



Cerebrovascular disease in South Asia – Part I: A burning problem

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DECLARATIONS

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Summary

Stroke is a non-communicable disease of increasing socioeconomic importance in ageing populations. According to the World Health Organization, stroke was the second most common cause of worldwide mortality. In South Asian countries demographic changes, urbanization and increased exposure to major stroke risk factors will fuel the stroke burden in the future. The prevalence of stroke in India is 44–843/100,000 (from community-based studies), 500–2000/100,000 in Bangladesh, 218/100,000 in Pakistan and 1000/100,000 in Sri Lanka and community-based prevalence studies in these countries are still lacking. There are no data on stroke prevalence from Nepal. Incidence studies are still less and an Indian study reported an incidence of 145/100,000. Incidence studies from other South Asian countries are lacking. This review attempts to give an overview of the evidence so far on the burden of stroke in this part of the globe.

Introduction

Definitions

A number of terms are used to describe vascular diseases of the brain, some of which are ambiguous and can only be applied after passage of 24 hours after onset. We, therefore, begin with certain definitions for terms we use in this article. The term ‘cerebrovascular disease’ is used to encompass all the diseases of the vascular system of brain. This includes:

(1) *Stroke*: Stroke is the major consequence of cerebrovascular disease. The World Health Organization (WHO) defines stroke as ‘the rapidly developing clinical symptoms and/or signs of focal [at times global] disturbance of cerebral function, with symptoms lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin.’

(2) *Transient ischaemic attacks (TIAs)*: The classical definition is as follows: a TIA is a clinical syndrome characterized by sudden onset focal cerebral or monocular dysfunction with symptoms lasting less than 24 hours and which is thought to be due to ischaemia as a result of arterial thrombosis or embolism associated with arterial, cardiac or haematological disease. Recently, some definitions have proposed to reduce the time period to one hour, and the American Heart Association has proposed a tissue-based definition, in which, besides the period of one hour, diffusion-weighted magnetic resonance imaging is required to be negative (as evidence of no tissue damage). There are problems with each of these definitions, but their discussion is beyond the scope of this paper.

(3) *Brain attack*: The term ‘brain attack’ is recently being used to describe the same clinical syndrome as stroke but within 24 hours of onset,

when it is not possible to classify it as either TIA or stroke. The term mimics heart attack and promotes a sense of urgency in management.

- (4) *Vascular dementia*: Dementia developing after multiple cerebral infarctions or after a single strategically placed infarction is called vascular dementia. Many patients presenting with progressive impairment of intellectual functions are often found to have multiple infarctions of brain. This condition is very often misdiagnosed as Alzheimer's disease in epidemiological studies because the distinction between the two conditions may be difficult on clinical grounds (or sometimes even with investigations).
- (5) *Stroke in evolution*: This term is used to describe the situation in which a patient with stroke shows worsening of his neurological condition over minutes, hours or days after the initial assessment. The deterioration may take several forms: worsening of existing neurological deficits, new deficits indicating involvement of the contiguous parts of brain or decrease in the level of consciousness.
- (6) *Others*: The conditions like Binswanger's disease, multiple lacunar infarcts, silent infarcts or lacunar state are relatively rare but of public health importance. Some authors use the term Reversible Ischaemic Neurological Deficit to describe situations in which the patient recovers between 24 hours and three weeks of stroke. We do not subscribe to the use of this term because this is only a retrospective diagnosis and does not require any diagnostic or treatment or prevention strategy which is different from other ischaemic strokes.

Thus, from a public health point of view, stroke accounts for the major part of the burden of disease usually described under the term 'cerebrovascular disease' and is the main condition to be targeted for prevention. The following discussion mainly refers to stroke.

Cerebrovascular disease: a burning problem

It is a fact that cerebrovascular disease is a huge public health problem imposing both a large

disease burden and a large economic burden on our country. A more disconcerting fact than this is that the dimension of the problem is increasing with passing years and is likely to accelerate further in the coming years. This is evident from the increasing prevalence and incidence of stroke in various studies.

