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Stroke in the Urban Population of Calcutta – An Epidemiological Study

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Key Words

Stroke · Prevalence · Incidence · Calcutta

Abstract

A population-based cluster survey on stroke disorders was conducted for the first time in the city of Calcutta, India. The population surveyed totaled 50,291. The crude prevalence rate of stroke was 147/100,000 (age-adjusted prevalence 334/100,000). The annual incidence rate of stroke for the year 1998–1999 was 36/100,000 (age-adjusted annual incidence rate 105/100,000). Women outnumbered men regarding stroke prevalence in all age groups except in the 50- to 69-year age group. There were relatively more cases of cerebral haemorrhage in our study, compared to those in the western countries. Case-control analysis found hypertension to be the most significant risk factor for stroke.

Introduction

Neuroepidemiological studies in India, which started in the early 70s [1], have now emerged as a major field of research. Epidemiological studies on neurological diseases have been carried out in rural and in urban communities in different parts of India, and these show profiles clearly different from those seen in the western hemisphere [2–8].

Calcutta is one of the principal cities of India with an approximate population of 4.5 million. Between July 1998 and June 1999, we conducted an extensive house-to-house survey on stroke in a part of the city. To our knowledge, this is the first population-based survey on neurological disorders in the city of Calcutta.

The objective of the present study was to determine the prevalence, incidence and nature of stroke in a part of the urban community of Calcutta and also to assess the influence of the common risk factors on the occurrence of stroke.

Subjects and Study Design

Investigational Area and Population

The survey was conducted in four municipal blocks located in the southern part of the city of Calcutta – one municipal block in Garia and three adjoining blocks in the Kasba-Tiljala area (fig. 1). These survey sites had fairly stable population with minimal migration in or out of the areas. The entire population of these blocks was included in the survey.

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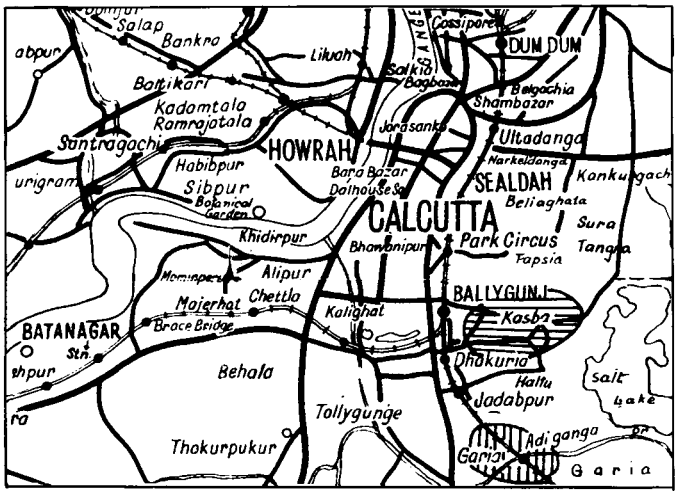

Fig. 1. The map of Calcutta, hatched areas being the survey sites.

Table 1. General family screening questionnaire

	Sociodemographic details
1. Serial No.	□□□□□ □□
2. Date of survey	□□ □□ □□
3. House No.	□□□□□
4. Name of the head of household (HOH) and address ----------	
----------	
5. Tel. No.	□□□□□□□
6. Name of the respondent and relation to HOH	
7. Religion	□
A. Hindu B. Muslim	
C. Christian D. Others, specify	
8. Total No. of household members	□□
9. Total approx. income per month	□□□□□
10. Period of stay in this locality (in months)	□□□

Sl No.	Name	Age	Sex M/F	Relation to HOH	Education*	Occupation*	Stroke** (Y/N)
1.	_____ □□□□	□	_____		□□	□□	□
2.	_____ □□□□	□	_____		□□	□□	□
3.	_____ □□□□	□	_____		□□	□□	□
4.	_____ □□□□	□	_____		□□	□□	□
5.	_____ □□□□	□	_____		□□	□□	□
6.	_____ □□□□	□	_____		□□	□□	□
7.	_____ □□□□	□	_____		□□	□□	□
8.	_____ □□□□	□	_____		□□	□□	□

* Education & Occupation coding systems were followed [9].

