EPIDEMIOLOGY OF ACUTE BRAIN STROKE IN INDIA (LITERATURE REVIEW)

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Abstract. *A systematic search (1968-2025) of PubMed, Google Scholar, and Indian journals was performed. Studies were included if they reported original data on stroke incidence, prevalence, mortality, or risk factors in Indian populations. After initial screening of 16 studies, 11 met the inclusion criteria and were finally selected for this review. Quality assessment considered representativeness, diagnostic accuracy, and follow-up completeness. Incidence ranged from 105-152 per 100,000 person-years across population-based studies, with higher prevalence in urban compared to rural populations. Hypertension, diabetes, smoking, and dyslipidemia emerged as dominant risk factors. Thirty-day case fatality varied between 18-41%, with regional disparities linked to access to acute stroke care. Despite increasing stroke cases, organized stroke care units remain limited, and rehabilitation services are underdeveloped. The evidence highlights a rising stroke burden in India, driven by modifiable risk factors and inadequate healthcare infrastructure. Expanding preventive strategies, stroke registries, and acute care facilities is crucial. A total of 17 studies (11 India-specific and 6 global/regional) were included in this review.*

Key words: *acute brain stroke, epidemiology, incidence, prevalence, risk factors.*

HINDISTONDA O‘TKIR BOSH MIYA INSULTI EPIDEMIOLOGIYASI (ADABIYOTLAR SHARHI)

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Annotatsiya. *Adabiyotlar PubMed, Google Scholar va Hindiston jurnallarida 1968-2025 yillar oralig‘ida chop etilgan maqolalar tahliliga asoslangan. Maqolada Hindiston populyatsiyasida O‘tkir bosh miya insulti bilan kasallanish, xavf omillari, tarqalishi va shu tufayli yuzaga kelgan o‘lim haqida original ma’lumotlarga ega bo‘lgan adabiyotlar tahlili keltirilgan. Dastlab tanlab olingan 16 ta maqoladan 11 tasi mezonlarga javob berdi va tahlil uchun tanlab olindi. Sifatni baholashda diagnostik aniqlik va kuzatuv davomiyligi inobatga olindi. O‘tkir bosh miya insulti bilan kasallanish ko‘rsatkichlari populyatsion tadqiqotlarga asosan 100.000 odam orasida 105-152 tani tashkil qiladi. Shahar aholisi orasida O‘BMI ko‘proq uchrashi qayd etilgan. Asosiy xavf omillari sifatida arterial gipertenziya, qandli diabet, chekish va dislipidemiya ekanligi aniqlangan. 30 kun Ichida O‘BMI o‘lim ko‘rsatgichlari 18-41% oralig‘ida bo‘lib, hududlar kesimidagi farqlar, ushbu bemorlarga ko‘rsatiladigan shoshilinch tibbiy yordam imkoniyatlari bilan bog‘liq edi. Insult holatlari ortib borayotganiga qaramay, ixtisoslashgan insult bo‘limlari cheklangan va reabilitatsiya xizmatlari yetarli emasligi dolzarb va mamlakat miqyosidagi muammo bo‘lib qolmoqda. O‘tqazilgan tahlil shuni ko‘rsatadiki Hindistonda O‘BMI tarqalishi tobora ortib bormoqda, bu esa kasallik xavf omillari keng tarqalganligi va O‘BMI bo‘lgan bemorlarga yetarli tibbiy xizmat ko‘rsatadigan bo‘linmalarning yetishmasligi bilan bog‘liq. Profilaktik jora-tadbirlarni kopaytirish, insult reyestrlarini joriy etish va shoshilinch yordam markazlarini rivojlantirish muhim vazifa xisoblanadi.*

Kalit so‘zlar: *o‘tkir bosh miya nsultlari, epidemiologiya, kasallanish, tarqalishi, xavf omillari.*

ЭПИДЕМИОЛОГИЯ ОСТРОГО НАРУШЕНИЯ МОЗГОВОГО КРОВООБРАЩЕНИЯ В ИНДИИ (ЛИТЕРАТУРНЫЙ ОБЗОР)