Stroke in India

Community-based prevalence studies

A number of prevalence studies have been conducted in India (Table 1).¹⁻¹² There is a wide range of the prevalence estimates in these studies. As the case definition, the instrument and the methodology used have been different in different studies, it is not clear whether the variation in prevalence is real or a result of sampling error, difference in study methodology or sample demography. The crude prevalence rate in these studies varied from 44 to 843 per 100,000.

Community-based incidence studies

The first study was conducted in Vellore, Tamil Nadu. The study was conducted in a population of 258,576 in and around Vellore. In first phase of the study (1968-1969), the population was surveyed to detect cases with hemiplegia.¹⁰ In the second stage (1969-1971), this population was kept under surveillance for the next two years to record all cases of hemiplegia. This study revealed an incidence of 13 per 100,000 per year and a point prevalence of 42 per 100,000. The second study was conducted at Rohtak, Haryana (1971-1974).¹ Case ascertainment was made using several information sources: notification by local doctors, regular inspection of local health centre records and examination of death certificates. Eighty-two cases of stroke were recorded yielding an annual incidence of 33 per 100,000 (for first ever stroke 27 per 100,000).

Both studies are of limited use in the current context for several reasons. First, they are probably underestimates because strokes other than hemiplegia were missed. Second, the number of registered stroke cases was small and hence precision of the estimates is poor. Third, computerized tomography (CT) scan was not available at the time of the studies. Thus, classification into haemorrhagic and ischaemic strokes could not be

Table 1**Prevalence of stroke in different studies in different part of India**

Zone	Place	Rural/ urban	Year study conducted	Population	Crude prevalence rate per 100,000	Age adjusted prevalence rate per 100,000
North	Rohtak, Haryana ¹	Urban	1971–1974	79,046	44	–
	Kuthar Valley, Kashmir ²	Rural	1986	63,645	143	244*
West	Mumbai, among the Parsis ³	Urban	1985	14,010	842	424*
	Mumbai ⁴	Urban	1997	145,456	220	–
	Mumbai ⁵	Urban	2005	186,000	–	–
East	Malda, WB ⁶	Rural	1989–1990	37,286	126	–
	Baruipur, WB ⁷	Rural	1992–1993	20,842	147	–
	Kolkata ⁸	Urban	1998–1999	50,291	147	334 [†]
	Kolkata ⁹	Urban	2003–2005	52,377	472	545 [‡]
	Guwahati ⁵	Urban	2005	–	–	922
South	Vellore ¹⁰	Rural	1968–1969	258,576	57	84
	Gowribidinur, Karnataka ¹¹	Rural	1982–1984	57,660	52	–
	Bangalore ¹²	Rural	1993–1995	51,055	165	262 [§]
	Bangalore	Urban	1993–1995	51,502	136	–
	Bangalore ⁵	Urban and rural	2005	4,700,000	115–203	–

*US population in 1960
[†]US population in 1996
[‡]World standard population
[§]Not mentioned

reliably performed. Fourth, with increase in life-expectancy and urbanization, the incidence has certainly increased.

No incidence study was reported from India over the next 30 years. A recent stroke incidence study conducted in Kolkata showed a crude annual incidence rate of 145 per 100,000. Studies of stroke incidence in India are shown in Table 2.¹³

According to the Indian Council of Medical Research¹⁴ there were 930,985 cases of stroke in 2004 in India with 639,455 deaths (Table 3). In India, stroke incidence is certain to increase in the coming years due to:

- (1) Increase in population;
- (2) Increase in life-expectancy;
- (3) Rapid urbanization from migration of villagers to the cities;
- (4) Changing lifestyles involving sedentary habits, smoking, excess alcohol use, etc.;
- (5) Rising stress levels.

