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Incidence & prevalence of stroke in India: A systematic review

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***Background & objectives*: There has been more than 100 per cent increase in incidence of stroke in low- and middle-income countries including India from 1970-1979 to 2000-2008. Lack of reliable reporting mechanisms, heterogeneity in methodology, study population, and small sample size in existing epidemiological studies, make an accurate estimation of stroke burden in India challenging. We conducted a systematic review of epidemiologic studies on stroke conducted in India to document the magnitude of stroke.**

***Methods*: All population-based, cross-sectional studies and cohort studies from India which reported the stroke incidence rate or cumulative stroke incidence and/or the prevalence of stroke in participants from any age group were included. Electronic databases (Ovid, PubMed, Medline, Embase and IndMED) were searched and studies published during 1960 to 2015 were included. A total of 3079 independent titles were identified for screening, of which 10 population-based cross-sectional studies were considered eligible for inclusion. Given the heterogeneity of the studies, meta-analysis was not carried out.**

***Results*: The cumulative incidence of stroke ranged from 105 to 152/100,000 persons per year, and the crude prevalence of stroke ranged from 44.29 to 559/100,000 persons in different parts of the country during the past decade. These values were higher than those of high-income countries.**

***Interpretation & conclusions*: A paucity of good-quality epidemiological studies on stroke in India emphasizes the need for a coordinated effort at both the State and national level to study the burden of stroke in India. Future investment in the population-based epidemiological studies on stroke would lead to better preventive measures against stroke and better rehabilitation measures for stroke-related disabilities in the country.**

Key words Epidemiology - incidence - prevalence - stroke - systematic review

Stroke is a major global public health problem. According to the Global Burden of Diseases (GBD) study in 1990, stroke was the second leading cause of death worldwide[1]. Subsequent efforts to update the GBD study reported nearly 5.87 million stroke deaths globally in 2010, as compared to 4.66 million in

1990[2,3]. This indicated a 26 per cent increase in global stroke deaths during the past two decades. With the rising proportion of mortality, stroke still remains the second leading cause of death worldwide[2,3].

According to the estimates from the GBD study in 2001, over 85 per cent of the global burden of stroke was borne by low- and middle-income countries (LMICs)[2]. Given the lack of reliable reporting mechanisms and disease or death registration systems in LMICs, the epidemiological findings from the GBD study for most of the LMICs are likely to be underestimates[4].

A global systematic review of population-based stroke studies has documented that the incidence rate of stroke in LMICs has increased from 56/100,000 person-years during 1970-1979 to 117/100,000 person-years during the period 2000-2008[5]. This study has also reported a decrease in the stroke incidence from 163 per 100,000 person-years in 1970-1979 to 94 per 100,000 person-years during 2000-2008 in high-income countries (HICs)[5] indicating approximately 42 per cent decrease in stroke incidence in HICs and more than double increase in stroke incidence in LMICs, during the past four decades[5].

India has been experiencing significant demographic, economic and epidemiological transition during the past two decades[6]. These have resulted in an increase in life expectancy and consequently an increase in ageing population[7]. Reliable morbidity and mortality estimates for stroke in India are very limited[8-12]. In addition, available research information on the epidemiology of stroke in India suffers from various methodological flaws such as small and variable sample sizes, inconsistent diagnostic criteria, different case definitions and survey strategies. Most of these studies are cross-sectional, and the primary objectives of these studies are also diverse[8-12].

Given the paucity of data and lack of reliable reporting mechanisms, understanding the epidemiology of stroke in India is challenging. Hence, we conducted a systematic review of epidemiological studies of stroke in India with an objective to investigate the incidence and prevalence of stroke in India and understand the true magnitude of the problem.

Material & Methods

The structured format outlined in the Cochrane Handbook for systematic reviews[13] was used.

Criteria for selecting studies for this review: Any population-based, cross-sectional studies and cohort studies that investigated the prevalence and incidence of stroke in India were included in the review. Since it is very difficult to define the exact catchment area of the population in hospital-based registries and studies, information from these studies was included only for discussion. Studies with participants of any age group diagnosed with stroke as defined by the World Health Organization (WHO)[14] were considered. Studies that reported stroke incidence rate or cumulative stroke incidence and/or prevalence of stroke were included.

