An Epidemiological Study of Hemiplegia due to Stroke in South India

BY J. ABRAHAM, M.D., P. S. S. RAO,* S. G. INBARAJ,† G. SHETTY, M.D., AND C. J. JOSE, M.D.

Abstract: An Epidemiological Study of Hemiplegia due to Stroke in South India

The findings of a preliminary epidemiological survey of Vellore, South India, and adjoining rural areas are presented. The prevalence of "completed strokes" and hemiplegias due to any cause is 56.9 per 100,000. The high incidence of hemiplegia in the young has been pointed out. The need for concerted efforts for a proper evaluation of the incidence of cerebrovascular disease in India seems imperative.

ADDITIONAL KEY WORDS cerebral infarction prevalence rate

The incidence of cerebrovascular disease varies in different parts of the world, and this group of disorders has become of vital importance in world health with increasing age of populations. Data regarding the incidence of cerebrovascular disease in India are not available through any population-based studies, although some information on hospital incidence of stroke is available from a few centers in India. It is generally agreed that hospital incidence of a disease is a fallacious figure by which to judge the prevalence of the disease in a population. Therefore, an epidemiological study covering a population of about 200,000 in and around Vellore, South India, was undertaken during 1968 and 1969 by the Departments of Neurological Sciences and Biostatistics of the Christian Medical College Hospital, Vellore, to assess the prevalence of hemiplegia. All cases of completed stroke with hemiplegia due to cerebrovascular disease or any other etiology were included in the study. General findings from this study are reported herein.

Geography
Vellore (area 11.65 sq km) lies between 11° 55' and 13° 15' of the northern latitude and 78° 20' and 79° 50' of the eastern longitude. The weather is warm throughout the year; the temperature varies from 15°C in December and January and to 42°C in May and June. The average rainfall in the district is about 101 cm annually. The relative humidity varies between 35% to 90% but averages around 60% most of the year.

Diet
A majority of the population are nonvegetarian, but consumption of meat is infrequent due to economical considerations. The average per capita consumption per day of protein is 35 to 60 gm, of fats (mainly vegetable) 7 to 35 gm, and of carbohydrates 300 to 400 gm, giving a total caloric intake of 1,600 to 2,100. The ratio of fats to protein to carbohydrate is 21:47:370.

Religion
Of the total population, 91.17% are Hindus, 6.32% are Muslims, 2.15% are Christians, 0.29% are Jains, and other religions make up the remaining 0.07%.

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TABLE 1
Age and Sex Distribution of Population Surveyed

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Population</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>34,941</td>
<td>37,743</td>
<td></td>
<td>72,684</td>
</tr>
<tr>
<td>10-19</td>
<td>26,872</td>
<td>23,856</td>
<td></td>
<td>50,728</td>
</tr>
<tr>
<td>20-29</td>
<td>20,932</td>
<td>21,783</td>
<td></td>
<td>42,715</td>
</tr>
<tr>
<td>30-39</td>
<td>18,291</td>
<td>16,013</td>
<td></td>
<td>34,304</td>
</tr>
<tr>
<td>40-49</td>
<td>13,708</td>
<td>11,978</td>
<td></td>
<td>25,686</td>
</tr>
<tr>
<td>50-59</td>
<td>8,679</td>
<td>8,132</td>
<td></td>
<td>16,811</td>
</tr>
<tr>
<td>60-69</td>
<td>5,281</td>
<td>5,142</td>
<td></td>
<td>10,423</td>
</tr>
<tr>
<td>70 and above</td>
<td>2,705</td>
<td>2,520</td>
<td></td>
<td>5,225</td>
</tr>
<tr>
<td>Total</td>
<td>131,409</td>
<td>127,167</td>
<td></td>
<td>258,576</td>
</tr>
</tbody>
</table>

Occupation
The main occupation in the rural area is agriculture; petty business and cottage industries come second. In the town, trade and commerce of various grains, tobacco and commodities such as jaggery, vegetables, cloth, brassware and ornaments are the occupations of a sizeable section of the community. In Vellore, an equally large number of persons are engaged in professional, technical and white-collar jobs. The average per capita income of the population per annum is $44.

Methods
The entire town of Vellore and two of the adjacent rural blocks of about 10.5 sq km area were included for this study. The total population actually surveyed in both the urban (Vellore town) and the rural areas was 258,576. The age-sex distribution of the sampled population is given in table 1.

The survey was conducted by 16 field workers and four supervisors who underwent a training and orientation program for six weeks. The training included case demonstration of hospitalized stroke patients and practice and familiarization with the proforma to be used in the survey. In addition they were taught to use the sphygmomanometer to record blood pressure. The emphasis, however, was to orient the field workers to detect any form of paralysis or lack of movement of a limb.

The plan of survey consisted of an interview with a responsible member in each family, usually the wife of the head of the household. Repeated visits were made by the field workers, and every effort was made to survey all the families in the geographically defined area. Over the period of one year it was thus possible to obtain information for the entire population included in the study. A specially prepared proforma was used during the interview to ascertain whether any member of the family had, or ever had had, any paralysis or weakness of the limbs or, if following a febrile illness, had developed weakness in one or more limbs. If affirmative, then details were noted as to the side affected, whether the upper and lower limbs were affected, and whether the face was involved. Also, whether the attack of paralysis was associated with loss of consciousness, the period of the year when it occurred, and whether the ailment still persisted. The interviewers also checked to determine whether any case of paralysis had occurred among any member of the family who had migrated or died during the previous year.

