Prevalence of Stroke
A Door-to-Door Survey in Rural Bolivia

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Background and Purpose—We carried out a door-to-door survey in rural areas of the Cordillera Province, Santa Cruz Department, Bolivia. A cluster sample of 10 124 inhabitants was selected, and 9955 subjects were screened. The aim was to determine the prevalence of the most common neurological diseases (epilepsy, stroke, parkinsonism, and peripheral neuropathy) in this population.

Methods—We used a modified version of the World Health Organization screening instrument. On screening we found that 1130 subjects tested positive, and 1027 underwent a complete neurological examination. According to the World Health Organization guidelines, we defined stroke as "rapidly developing clinical signs of focal (or global) disturbance of cerebral functions, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin." We considered only first stroke and excluded a possible stroke.

Results—We found 16 subjects (cases) who had experienced 1 complete stroke on prevalent day (November 1, 1994). The crude prevalence of stroke was 174/100 000 (322/100 000 age-adjusted to the world standard population) and 663/100 000 in subjects aged ≥35 years. Prevalence was >2-fold higher in men than in women (247/100 000 and 99/100 000, respectively) and increased rapidly with age. Seven cases were hospitalized and received specific treatment.

Conclusions—Our crude prevalence is lower compared with rates from developed countries, probably because of a high case fatality rate. Our findings are comparable with those reported from other surveys carried out in rural developing countries. **(*Stroke*. 2000;31:882-885.)**

Key Words: Bolivia ■ developing countries ■ epidemiology ■ stroke

Stroke is the third most common cause of death in most western populations, after coronary heart disease and cancer. Information on incidence, prevalence, and mortality of stroke is extremely important in the assessment of priorities for dealing with this disease, in the recognition of unusual patterns of its occurrence, and hence the design of programs for prevention and control. Such information is limited in the developing world.[1] Actually, few data are available from developing countries and, especially, from rural areas. Methodological approaches used in developed countries are often unsuitable for developing countries, especially for rural populations. Major difficulties are the relative absence of accurate case registers or medical records, the lack of sophisticated technology, and the concentration in urban centers of specialty-trained medical staff. Several studies have been carried out through door-to-door community surveys in developing countries. Such surveys are usually performed with a 2-phase design, in which the first phase consists of a screening interview by field workers, often using the World Heath Organization (WHO) Research Protocol for Neurological disorders,[2] and the second phase comprises a complete neurological evaluation by neurologists.

We studied the prevalence of major neurological disorders (epilepsy, stroke, parkinsonism, and peripheral neuropathy) in a sample of the rural areas of the Cordillera Province, Bolivia.[3]

In our study we used the Sicilian Neuroepidemiological Study (SNES) screening instrument, a slightly modified version of the WHO protocol.[4] Background and methods have been extensively described elsewhere.[5]

Subjects and Methods

The study was carried out in the Cordillera province, Santa Cruz Department, in the southeastern part of Bolivia. Bolivia has a total land surface of 1 098 591 km^2 and a population of 6 400 000, with a density of 5.8 people/km.^{2} According to the Bolivian National Institute of Statistics (Instituto Nacional de Estadistica INE), the life expectancy at birth is 60 years, and the infant mortality rates are 88/1000 and 145/1000 for urban and rural areas, respectively. The Santa Cruz Department covers 370 621 km,^{2} with a population of 1 359 383. The Cordillera province covers 86 245 km^2 and borders

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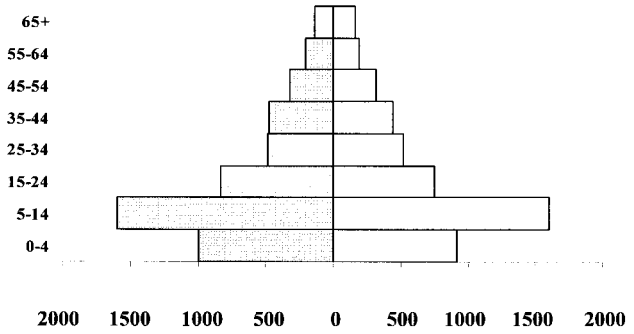