** The questions asked for screening of stroke are:

(a) Was the speech slurred?

(b) Was the face ever paralyzed with deviation of mouth to one side?

(c) Were the arms and legs paralyzed on one side?

(d) Was the sensation on one side of the face or body ever lost or abnormal?

(e) Were (a) to (d) of acute onset and with duration >24 hours?

Table 2. Stroke pro forma for the neurologist

Serial and individual No.		□□□□□ □□	
1. Name of the subject:		□□	□□
2. When stroke: month/year		□	
3. Side affected: R/L/Other			
4. History and examn findings			
5. Investigation reports (Diabetes mellitus)			
6. Brain CT/MRI – Yes/No			
If yes,			
Infarct		Hemorrhage	
(a) Cortical		(a) Lobar	
(b) Lacunar (basal ganglia/periventricular)		(b) Basal ganglia	
(c) Multi-infarct		(c) Brainstem	
		(d) Cerebellar	
HTN Y/N	DM Y/N	Smoker Y/N	
Date of examination ----------	Signature ----------		

Study Design

It was a two-stage survey. In the 1st stage, field investigators carried out a door-to-door survey with the help of a pre-designed questionnaire (tables 1, 2) to screen the cases of stroke disorders. The field workers were non-medical personnel with prior experience in carrying out surveys. Prior to carrying out the present survey, they had been given comprehensive training in the medical part of the research to enable them to identify positive cases accurately. The screened-positive individuals were then clinically examined in detail by a neurologist (one of us) applying a preset protocol, and their cerebral scans (CT/MRI) of the stroke, if obtained, were examined.

The specificity and sensitivity of the screening instrument was evaluated. The neurologist examined screened-positive cases and from this the non-diseased individuals found positive on screening (false-positive) were ascertained. Furthermore, 48 screened-negative cases were randomly chosen from the community using statistical random numbers, and they were examined by one of us to ascertain the false-negative cases.

The formula shown in table 3 was applied to obtain sensitivity and specificity [9]:

The annual incidence rate of stroke for the year 1998 (January 1, 1998 to December 31, 1998) was ascertained. However, only the stroke survivors were included in the calculation of the incidence rate. Besides, the survey was done once only so the households checked in the early part of the year were not rechecked in the later part of the year.

The influence of risk factors like hypertension, diabetes mellitus and smoking on stroke were examined by means of case-control analysis. Hypertension was defined as systolic blood >140 and/or diastolic blood pressure >90 and/or taking antihypertensive medication.

Table 3. Sensitivity and specificity

Screening test results	True status	
	diseased	not diseased
Positive	a	b
Negative	c	d
Total	a + c	b + d

Sensitivity (%) = (a/a + c) × 100.
Specificity (%) = (d/b + d) × 100.

Diabetes mellitus was defined when either the patient was on antidiabetic medication or when fasting plasma glucose >140 mg/dl and/or plasma glucose concentration >200 mg/dl 2 h after a glucose challenge [10]. Smoking was only considered in men, since smoking in women was extremely rare in the communities surveyed. The controls were those who did not have any clinical evidence of peripheral vascular disease, coronary artery disease or cerebrovascular disease. They (n = 148) were randomly selected from the urban population of Calcutta. For each case, 2 age- and sex-matched controls were taken into account.

Statistical Analysis. The Mantel-Haenszel method combining stratified two by-two tables [11] was applied to evaluate the risk factors statistically. Odds ratios (OR) for effects were reported with 95% confidence intervals (95% CI).