Search methods for identification of studies: Five electronic databases (Ovid, PubMed, Medline, Embase and IndMED) were searched using appropriate Medical Subject Heading (MeSH) terms to identify relevant publications. The initial search was conducted in 2012, and an updated search was conducted in November 2014 and December 2015.

Studies published in English between January 1960 and December 2015 was considered. Some of the earlier studies (1960-1990) used different case definitions, survey methods and data presentation. Hence, studies published between January 1990 and December 2015 that used the WHO case definition for stroke, were included. The reference lists from retrieved studies were also checked to identify additional studies. Literature was also searched from Proceedings of stroke Conferences, Google, Indian English-language newspapers and print media.

Data collection and analysis: The searches were done using the following terms: stroke, isch(a)emic stroke, intracerebral, intraparenchymal, subarachnoid, h(a) emorrhage, population-based, community-based, community, epidemiology, incidence, attack rates, survey, surveillance, mortality, morbidity, fatality, case-fatality, trends. Two authors independently screened the titles, abstracts and full-texts of the identified studies. The same authors independently assessed the methodological quality of the included studies. To carry out this assessment, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement was used[15]. A third author was available to address any disagreement between the two authors. The flowchart explaining the study selection process according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement[16] is provided in the Figure.

Results

The search retrieved a total of 3221 relevant records. After removing duplicates, 3079 records

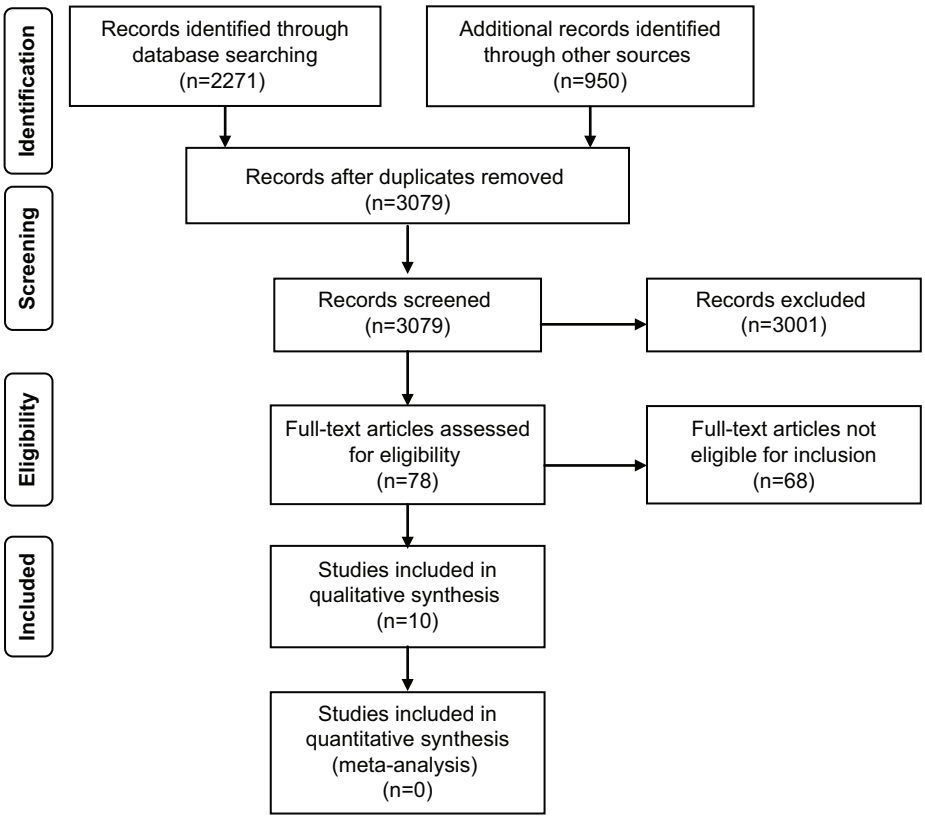

Figure. Study identification and selection process for the review.

were identified for screening. Following independent screening, 78 records were selected that were eligible for full-text review. After reviewing the full text of these 78 records, we identified 10 population-based cross-sectional studies were identified that met our inclusion criteria. The remaining 68 were not eligible for inclusion because they were not population-based. Of these 68 studies that were excluded, four studies were hospital-based. Only one cohort study was identified in our search and study selection process.