Figure 1. Age and sex distribution (women, unshaded bars; men, shaded bars) of the study population.

the departments of Chuquisaca and Tarija as well as Paraguay. According to the Bolivian National Census (INE, 1992), Cordillera Province has a population of 88 628, of whom 32 953 live in urban areas and 55 675 in rural areas.[6] The province is administratively divided into 10 areas of 3000 to 8000 inhabitants each. Racially, the population is a mixture of Mestizos, descendants of intermarriage between Spanish colonists and the native tribes (the Guaranì-Chiriguanos), and approximately 30% pure Guaranì Indians. The majority of the population speak both Spanish and Guaranì; a minority speak only Guaranì. Agriculture and animal breeding are the major subsistence activities. The healthcare infrastructure consists of a district hospital, 9 area hospitals, and rural health centers. The province lies in the foothills of the Andes, at altitudes ranging from 400 to 900 meters.

The study was conducted with the agreement of the National Department of Epidemiology of the National Secretary of Health and with the support of the Guaranì political organization (Asamblea del Pueblo Guaranì; APG).

A cluster survey method was used, with the 10 areas acting as strata. Within each stratum, communities were selected at random, and each constituted 1 cluster. Sampling was designed to select approximately 20% of the population in each area. Urban areas, defined as a community with >2000 inhabitants, were excluded from the sampling frame. In total we selected 10 124 people in 55 communities, 9955 of whom were effectively screened (Figure 1). All the communities selected had <600 inhabitants. Demographic data obtained from the Bolivian National Census combined with records available at area hospitals allowed us to estimate that the rural population in 1994 was 54 324.[6]

We determined the prevalence of stroke as a point prevalence, defined as the proportion of patients who had a first stroke in a given population at a specified time (prevalence day: November 1, 1994). Inhabitants were eligible only if they had resided in the communities for the 6 months preceding the prevalence day.

This was a 2-phase study. In phase 1, the sample of the rural communities selected from the 10 areas of the Cordillera Province was screened door-to-door to identify persons who possibly had a disorder of neurological interest. The screening included standardized questions and simple tasks. The interviewers who carried out the screening were 26 Guaranì non-doctor health workers, who were all selected from the 10 areas involved in the survey and able to speak both the Spanish and Guaranì languages fluently. The 26 field workers received prior training and always worked in the field supervised by at least 1 of the 2 local physicians involved in the study and the health representative of the APG. In phase 2, all subjects positive on screening underwent a complete neurological examination performed by neurologists able to speak Spanish. Furthermore, a local physician and the health representative of the APG, able to speak Guaranì, always assisted the neurological fieldwork in the second phase.[5]

We adopted the SNES screening instrument,[4] a slightly modified version of the WHO Neuroscience Research Protocol. In the SNES study, the sensitivity of the screening instrument was 100% for parkinsonism and 96% for peripheral neuropathies, stroke, and epilepsy; the specificity was 86%.[7] The instrument had been translated into Spanish and pretested in the field. We performed a pilot study to determine compliance with the screening instrument and evaluate the comprehension of each item. All the members of the field staff carried out the pilot investigation in October 1994 in 2 small communities of 291 inhabitants.[5]

To obtain a successful survey, a high level of community cooperation was required. Local radio was used to inform populations about the survey. Meetings with the head and the adults of each community were held before the start of the field work to explain the aim of the survey and to obtain the communal consent. Meetings were held more than once with the health workers of each community.

Diagnostic Criteria

According to the WHO criteria, we defined stroke as "rapidly developing clinical signs of focal (or global) disturbance of cerebral functions, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin."[8] Ischemic cerebral infarction and intracerebral hemorrhage were included, but transient ischemic attacks were excluded. As lumbar puncture and CT scan were not available in the rural communities, we could not distinguish between cerebral thrombosis, cerebral embolism, and intracerebral hemorrhage; the diagnoses were made exclusively on clinical grounds.