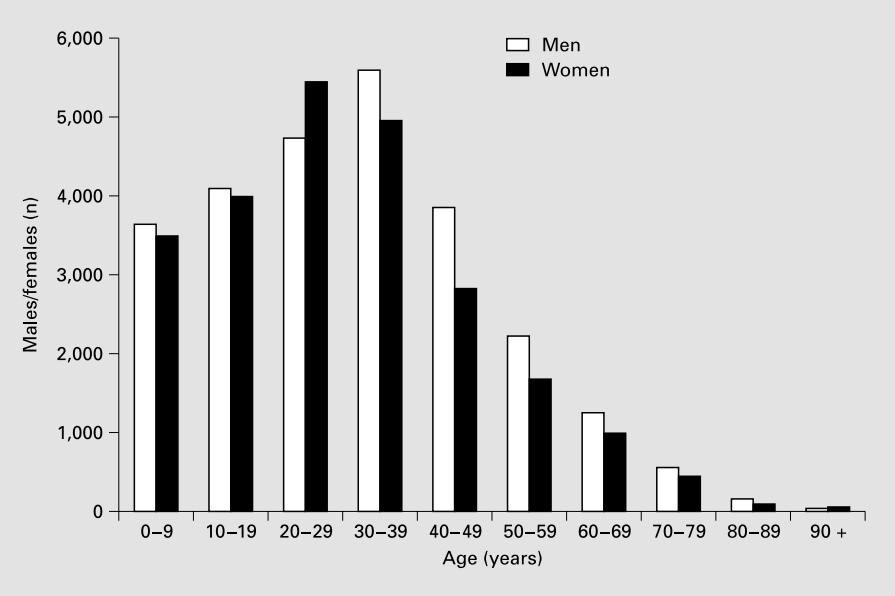

Fig. 2. Age and sex distribution of the population surveyed (n = 50,291).

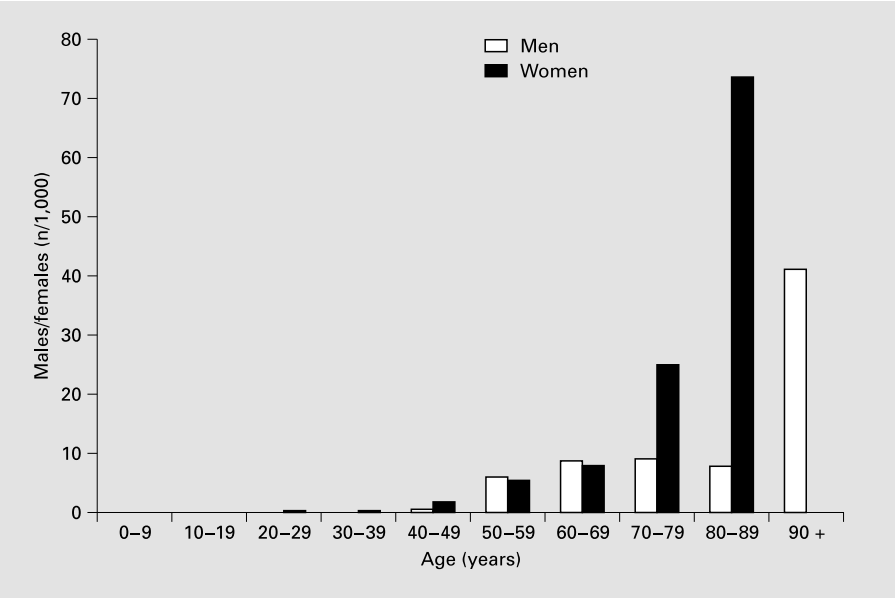

Fig. 3. Age-specific prevalence rate of stroke (per 1,000 inhabitants).

Definition of Stroke

The World Health Organization defined Stroke as rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than due to vascular origin [12]. The above definition was strictly followed, and therefore cases that demonstrated features of a transient ischaemic attack only were not taken into consideration.

Results

The total population surveyed was 50,291, the number of families being 15,022. The demographic characteristic of the population revealed that men did outnumber women and that the majority of the population was in the 20- to 39-year age group (table 4, fig. 2). Hindus were predominant; the majority of families belonged to the middle-income group, with an average family income between Rs 2,500–3,500/month (table 5).