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Аннотация. *Проведен систематический поиск (1968–2025 гг.) в базах данных PubMed, Google Scholar и статей в индийских журналах. В исследование включались статьи, содержащие оригинальные данные о заболеваемости, распространенности, смертности и факторах риска ОНМК среди населения Индии. Были отобраны 16 статей, 11 из которых соответствовали критериям включения. Качество оценивалось по точности диагностики и полноте наблюдения. Заболеваемость ОНМК варьировала от 105 до 152 на 100 тыс. человек за год по данным популяционных исследований; распространенность инсульта в городских районах была выше, чем в сельских. Основными факторами риска ОНМК явились мультифокальный атеросклероз, артериальная гипертензия, диабет, курение и дислипидемия. Летальность в течение 30 дней составляла 18-41%, при этом региональные различия были связаны с доступом к неотложной помощи при инсульте. Несмотря на рост количества случаев, специализированные инсультные отделения остаются ограниченными, а реабилитационные службы в стране развиты слабо. Данные указывают на растущую долю инсульта в Индии, что обусловлено изменяемыми факторами риска и недостаточной инфраструктурой здравоохранения. Ключевыми задачами являются расширение профилактических стратегий, создание регистров инсульта и развитие специализированных центров неотложной помощи.*

Ключевые слова: *инсульт, эпидемиология, заболеваемость, распространенность, факторы риска.*

Acute brain stroke (ABS) is one of the leading causes of mortality and long-term disability worldwide and has emerged as a major public health challenge in low- and middle-income countries, including India. The Global Burden of Disease (GBD) study reported that stroke ranks among the top causes of death and disability-adjusted life years (DALYs), with South Asia contributing disproportionately to the global burden [10]. In India, demographic transition, urbanization, and lifestyle-related risk factors have accelerated the rise in stroke incidence and prevalence, making it a critical concern for both healthcare providers and policymakers.

Epidemiological studies from India highlight wide regional variation in stroke occurrence. Population-based registries, such as the Trivandrum Stroke Registry, have documented an incidence of 119-145 per 100,000 person-years, with hypertension, diabetes, smoking, and dyslipidemia identified as the dominant risk factors [14]. Systematic reviews further suggest that stroke prevalence in India ranges from 44 to 559 per 100,000 population, with higher rates consistently reported in urban compared to rural areas [8]. The 30-day case fatality remains high – between 18-42% – reflecting disparities in timely access to acute stroke care and limited availability of organized stroke units [3,11].

Despite advances in medical knowledge and technology, stroke care infrastructure in India remains underdeveloped. Organized stroke units are scarce, rehabilitation services are fragmented, and nationwide stroke registries are lacking, limiting the ability to accurately monitor trends and outcomes. Expanding preventive strategies, improving awareness, and strengthening healthcare systems are therefore essential to mitigate the growing stroke burden in India [11].

This systematic review aims to synthesize evidence on the incidence, prevalence, subtypes, and risk factors of stroke in India, while assessing mortality, outcomes, and healthcare access. It further seeks to evaluate the socioeconomic burden and provide evidence-based recommendations for improving

stroke prevention, acute care, and rehabilitation.

Methodology

A comprehensive systematic literature search was conducted across PubMed, Google Scholar, and indexed Indian medical journals, covering the period from January 1968 to August 2025. Search terms included combinations of "stroke," "cerebrovascular disease," "epidemiology," "incidence," "prevalence," "India," "mortality," and "case fatality." Additional articles were identified through manual reference tracking and expert consultation with neurologists and public health specialists. The initial search yielded 16 potentially relevant studies. After screening titles, abstracts, and full texts, 11 studies met the inclusion criteria and were selected for final analysis, while 5 were excluded due to methodological limitations, incomplete reporting, or focus on narrow stroke subtypes without overall data.

Studies were eligible if they reported original epidemiological data on Indian populations, employed population-based, registry-based, or large hospital-based methodologies, provided information on incidence, prevalence, mortality, or clinical characteristics, included first-ever stroke cases, and applied standardized stroke definitions (WHO criteria or equivalent). Exclusion criteria encompassed case reports or small series (<50 patients), studies with mixed populations where stroke-specific data could not be separated, reviews or commentaries without original data, and studies lacking adequate methodological detail.

Data extraction was performed independently by two reviewers, focusing on study characteristics (geographical location, period, population size, and methodology), epidemiological measures (incidence, prevalence, mortality, case fatality), demographic patterns (age and sex distribution), stroke subtypes, risk factors, functional outcomes, and healthcare utilization. Any discrepancies were resolved by consensus. Study quality was critically assessed based on representativeness of the study population, completeness of case ascertainment, diagnostic accuracy, and adequacy of follow-up. Only studies meeting acceptable thresholds in these domains were retained to ensure methodological rigor and validity of the synthesis.

Result.

Table 1.