The diagnosis of stroke was considered definite if (1) physicians had already diagnosed stroke and study neurologists agreed and (2) study neurologists found presenting sequelae consistent with such a diagnosis. We considered possible stroke cases in which only suggestive anamnestic data were available.[9] Only first definite strokes were considered. All the data collected were examined and discussed by a panel of neurologists to reach consensus diagnosis.

Analysis was carried out with the Csample module of EPI-INFO 6 to allow for the cluster sampling. All results presented are therefore adjusted for both area stratification and clustering.[10] In addition, results were age adjusted to the world standard population, as used in

Age- and Sex-Specific Prevalence of Stroke

	Men			Women			Both Sexes			
Age	Population, n	Cases, n	Cases/100 000	Population, n	Cases, n	Cases/100 000	Population, n	Cases, n	Cases/100 000	95% CI
0–34	3902	0	...	3796	2	63	7698	2	31	0–74
35–44	471	1	295	445	0	...	916	1	151	0–444
45–54	323	1	165	318	2	796	641	3	472	0–1057
55–64	206	5	2419	198	0	...	404	5	1216	240–2192
≥65	133	5	4419	163	0	...	296	5	1933	230–3635
Total	5035	12	247	4920	4	99	9955	16	174	94–254
Age adjusted*									322	

*Age adjusted to the world standard population.

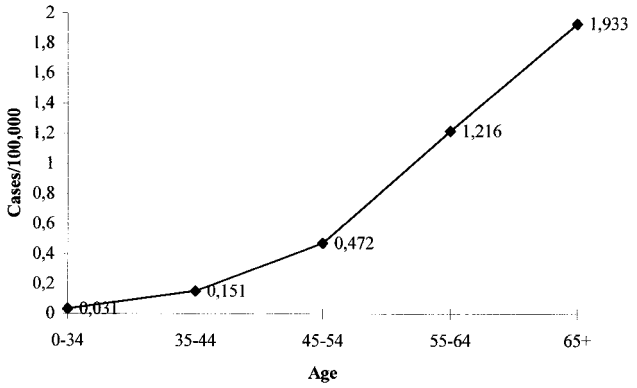

Figure 2. Age-specific prevalence of stroke (cases per 100 000).

Cancer Incidence in Five Continents,[11] to facilitate international comparison.

Results

The survey began the day after the prevalence day (November 1, 1994) and was completed in November 1996.

Fifty-five communities were selected by cluster sampling from the 10 areas of the Cordillera Province. They contained a total of 1941 households. The eligible population consisted of 10 124 subjects. At the end of the screening, 9955 questionnaires had been completed. The age and sex distribution of the eligible population is shown in Figure 1 and in the Table.

Of the 9955 subjects screened, 1130 (11.3%) were positive at the screening instrument. Of these, 1027 were directly examined by neurologists in phase 2. One hundred three (10%) were not examined; of these, 86 were not found, 10 died during the study, and 7 refused the neurological examination. Of the 86 subjects not found in second phase, only 9 were aged >50 years.

After an extensive neurological evaluation, we found 18 subjects who had experienced 1 complete stroke on prevalent day. After the panel evaluations, 16 patients were considered to have had a stroke and 2 a possible stroke. The prevalence of stroke was 174/100 000 (322/100 000 age adjusted to the world standard population) and 663/100 000 in subjects aged ≥35 years.

Age-specific prevalence increased rapidly with age, reaching a peak in the group aged >65 years (1933/100 000; Figure 2). The median age at first stroke was 60 years.

Prevalence was >2-fold higher in men than in women (247/100 000 and 99/100 000, respectively).

In 3 cases stroke occurred in the vertebrobasilar circulation; the rest involved the carotid territory. No further attempt was possible to differentiate between the different types of occlusive or hemorrhagic stroke.

Only 7 patients were hospitalized and received specific treatment in one of the district hospital and were examined only by a general physician.