Description of included studies: Ten studies that met the inclusion criteria were included for the review[17-26]. Of these 10 studies, two estimated the prevalence of neurological disorders including stroke[17,18], two estimated both incidence and prevalence of stroke[19,20], two exclusively looked at cumulative stroke incidence[21,22], two studies looked exclusively at stroke prevalence[23,24] and two studies looked at stroke mortality[25,26].

There were substantial variations in the sample size, survey methods and case definition among the included studies. Given the heterogeneity among the included studies, meta-analysis was not carried out and findings from these studies were summarized as a narrative. The results of the included studies are provided in Table I.

Of the 10 studies included in the review, three were from Kolkata[19,20,25], the capital city of West Bengal, three studies were from Mumbai[21,23,24], the capital city of Maharashtra, one study from Gadchiroli, a rural region in Maharashtra[26], one study from Rohtak in Haryana[20], one from Srinagar in Kashmir[18] and one from Bengaluru in Karnataka[17]. One study looked at stroke prevalence in both urban and rural context[17] and another looked at stroke mortality in a rural context[26]. All other studies were conducted in urban areas[18-24].

Outcomes

Incidence of stroke in India: Five of the studies included in the review estimated cumulative stroke incidence - three in urban Kolkata[19,20,25] and two in Mumbai[23,24]. In the three Kolkata studies, ascertainment of new stroke cases was through a two-stage survey. The first stage was a door-to-door survey in a defined target population conducted by trained field investigators (who asked about the occurrence of stroke in the

Table I. Incidence and prevalence of stroke in India - details from studies included

Study	Year	Location	Sample size	Mean age of population in yr (range)	Number of cases of stroke identified	Cumulative incidence/ 100,000 people	Age-adjusted cumulative incidence/ 100,000 people	Crude prevalence/ 100,000 people	Age-adjusted prevalence/ 100,000 people	WHO STEP
Gourie-Devi *et al*[17]	1993-1995	Bangalore, Karnataka	102,557	Age range (<15-61+)	154	-	-	150 Rural-165 Urban-136	262	3
Banerjee *et al*[19]	1998-1999	Kolkata, West Bengal	50,291	Age range (20-90+)	74	36	105	147	334	3
Salaam[18]	1999-2000	Srinagar, Jammu & Kashmir	10,368	>55	58	-	-	559	-	3
Dhamija *et al*[22]	2000	Rohtak, Haryana	Urban-79,046 Rural-51,165	Male: 61.6 Female: 59.0	Urban-35 Rural-23	-	-	Urban-44.28 (CI±1.43) Rural-44.95 (CI±1.8)	109	3
Das *et al*[20]	2003-2005	Kolkata, West Bengal	52,377	>60 (11-17%)	247	123.15 (102.46-232.50)	145 (120-175)	472 (415-534)	545	3
Dalal *et al*[23]	2005-2006	Mumbai, Maharashtra	156,861	Age range (25-94+)	521	145 (120-170)	152 (132-172)	-	-	1, 2 & 3
Mukhopadyay *et al*[21]	2006-2008	Mumbai, Maharashtra	1726	66.0 (60-105)	66	-	-	3.82/100 (3.01-4.84)	4.87/100 (3.76-6.23)	3
Dalal *et al*[24]	2009	Mumbai, Maharashtra	174,398	Age range (25-94+)	223	127.8 (110-150)	137 (119-155)	-	-	1, 2 & 3
Ray *et al*[25]	2003-2010	Kolkata, West Bengal	100,802	Age range (40-85+)	763	-	141 (114-171)	-	-	2 & 3
Kalkonde *et al*[26]	2011-2013	Gadchiroli, Maharashtra	94,154	Age range (<25->85)	229 Stroke deaths	-	-	-	-	2

household during the past six and 12 months) and the second stage was a confirmatory clinical examination performed by a senior neurologist. Computerized tomography (CT) reports, if available, were used by a neurologist to confirm the diagnosis in these studies.