The cases of paralysis identified by the field interviewers were termed "suspects," and each of them was given a referral slip to attend the Neurological Clinic at the Christian Medical College Hospital, Vellore. Confirmation of the diagnosis of stroke was made at the Clinic. The "suspects" who failed to attend the Clinic were visited at their homes by one of the neurologists and the diagnosis was ascertained. It was possible to examine all the "suspects."

TABLE 2
Number of Suspected and Confirmed Stroke Cases by Age and Sex

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Suspected stroke cases</th>
<th>Confirmed stroke cases</th>
<th>Percentage of stroke cases to the suspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>0-9</td>
<td>75</td>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>10-19</td>
<td>58</td>
<td>59</td>
<td>3</td>
</tr>
<tr>
<td>20-29</td>
<td>72</td>
<td>133</td>
<td>4</td>
</tr>
<tr>
<td>30-39</td>
<td>51</td>
<td>139</td>
<td>7</td>
</tr>
<tr>
<td>40-49</td>
<td>90</td>
<td>105</td>
<td>13</td>
</tr>
<tr>
<td>50-59</td>
<td>90</td>
<td>79</td>
<td>16</td>
</tr>
<tr>
<td>60-69</td>
<td>87</td>
<td>66</td>
<td>19</td>
</tr>
<tr>
<td>70 and above</td>
<td>51</td>
<td>41</td>
<td>22</td>
</tr>
</tbody>
</table>
HEMIPLEGIA DUE TO STROKE

The diagnostic criteria used for confirmation of a case were based on a history of an ictus following which there was paralysis of one side of the body, or any episode of illness which was followed by hemiplegia. This was then checked by a careful neurological examination. No attempt to categorize the cerebrovascular accidents into embolic, thrombotic or hemorrhagic was made nor was there any attempt made to identify specific etiological factors in the confirmed hemiplegics.

**Findings**

A total of 1,245 persons were identified as suffering from paralysis, paresis, inability to use a limb, bed-ridden, etc., and were classified as “suspects” by the field workers. Of the 1,245 “suspects,” 147 were identified as genuine strokes with hemiplegia by the neurologists.

The number of suspects and the percentage confirmed to the total suspects in each age and sex group are presented in table 2. From this table it is observed that a relatively smaller percentage of cases in the lower age groups were ultimately confirmed to be patients suffering from strokes. It is also observed that 40 of the confirmed hemiplegics among the 147, or nearly 25%, were under 40 years of age.

The prevalence rate per 100,000 population is 68.5 in males and 44.8 in females. The age-sex specific rates are indicated in table 3 and figure 1. It is evident that the prevalence rate increases with age and that there is a statistically significant male preponderance in the age groups above 50 years (P < 0.01).

The rural and urban differences in prevalence are shown in table 4. While the female rates are lower in both rural and urban areas, the rural rates are lower than urban. Further analysis on this difference is under way.

**Discussion**

This study was undertaken to assess the prevalence of hemiplegia in all age groups. That the sample population studied is not biased is shown in figure 2, where the population according to age and sex in India during the 1961 census is compared to the population studied. The surveyed population in Vellore and in the surrounding rural areas represents quite adequately the conditions of villages and towns in southern India, barring the major cities such as Madras. The southern states in India, which include Andhra Pradesh, Tamil Nadu, Pondicherry, Mysore and Kerala, had an estimated population of 131 million in 1969. Thus, we could expect at least 75,000 persons to be affected with hemiplegia due to stroke. Though the other parts of India might differ from the southern areas in terms of both...
TABLE 4

Prevalence of Stroke (per 100,000) According to Region and Sex

<table>
<thead>
<tr>
<th>Region</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>74</td>
<td>53</td>
<td>63</td>
</tr>
<tr>
<td>Rural</td>
<td>64</td>
<td>38</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>45</td>
<td>57</td>
</tr>
</tbody>
</table>

climatic factors and dietary habits, one could reasonably expect similar conditions with regard to environmental and social conditions. We might, therefore, expect at least 300,000 affected persons in the whole of India. Even though this is a pilot study and probably the first of its kind in India, it focuses attention on the tremendous need for further concerted efforts to study the problem of stroke on a nationwide basis.

The total number of people who suffer from cerebrovascular disease of all types will naturally be considerably higher. However, as autopsy and morbidity studies have not been done in India, the exact extent of this disease is unknown.

A unique finding in this study was that 25% of the stroke patients were below the age of 40 years. This is further corroborated by the findings of a prospective study of strokes done in this department which show a similar incidence of stroke in the younger age group. The high incidence of stroke in the younger age group is also seen in some studies reported from other Indian centers. Therefore, this finding is not peculiar to the South alone. The etiological factors at play in the younger age group are perhaps different from the older age groups, and ongoing studies examining this are under way. The higher prevalence rate among women in the early childbearing period (the late teens) is obviously due to puerperal phlebothrombosis or thrombophlebitis, but the factors which predispose to the development of this condition require further study.

The prevalence rate of 13.1 per 100,000 in the 0 to 9-year age group is disconcerting. This large number denotes that birth injuries and early infective lesions leaving hemiplegia as a sequela are still important factors. Unless the etiology is understood and proper preventive measures taken, this group of patients with a fairly long life expectancy will only serve to increase the demands on an already economically overburdened society.

A prospective longitudinal study to evaluate the incidence of stroke and to assess the influence of factors such as hypertension, diabetes, syphilis, diet and the weather is necessary to obtain a broader and truer conception of some of the aspects of cerebrovascular disease as it exists in India.

Acknowledgment

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*Studies show that 25% of all strokes in the younger age group among women are due to puerperal phlebothrombosis or thrombophlebitis.
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