Table 4. Age and sex distribution of the population surveyed (n = 50,291)

Age, years	Men	Women	Total
0–9	3,635	3,512	7,147
10–19	4,095	4,008	8,103
20–29	4,751	5,467	10,218
30–39	5,642	4,988	10,630
40–49	3,891	2,861	6,752
50–59	2,235	1,697	3,932
60–69	1,256	999	2,255
70–79	551	437	988
80–89	130	80	210
>90	24	32	56
All ages	26,210	24,081	50,291

Table 5. Demographic analysis of the families surveyed

	Families	
	n	%
Total	15,022	100
Hindu families	13,674	91.03
Muslim families	763	5.08
Christian families	84	0.56
Families from other religions	90	0.60
Religion not noted	379	2.52
Family income		
Rs 250–1,000/month	272	1.81
Rs 1,001–2,500/month	2,302	15.32
Rs 2,501–3,500/month	5,038	33.54
Rs 3,501–5,000/month	3,205	21.34
Rs >5,000/month	2,582	17.19
Not noted	1,621	10.79

Rs 40 = US $1 (approximately).

Table 6. Number of stroke cases in each age group (age-specific prevalence rate/1,000 inhabitants in parentheses)

Age group, years	Men	Women
0–9	0	0
10–19	0	0
20–29	0	1 (0.2)
30–39	0	1 (0.2)
40–49	2 (0.5)	5 (1.7)
50–59	13 (5.8)	9 (5.3)
60–69	11 (8.8)	8 (8.0)
70–79	5 (9.1)	11 (25.2)
80–89	1 (7.7)	6 (75)
≥90	1 (42)	–

Table 7. Analysis of stroke cases with available scan (n = 44)

Age, years	Men	Women
20–29		1 (100%) 1 LH
30–39		
40–49	1 (50%) 1 IBG	3 (60%) 3 IBG
50–59	10 (77%) 5 IBG; 4 HBG; 1 CI	6 (67%) 2 IBG; 3 HBG; 1 CI
60–69	9 (82%) 4 IBG; 2 HBG; 3 CI	5 (62.5%) 3 IBG; 2 HBG
70–79	1 (20%) 1 IBG	5 (45%) 3 IBG; 1 HBG; 1 CI
80–89		2 (33%) 1 HBG; 1 IBG
≥90	1 (100%) 1 IBG	

The figures in parentheses are percentages of the stroke cases in each subgroup who had neuroimaging studies. Types of stroke and numbers are given. LH = Lobar haemorrhage; IBG = infarct at basal ganglia/paraventricular region; HBG = haemorrhage at basal ganglia; CI = cortical infarct.

Seventy-four cases of stroke were identified. The crude prevalence rate of stroke was 147/100,000. When adjusted to the US population of 1996 [13], the age-adjusted prevalence rate of stroke was 334/100,000 (men 196 and women 564 per 100,000). In our study, stroke was found to be more prevalent among women in all age groups except in the 50- to 69-year range (table 6; fig. 3). In both sexes the prevalence of stroke increased with age.

Neuroimaging (CT or MRI scan of the brain) was performed soon after the stroke in 44 of 74 (59.5%) cases. Table 7 illustrates those subjects who had neuroimaging done, their age and sex distribution and types of stroke. The imaging revealed infarcts in 30 (68%) and haemorrhage in 14 (32%) cases. All of those who had imaging tests had the tests done at their own expense. Proportion-

ately fewer patients in the 70- to 89-year age group had imaging tests compared to those in the younger age groups (table 7). Residual neurodeficits did not differ in terms of extent or severity between those who had scans and those who had not.

Seven (approximately 10%) cases (4 men and 3 women; age 65.4 ± 10.4 years) had two separate events of stroke. In all except 2, both events were cerebral infarctions. In the other 2 cases there was haemorrhage in one episode and infarct in the other. None of the positive cases in our survey had had more than two strokes.

From January 1, 1998 till December 31, 1998, there were 18 new cases of stroke (7 males and 11 females); thus the annual incidence rate of stroke was 36/100,000. The age-adjusted annual incidence rate was 105/100,000 (43 men and 204 women per 100,000), when adjusted to the US population of 1996 [13]. Eight out of 18 (44%) had neuroimaging studies, out of which 4 (50%) had infarcts and 4 (50%) haemorrhage.