The first study was conducted in Kolkata during 1998-1999[19]. The age-adjusted cumulative incidence of stroke in this study was estimated to be 105/100,000 people per year. Stroke incidence was higher among women and people aged 40 yr and older. Only those who survived a stroke were counted in the survey, and the study population was surveyed only once during the specified period (household surveyed in the early part of the year were not rechecked in the later part of the year).

The second study was conducted in Kolkata during the years 2003-2005[20]. The age-adjusted cumulative incidence of stroke was estimated to be 145/100,000 people per year. There was progressive increase in stroke incidence as age increased. Cumulative incidence of stroke was higher among women (178/100,000) compared to men (117/100,000). However, confirmatory CT diagnosis was available only for 51 per cent of the identified new cases, and only one-tenth of the new cases had death certificates to identify the exact cause of death.

The first ever longitudinal study on stroke was conducted during 2003-2010 in Kolkata[25]. This study was aimed at investigating stroke mortality and other long-term outcomes post-stroke in a cohort of population living in a well-defined urban area in Kolkata. The bi-annual, cross-sectional survey conducted every year during the study period by a trained survey team helped in identifying the stroke survivors within the target population. A cohort of 763 first ever stroke (FES) cases and 278 recurrent stroke cases (total - 1041) were identified during the survey and were followed up. The age-adjusted, annual cumulative stroke incidence was 141/100,000 persons. The overall stroke mortality was 59 per cent in the first five years and 61 per cent at seven years. This study reported significant proportion of early stroke mortality compared to developed countries. Men were at greater risk of death due to stroke than women in this study.

Two studies estimated cumulative incidence of stroke in a well-defined geographic area in Mumbai at two different time periods. As a part of the Mumbai stroke registry surveillance using the WHO STEPwise approach to surveillance (STEP) guidelines, Dalal *et al*[23] conducted a two-year survey (January 2005 to December 2006) in a defined geographical area. The survey included all three WHO STEP to surveillance[23]. The age-standardized cumulative incidence of FES in this study was 152/100,000 persons per year. The age-standardized cumulative stroke incidence among men and women in this study was 162 and 141 per 100,000 persons per year, respectively. Two-thirds (67.2%) of the FES cases in this study were identified at hospital facilities (WHO Step-1). The resurvey was conducted in the same district in 2009 by the same team and using the identical protocol that was used before[24]. The age-standardized cumulative incidence of FES in the re-survey was 137/100,000 persons per year.

Overall, the annual cumulative incidence of stroke reported in the studies conducted in urban Kolkata[19,20,25] ranged from 105 to 145/100,000 persons between 1998 and 2005. The age-standardized cumulative annual incidence of stroke in Mumbai[23,24] was 152/100,000 persons in 2005 and 137/100,000 persons in 2009 Given the heterogeneity among these studies, the results of these studies were not combined.

Prevalence of stroke in India: Six population-based cross-sectional studies were identified that estimated the prevalence of stroke[17-22]. A population-based survey of neurological disorders in Bengaluru during 1993-1995 had systematically identified prevalent stroke cases from a defined urban and rural area[17]. The age-adjusted prevalence of stroke in this study was 262/100,000 persons (Table I). Prevalence of stroke in rural areas was higher (165/100,000) compared to urban areas (136/100,000). The two Kolkata-based studies[19,20] showed a rising trend in the prevalence of stroke, with 262/100,000 persons affected during 1993-1995, 334/100,000 persons in 1999 and 545/100,000 in 2005.

