7–203.7 | 1    | 12.9 0.3–72.0 |
| 55–64                          | 22   | 491.6 308.3–743.4 | 4    | 89.4 24.4–228.7 |
| 65–74                          | 22   | 757.3 475.2–1144.4 | 4    | 137.7 37.5–352.2 |
| ≥75                            | 13   | 860.4 458.9–1466.7 | 2    | 132.4 16.0–477.3 |
| All                            | 69   | 91.9 71.5–116.3 | 11   | 14.7 7.3–26.2 |
The higher stroke incidence in males could be explained by data from the Brazilian Ministry of Health, which showed a higher prevalence of risk factors for stroke among males in 15 Brazilian state capitals, including the state where Matão city is located.30

The 30-day and 1-year case fatality rates were among the lowest reported in the literature,21,23,25–28,31,32 only exceeding those observed in Scotland24 and in Rochester.25 This fact could be explained by the high proportion of lacunar infarcts, which have also shown a low mortality in other studies.14,28

The 30-day and 1-year case fatality rates for patients with cerebral infarction and intracerebral hemorrhage were within reported rates.24,25,27,34 It is difficult to compare stroke prognosis because not only the scales used but also the time of follow-up vary between studies.28,31,35 Our percentage of patients independent in scales used but also the time of follow-up vary between studies.28,31,35

In summary, although our patients could not be stratified at older than age 75 years and the size of the population at risk was smaller than recommended, these data are similar to those reported by other stroke population-based studies. The city of Matão offers the opportunity to conduct epidemiologic studies with high methodological quality in a country with high stroke mortality. Future follow-up studies of stroke incidence in Matão can provide information for the planning of public health policies aiming to decrease the stroke burden in Brazil.

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Disclosures

None.

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