The National Commission of Macroeconomics and Health estimated that there will be 1.67 million stroke cases in India by 2015 (Table 4).⁵

Stroke in Bangladesh

Prevalence

There are no hospital- or community-based studies that have looked at the incidence of stroke in Bangladesh. Among prevalence studies, there are two recent cross-sectional community-based studies and older hospital-based studies. In a door-to-door survey by Mohammad *et al.*, which looked at the prevalence of stroke in patients aged 40 years and above in 15,627 participants, the overall prevalence rate was 3.00 per 1000 (95% confidence interval, 0.95–2.45). Stroke prevalences were 2.0, 3.0, 2.0, 10.0 and 10.0 per 1000 within age groups of 40–49 years, 50–59 years, 60–69 years, 70–79 years and ≥80 years, respectively.¹⁵ Prevalence was found to be higher

Table 2
Incidence of stroke in various studies

Place	Rural/ urban	Year	Population	Annual incidence rate per 1,00,000*	Age adjusted AIR per 1,00,000
Vellore ¹⁰	Rural	1969–1971	258,576	13	–
Rohtak ¹	Urban	1971–1974	79,046	33	–
Kolkata ⁸	Urban	1998–1999	50,291	36	105*
Baruipur, West Bengal ⁷	Rural	1993–1998	20,842	124	262 [†]
Kolkata ⁹	Urban	2003–2005	52,377	145	215.5 [‡] (145.3) [§]
Mumbai ⁵	Urban	2005	186,000	148 (crude)	–
Trivandrum ¹³	Rural	2005	184,560	119 (crude)	138
Trivandrum ¹³	Urban	2005	741,307	116 (crude)	135
Guwahati ⁵	Urban	2005	–	163 (crude)	–
Bangalore ⁵	Urban+rural	2005	4,700,000	105–124 (crude)	–

*US population in 1996
[†]US population in 1990
[‡]US population in 2002
[§]Age-adjusted to world standard population

Table 3
Burden of stroke

	1998	2004
No. of cases of stroke	792,628	930,985
No. of deaths	593,362	639,455
No. of years life lost	4,818,740	5,289,357
No. of disability adjusted	5,802,295	6,368,970

Source: ICMR: National Health Profile 2008¹⁴

among men in comparison with women (male-to-female ratio, 1.43:1). Bangladeshi male populations in rural areas were found to suffer strokes more than urban people. The study suggested that a larger community-based study should be undertaken to further confirm the result. In another cross-sectional study of a rural population more than 60 years of age, the prevalence of a stroke was found to be 0.9%.¹⁶ However, this study primarily dealt with the prevalence and distribution patterns of multimorbidity among the elderly rural population in Bangladesh. Stroke was defined as the 'presence of hemi or mono paresis judged to be of central origin or presence of pseudobulbar symptoms (dysarthria, dysphasia)' which could have overestimated the prevalence. In a multisite study of chronic diseases (INDEPTH study) conducted in 2005, the

prevalence of stroke in Bangladesh centres ranged from 0.5 to 2.0%.¹⁷ This was a self-reported prevalence study, and gives only a crude idea of the prevalence of stroke.

Two small hospital-based studies^{18,19} of 106 and 48 patients, respectively, documented the characteristics and risk factors. Large population-based incidence and prevalence studies and a stroke registry are lacking.

Stroke in Nepal

Prevalence

There are no population-based prevalence or incidence studies of stroke in Nepal. Multicentre studies looking at the prevalence of cardiovascular risk factors in South Asia have found that the conventional risk factors are more prevalent²⁰ than they are among people of European origin.

Stroke in Pakistan

Prevalence

Lifetime prevalence of stroke and TIA in a recent randomized, community-based, cross-sectional survey was found to be as high as 21.8% (18.4–25.5).²¹ Rigorous epidemiological and community-based stroke data from Pakistan

Table 4
Projection of number of cases of stroke in India

Year/age	Estimated prevalence of stroke per 1000	Estimated population	Estimated cases
2000			
20–39	0.3022	306,904,000	92,746
40–59	2.7188	168,223,000	457,365
60–79	8.4733	62,711,000	531,369
Others		464,304,000	
Total		1,002,142,000	1,081,480
2005			
20–39	0.3022	346,437,000	104,693
40–59	2.7188	196,422,000	543,032
60–79	8.4733	71,883,000	609,086
Others		468,027,000	
Total		1,082,769,000	1,247,812
2010			
20–39	0.3022	392,531,000	118,623
40–59	2.7188	227,674,000	619,000
60–79	8.4733	84,168,000	713,181
Others		463,688,000	
Total		1,168,061,000	1,450,804
2015			
20–39	0.3022	428,582,000	129,517
40–59	2.7188	258,731,000	703,438
60–79	8.4733	98,476,000	834,417
Others		466,053,000	
Total		1,251,842,000	1,667,372