A two-year survey (2006-2008) was conducted at Dharavi in Mumbai to study the prevalence of stroke and post-stroke cognitive impairment in the elderly[21]. It was a multi-stage survey using the WHO screening tool for stroke with minor modification. The age-standardized stroke prevalence in this study was 4.87/100 persons. The stroke prevalence in men was 6.74/100 persons, which was almost twice the level observed in women (3.48/100 persons). Given the participant inclusion criteria, findings from this study indicated the prevalence of stroke only in the elderly (≥60 yr).

Prevalence of neurological disorders was studied in Ganderbal block, a rural area in Srinagar, the capital of

Jammu and Kashmir[18]. This survey was conducted in two stages for about five months between October 1999 and March 2000. This study showed that the crude prevalence of stroke in Ganderbal block was 559/100,000 persons. Seventy four per cent of the stroke survivors identified in the survey had haemorrhagic stroke.

Prevalence of stroke was also studied in Rohtak in Haryana in 1974[22] and the same population was re-surveyed 15 yr later in 1999[22]. The crude prevalence of stroke was 44.28/100,000 persons in the 1999 study[22]. Prevalence of stroke in men (46.78/100,000 persons) was higher than women (41.52/100,000 persons). Prevalence of stroke in urban and rural population was similar. The overall stroke prevalence in this study[22] was 7.20 per cent lower than the survey conducted 15 yr before in the same area[22].

Stroke was found to be the leading cause of mortality in a rural tribal area called Gadchiroli in Maharashtra, India[26]. A death audit conducted in this remote rural region of India during 2011-2013 using verbal autopsy method estimated nearly 14.3 per cent (229) deaths due to stroke out of 1599 total deaths. Stroke was the most frequent cause of death with an age-adjusted stroke mortality rate of 192/100,000 persons in this cross-sectional study. Nearly 87 per cent of the stroke deaths reported occurred at home and 45 per cent of the stroke deaths occurred within the first 30 days of the onset of stroke symptoms. However, this mortality audit was conducted using verbal autopsy method. Given the lack of imaging facilities in the study region, CT scans were not available in most of the cases to confirm the cause of death during the audit.

Information from hospital-based studies on stroke: Given the insufficient number of population-based studies, information from hospital-based studies was also reviewed. Hospital-based registries for stroke in India have estimated cumulative stroke incidence based on the WHO STEPs[27] guidelines (Table II)[28-31]. Hospital-based stroke registries at Chennai and Bengaluru have not described the catchment population, and hence, it was not possible to calculate cumulative incidence of stroke from these studies[28,29]. The Trivandrum (Thiruvananthapuram) stroke registry estimated cumulative stroke incidence from a convenient urban and rural sample[30]. However, most of the rural patients did not report at the selected hospital sites in this study. The Ludhiana stroke registry estimated an age-adjusted cumulative stroke incidence of 155/100,000 people during the year 2011[31].

Methodological quality assessment: Methodological details of the studies were not completely reported in the included studies. Three studies[18,23,24] did not report how participants for the survey were selected. Only four studies[17-20] reported the use of quality control procedures for case detection, in terms of confirmatory diagnosis by a neurologist and also by the CT scan. Two studies[25,26] used verbal autopsy procedure to estimate stroke mortality, but CT scan reports and death certificates were sparsely available to confirm the diagnosis of stroke in these studies.

Two studies[23,24] that followed the complete WHO STEPs surveillance method did not report about the ways, in which stroke mortality was calculated, especially when the cause of death was not mentioned in the death registers. These studies did not report the ways in which hospital-based information, mortality statistics and the survey information were combined to arrive at the stroke estimates.