The quality of the screening instrument was assessed. There was no false-negative case found, and so the sensitivity was 100%. Some false-positive cases were found, so the specificity of the screening method was 72%.

The influence of hypertension, diabetes mellitus and smoking (in males) on stroke was evaluated by means of case-control analysis. OR for hypertension was 5.04 (95% CI 4.16–5.92) in women and 21.87 (95% CI 18.69–25.05) in men. Diabetes mellitus had the OR 0.99 (95% CI –0.28–2.26) in women and 1.61 (95% CI 0.17–3.05) in men. Smoking in men had the OR 2.91 (95% CI 1.57–4.25).

Discussion

The crude prevalence rate of stroke was 147/100,000 in our study. A cluster survey carried out earlier on a rural Indian population of 37,286 in a place about 350 km away from Calcutta showed a prevalence of 126/100,000 [5]. Reports of population-based studies carried out in different parts of India showed a wide variation in the prevalence rate of stroke. South Indian survey disclosed a prevalence rate of stroke of 55–57/100,000 [1, 3]. Kashmir in North India had a prevalence rate of 143/100,000 [2]. The incidence of stroke was much higher among the Parsi community of Bombay where the prevalence was about 850/100,000 [7]. Differences in age distribution among different survey populations could partly be responsible for the variation in prevalence rates, since only the crude rate was considered in the earlier studies.

Our age-adjusted prevalence rate of stroke was 334/100,000. This figure is less than those reported in the Western literature. In the UK, a study showed the overall rate to be 486/100,000 [14], and in another study from Norway 439/100,000 [15]. There were similar results from Denmark [16] and also from Rochester, Minn., USA [17].

The age-adjusted annual incidence rate was 105/100,000. This was, however, an underestimate since we captured only the stroke survivors and not those who died after stroke. Also households were surveyed only once; so if a stroke occurred in the later part of the year in a household surveyed earlier that could not be ascertained. In Europe, although there was a moderate difference in the stroke incidence between countries, the mean incidence rate was 200/100,000 [15, 17–20]. In Rochester, Minn., USA, the incidence of stroke showed a striking decline from 186 in 1945–1949 to 89 in 1975–1979 [21].

In European countries, the ratio of intracerebral haemorrhage to cerebral infarction was in the range of 0.10–0.20 [15, 18, 22]. On the other hand, our prevalence and incidence data showed a much higher incidence of haemorrhage compared to that of the western countries. However, only 59.5% of our subjects had neuroimaging studies. This was because in our country in the large majority the individual or his family has to bear the expense of his neuroimaging investigations; this is an expensive test, and many people cannot afford the test even if they have a major stroke event.

Hypertension [18, 23, 24], diabetes mellitus [18, 24] and smoking [25, 26] are the known risk factors for stroke. Our case-control analysis showed hypertension to be by far the most important risk factor. There was also an association between stroke and smoking, but we did not find diabetes mellitus to be a significant independent risk factor for stroke.

This survey revealed that the age-specific prevalence rate of stroke was higher in women than in men in all age groups except in the 50- to 69-year age range. Even the age-adjusted annual incidence rate was higher in women. This is in striking contrast to other studies from India and abroad [1, 5, 14–16]. Smoking in women is very uncommon in the community surveyed. Therefore, it was possible that hypertension was less well managed among women than men in our community resulting in an increased incidence of stroke in women.

The sensitivity of 100% indicates adequate reliability of our screening instrument; however the specificity was slightly lower than desired at 72%, which implies that the screening questionnaire needs to be further modified.

Conclusion

This survey, the first population-based study on stroke in Calcutta, revealed that the age-adjusted prevalence and incidence rates of stroke were lower than those reported from western countries, but there were relatively more cases of intracerebral haemorrhage in this survey than in those observed in European countries. Incidentally, this is the first population-based study to report on the nature of stroke in India. We also observed that the age-specific incidence and prevalence rates of stroke were higher among women, which was in contrast to the other reports. Our cluster survey, therefore, showed certain distinct characteristics of stroke disorders in our study cohort, and this necessitates a more extensive study in the future through a careful random sample survey in the city of Calcutta.

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