Source: National Commission of Macroeconomics and Health⁵

are lacking.²² The review by Farooq *et al.*²² enumerated 27 studies that looked at the stroke subtypes, risk factors, outcomes and complications. Most of these studies were hospital-based case series, included small numbers of patients and lacked long-term follow-up. Thus, all the data on prevalence and risk factors come from hospital-based case series.^{23–25} Hospital-based registries have been established to provide data on risk and burden of stroke.²⁶ Community-based incidence or prevalence studies of stroke are still lacking in Pakistan.

Stroke in Sri Lanka

Prevalence

The prevalence of stroke in Sri Lanka was 1.0% in a community-based study.²⁷ This was a community-

based, cross-sectional study done in Colombo in 2313 adults of age ≥ 18 years. Hypertension was the most common risk factor (62.5%) followed by smoking (50%), excess alcohol (45.8%), diabetes (33.3%), TIA (29.2%) and family history (20.8%). While steps are being taken to develop stroke care,^{28,29} there are no large population-based studies so far. In a hospital-based stroke series of 103 patients, the proportion of pathological subtypes confirmed by CT scanning was cerebral infarction in 74.7%, intracerebral haemorrhage in 19.1% and subarachnoid haemorrhage in 62.2%. Of the infarcts, 31 (42%) were cortical, 30 (41%) were lacunar, 12 (16%) were cerebellar and brainstem and 1 (1.3%) was a border zone infarct.³⁰

Disease burden ('the human health cost') of stroke

Mortality statistics are commonly cited to indicate burden of various diseases. Unfortunately, reliable mortality statistics are not available as a whole due to incomplete death registry and certification, incorrect cause attribution and uncertainty of cause in cases of sudden death or multiple co-morbidities. Only 14% of deaths are even registered and classified. These data indicated that death from diseases of the circulatory system (including stroke) accounted for 24% of all deaths between 1998 and 1999.¹⁴ The numbers have certainly increased, but time trend estimates are not available. The Indian Council of Medical Research has estimated that mortality due to stroke increased by 8% between 1998 and 2004.¹⁴ The Global Burden of Disease Study has projected that total deaths from stroke in India will surpass established market economies by year 2020.³¹

The measure commonly used for estimating the burden is mortality, but this ignores significant non-fatal disability. Because of this and other limitations, nowadays disability-adjusted life years (DALYs) are commonly used to measure disease burden. Estimation of DALYs requires measures of incidence, average age of onset and prognosis (deaths and disability at various levels of severity). DALYs can be thought of as healthy person-years equivalent lost due to the disease. These counts the number of healthy person-years lost due to

premature mortality as well as morbidity. To calculate premature mortality, life-expectancy at birth is taken as 82.5 years for women and 80 for men. One year of morbidity is counted as some fraction of a healthy person-year. In the WHO–World Bank methodology of calculating DALYs, more weight is given to the economically productive years and to the years lost earlier than later. For example, death at age five leads to 35.85 DALYs lost, whereas death at age 15 means 36.23 DALYs lost. In summary, the DALY is an indicator of the time lived with a disability and the time lost due to premature mortality.

In the absence of reliable data, the WHO has estimated the incidence, average age of onset, etc. from unknown sources. The accuracy of the estimates is open to question, but these have served as the basis for calculating the DALYs lost is due to all important diseases including stroke in India.

Economic burden of stroke

Stroke, like other chronic diseases imposes direct costs (e.g. the cost of medical care), indirect costs (e.g. the cost incurred due to loss of productivity) and intangible costs (e.g. the cost of suffering or pain). No methodologically rigorous study has estimated the economic burden of stroke in any of the South Asian countries. However, rough estimates indicate that India lost 8.7 billion international dollars (US dollar at 1998 terms) in 2005 due to coronary artery disease (CAD), stroke and diabetes. This is likely to increase to 54 billion international dollars by 2015.³² It is estimated that India's growth of gross domestic product may fall by 1% because of the combined economic impact of CAD, stroke and diabetes.³²

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