Methods of case ascertainment also varied among the studies included in the review. In terms of case

Table II. Age-adjusted cumulative stroke incidence and the number of new stroke cases from stroke registries

Place	Number/Types of hospitals within the registry	Period of the study	Duration of surveillance (months)	WHO STEPs stage	Catchment population	Number of new cases or age-adjusted cumulative incidence/100,000 people
Chennai[28]	Two private hospitals	2003-2004	12	Step 1	Not known	402 cases
Bangalore[29] (Bengaluru)	One government, two private hospitals	2005	Six	Step 1 and 2	Not known	1,174 cases
Trivandrum[30] (Thiruvananthapuram)	Group of hospitals in rural & urban in catchment area	2005	Six	Step 1 and 2	Rural - 185,000 Urban - 741,000	Rural - 138 Urban - 135
Ludhiana[31]	Major hospitals, scan centres, general practitioners	2011	12	Step 1 and 2 (modified)	Urban - 1,398,467	155 cases

Table III. Methodological quality of the studies included in the review

Study	Specific objective	Study design	Method of participants selection described	Data sources	Efforts to address source of bias	Explanation on sample size estimation	Limitations discussed	Generalisability of the findings
Kalkonde *et al*[26]	To measure mortality burden of stroke	Cross-sectional	Yes	Survey	Large sample size; Systematic sample selection and piloting verification of study procedures	Yes	Yes	May be generalisable to rural areas with similar demographic characteristics
Ray *et al*[25]	To assess stroke incidence, case fatality and survival trends in a metropolitan city	Longitudinal	Yes	Survey	Large sample size; Study quality control measures taken	Yes	Yes	May be generalisable to only First Ever Strokes from an urban area in cities with similar demographic characteristics
Mukhopadyay *et al*[21]	To determine the prevalence of stroke in urban slum-dwellers aged 60 years and above	Cross-sectional	Yes	Survey	Large sample size; Study quality control measures taken	Yes	Yes	May be generalisable to urban slum dwellers aged 60 and above in cities with similar demographic characteristics
Dalal *et al*[24]	To calculate the incidence of First Ever Strokes during a resurvey	Cross-sectional	No	Survey	No	No	No	May be generalisable to only First Ever Strokes from an urban area in cities with similar demographic characteristics
Dalal *et al*[23]	To describe observations made during a survey using WHO STEPs tool	Cross-sectional	No	Survey	No	No	2/3rd of the cases identified were from hospitals and not the community.	May be generalisable to only First Ever Strokes from an urban area in cities with similar demographic characteristics
Das *et al*[20]	To determine the incidence and prevalence and case fatality rates of stroke	Cross-sectional	Yes	Survey	Large sample size; Study quality control measures taken	Yes	Yes	May be generalisable to urban areas in cities with similar demographic characteristics
Gourie-Devi *et al*[17]	To determine the prevalence and pattern of neurological disorders in urban and rural areas	Cross-sectional	Yes	Survey	Large sample size; Systematic sample selection and piloting verification of study procedures	Yes	No	May be generalisable to urban & rural areas of cities with similar demographic characteristics
Salaam[18]	To determine the prevalence of all neurological disorders	Cross-sectional	No	Survey	No	Yes	No	May be generalisable for people aged over 14 in rural areas with similar demographic characteristics

Contd...

Study	Specific objective	Study design	Method of participants selection described	Data sources	Efforts to address source of bias	Explanation on sample size estimation	Limitations discussed	Generalisability of the findings
Banerjee *et al*[19]	To determine the prevalence and incidence of stroke in urban Kolkata	Cross-sectional	Yes	Survey	The sensitivity of the screening method (72%) was not satisfactory	No	Yes	May be generalisable to urban areas in cities with similar demographic characteristics
Dhamija *et al*[22]	Prevalence of stroke	Cross-sectional	Yes	Survey	No training for data collection	No	Yes	May be generalisable for people aged over 20 in cities with similar demographic characteristics

definitions, some studies included only FES; some included all kinds of strokes. Some studies included only the stroke survivors and a few studies included those who died of a stroke as well. Table III summarizes the methodological quality of all the studies included.

Discussion

Our review showed that the crude stroke prevalence in different parts of India ranged from 44.29 to 559/100,000 persons during the past two decades. The cumulative incidence of stroke in India ranged from 105 to 152/100,000 persons per year during the past two decades in different parts of the country.