Discussion

Epidemiology of stroke in developed countries is well established. Such information is limited in the developing world, where more than half the world's population lives. The demography and the lack of national health resources in these regions contribute to the difficulty in conducting neuroepidemiological studies. The absence of death certification in rural areas is one of the reasons for the unreliability of stroke mortality and incidence rates in rural developing countries,[1] and therefore prevalence is the only study available in rural areas. Moreover, due to the lack of hospital registers and the low rate of hospitalization for stroke, community-based door-to-door surveys represent the only possible method of ascertainment.

One of the essential requirements for the implementation of neuroepidemiological studies in rural areas of developing countries is community collaboration. In this study the establishment of a working relationship with the APG was particularly important. The involvement of local health workers favored acceptance by this rural population, and thus the refusal rate was very low. We did not find language a major barrier. In fact, the vast majority of the population understand Spanish. Only a few subjects spoke only Guaranì; local physicians and health workers used the local language.[5]

Our study represents one of the few surveys totally carried out in a rural area of a developing country.

Prevalence rates from developed countries are higher than those from developing countries. Different methodological approaches, case ascertainment, stroke mortality rate, and age distribution of study population could explain this difference. For all these factors, comparison with developed countries is not available.

Only a few door-to-door neuroepidemiological surveys have been carried out in developing countries, and the majority of these have been carried out in urban areas. Prevalence rates in urban areas are often higher than those in rural areas.

In our survey we selected only rural communities with <600 inhabitants. The socioeconomic conditions are very poor (eg, latrines not always available, absence of running water, and presence of animals around the households; low educational level; poverty). The area hospitals are often very far from the communities, and sometimes only primary care is available. Neurological departments and CT scan are not available in all areas of Cordillera Province. We would like to stress that the economic, hygienic, and sanitary conditions described in other surveys carried out in rural developing countries are often different, and these factors must be considered when interpreting international comparisons.

Our crude prevalence rates, 174/100 000 and 663/100 000 in population aged ≥35 years, are higher than those reported in other rural surveys (rural Kashmir, 143/100 000[12]; Nigeria, 58/100 000[13]) but lower than those reported in other surveys in which urban or mixed areas were investigated (Parsi Community, Bombay, 424/100 000[14]; People's Republic of China, 620/100 000[15]; Cuzco, Perú, 647/100 000[16]; Taiwan, 595/100 000[17]; Kinmen, China, 2400/100 000 in a population aged >50 years[18]; and Greece, 995/100 000 in a population aged >20 years[19]).

As in other surveys, age-specific prevalence increases steeply with age, reaching a peak of 1933/100 000 for the population aged ≥65 years (1933/100 000).[12–19] Sex-specific

prevalence is 2-fold higher in men than in women, in agreement with several other studies.[12–19]

Several reasons could explain the low point prevalence rate for stroke in Cordillera Province. The low crude prevalence rate could be partially explained by the age distribution of the study population. Prevalence and incidence of stroke increase dramatically with age and reach a peak in the elderly population. In our study population, the older age groups represent only 7% (those aged >55 years) and 3% (those >65 years) of the overall population.

The lower availability of emergency and general care for stroke patients in rural communities of developing countries might result in a higher case fatality rate for both acute and chronic stroke patients. The resulting lower number of stroke survivors might be responsible for the lower stroke prevalence rate, especially in the more advanced ages. This hypothesis is supported by the fact that almost all patients reported minor sequelae of stroke, probably due to the high case fatality rate for severe stroke, and it is also supported by the low rate of hospitalization.

Several factors contribute to the low hospitalization rate. Because the communities are often very far from the nearest area hospital (sometimes several hours), the long distances and the poor condition of the roads, especially during the rainy season, sometimes make it impossible to reach the area hospital. Furthermore, because of the lack of social security and also for cultural reasons, patients are usually cared for by traditional healers, and only sometimes by general physicians in the community. None are under the care of a neurologist. However, we cannot exclude that this low prevalence rate could also result from a lower risk of stroke in the Guaranì population; other types of epidemiological studies are necessary to test this hypothesis.

Government and health planners in developing countries tend to underestimate the importance of stroke; to compound this difficulty, 80% of the population in developing countries is in rural areas. This factor, together with the lack of resources and cultural practices, limits access to stroke services.

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