These estimates on stroke incidence and prevalence are found to be higher than those of HICs[5,32]. In a global systematic review on stroke epidemiology, the age-adjusted stroke incidence rate in HICs was reported to be 94/100,000 person-years during the 2000-2008[5]. This review reported a decrease in stroke incidence by 42 per cent during the past four decades in HICs (163/100,000 person-years during 1970-1979) and an increase by 100 per cent in LMICs[5] (*i.e.* from 52/100,000 person-years in 1970-1979 to 117/100,000 person-years in 2000-2008). Information from the studies included in this review showed that the cumulative stroke incidence reported in two major metropolitan cities of India (Mumbai and Kolkata) was much higher than what has been reported in HICs[5]. Early stroke mortality rates were also higher compared to HICs[25,26]. The case fatality was 42 per cent within a week in one study conducted in urban India[25] and 46 per cent in another study conducted in rural India[26]. Thus, the findings from the global stroke review and other studies related to stroke support our findings.

Only two studies[23,24] included in the review, followed all three steps of the WHO STEPs guidelines for stroke surveillance[27]. The remaining studies could have only identified individuals who survived a stroke and not those who died due to stroke in their survey. However, there has been some effort to identify the cause of death using verbal autopsy procedures. Given the lack of reliable information from death registers on the cause of death in India[33-35], estimates on stroke mortality even in those two studies[23,24] that followed WHO STEPs guidelines may not necessarily be true estimates. Hence, it is assumed that the results from included studies may probably be gross underestimates of stroke incidence and prevalence in India. There are no referral pathways and systematic care for

stroke survivors organized by the government health services in the country[33-35]. Therefore, calculating stroke incidence and prevalence using data available from hospital-based stroke registers might not provide reliable estimates[8-12,35-37].

Most of the studies included in this review were conducted in urban metropolitan cities. Possible reason for this could be the logistical convenience and availability of resources and trained personnel in these cities[29]. Of the 10 studies included in this review, only two studies looked at the urban-rural distribution and stroke prevalence. Only one study looked at stroke mortality in a rural region of India. Given the demography characteristics of India, where close to 80 per cent of the population live in rural settings, it is important to investigate the epidemiology of stroke in rural regions of India rather than cities alone. This could provide more reliable estimates on the magnitude of the problem in India[8-12,32,38].

In the light of relatively few numbers of studies and the variation in their study methods, it would not be possible to generalize the findings from the included studies to the entire country. All studies were cross-sectional except one which estimated stroke mortality and not incidence or prevalence. Studies included in the review were heterogeneous in terms of their participant selection, case definition and survey methodology. Hence, a comprehensive meta-analysis was not possible.

In the light of scarce and variable data regarding stroke epidemiology from India, it is imperative that more efforts are directed at data acquisition and analysis. Stroke registries can act as important reservoirs of such information. Although there has been some effort in certain hospitals to understand stroke epidemiology through hospital-based registries, it is important to initiate a government-regulated, State and national population-based stroke registry in India. These registries could include all possible stroke detection facilities and ensure real-time documentation of stroke in these facilities[39], which would benefit the community as (*i*) Epidemiological information obtained from population-based registries can be used to enable evidence-informed advocacy and policy changes for the allocation of funds for stroke-related programmes[35]; (*ii*) Since the management of stroke varies according to aetiology, the data on risk factors and most prevalent stroke subtypes would guide in the preparing stroke treatment protocols according to the prevalence of various aetiologies/risk factors in a community[40,41]; and (*iii*) The data on case fatality would facilitate evaluation of standards and efficacy of acute post-stroke treatment[5].

In conclusion, there is a paucity of epidemiological studies on stroke in India which emphasizes the need for a focussed, coordinated effort at the State and national level to study the extent of stroke in India. This would facilitate planning policies and programmes for primary prevention of stroke and address the existing magnitude of stroke-related disability in the country. Given the disabling nature of the condition and available evidence on the silent stroke epidemic in India, the rehabilitation needs of the stroke survivors are also expected to be high. Thus, future investment in the study of epidemiology of stroke in India would lead to the development of better preventive measures against stroke and related mortality. It can also enhance organizing cost-effective stroke care services and better rehabilitation measures to address the unmet needs of the stroke survivors which are expected to be varied and substantial.

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***Conflicts of Interest*:** None.

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