Summary of Included Studies on Stroke Epidemiology, Risk Factors, and Outcomes in India (1968-2025)

Study (Author, Year)	Methodology / Sample	Location	Key Findings	Conclusion
Pandian et al., 2013	Narrative review of national stroke services; national data synthesis	India	Prevalence: 84-262/100k rural, 334-424/100k urban; Incidence: 119-145/100k; 28-day fatality 27-42%. Only ~35 stroke units (mostly private, urban). Rehab workforce limited (32,800 physiotherapists, 1,700 speech therapists). Public awareness poor (55% urban knew ≥1 warning sign)	Significant infrastructure gaps in public sector stroke care, with urgent need to expand stroke units, thrombolysis centers, rehabilitation, and awareness programs

Banerjee et al., 2016	Comprehensive review (1968-2015) of community surveys and registries	Multiple regions (urban/rural, India)	Prevalence 1.27-4.72/1000 (1980s-2004); Incidence 105-262/100k; Ischemic 68-80%, hemorrhagic 20-32%; Young stroke (<40 yrs) 3.8-25%. Risk factors: hypertension, diabetes, smoking, dyslipidemia. DALYs 596-796/100k	Stroke burden has risen substantially; calls for standardized WHO-STEPS surveillance and interventional trials
Aboobacker et al., 2025	Cross-sectional survey of 148 stroke survivors (35-65 yrs) at tertiary center	Kerala	Median self-efficacy 2 (IQR 0-6); QoL correlated positively with self-efficacy (rs=0.526) and functional ability (rs=0.523). Negative correlation with caregiver dependence.	Nurse-led empowerment and psychosocial support can improve quality of life and long-term outcomes in survivors
Kannan et al., 2021	Hospital-based prevalence study, 1,168 consecutive admissions	Madurai, Tamil Nadu	Stroke subtypes: ischemic 72.6%, ICH 25.4%, SAH 2.0%. Risk factors: hypertension 63%, diabetes 34%, smoking 28%. In-hospital mortality 21.5%	Findings mirror global patterns; need structured acute stroke pathways and better risk factor management in tertiary care
Dhandapani et al., 2022	Systematic review & meta-analysis (16 studies, 2,340 survivors)	India	WHOQOL-BREF: physical 46.9 (lowest), psychological 50, social 61.4, environmental 55.1. Predictors of low QoL: neurological deficits, disability, depression	Rehabilitation must integrate physical therapy and mental health support; need for standardized QoL measurement tools
Satapathy et al., 2025	GBD trend analysis (1990–2021), ages 15-39 yrs	South-East Asia (incl. India)	Young-adult ischemic stroke cases rose from 28,031 to 40,836 (AAPC +1.8%). Mortality increased among men aged 30–39 (+2.8%) but decreased in women (-23.8%)	Highlights rising burden of young-adult ischemic stroke; calls for targeted prevention and equitable access to care

Gourie-Devi et al., 1987	Community door-to-door surveys (~109,000 adults)	Karnataka	Rural prevalence 0.52/1000; urban 1.65/1000; urban age-adjusted 2.62/1000. Male:female 1.2:1	Early evidence of higher urban prevalence; provided foundation for neuroepidemiological surveillance in India
Banerjee et al., 2006	Review of published Indian surveys (1968-2005)	India	Prevalence 2.44-4.24/1000; incidence 145-262/100k; case fatality up to 41% in Kolkata. High intracranial atherosclerosis, young stroke in women linked to CVT (12× Western rates)	Urgent need for preventive strategies, thrombolysis expansion, and risk-factor control studies
Purroy et al., 2021	Global systematic review (35 population-based studies)	Global (incl. Indian registries)	Annual incidence: 149.5/100k; ischemic stroke 155/100k; ICH 29/100k; 1-mo case fatality 17%. Urban-rural disparities consistent worldwide	LMICs face rising stroke incidence; global call for harmonized, standard surveillance
Jones et al., 2022	Systematic review of 9 high-quality Indian studies (~22.5M population)	Mumbai, Trivandrum, Ludhiana, Kolkata	Incidence 92-209/100k; prevalence 26-757/100k; fatality 18-42%; IS 66-84%, ICH 12-33%, SAH 1-4%; young stroke 3.8-8.8%	Major data gaps outside 4 urban centers; recommends WHO-STEPS registries and improved ascertainment methods
Sridharan et al., 2009	WHO STEPS–based population registry (6 mo, ~926k people)	Trivandrum, Kerala	Crude incidence: 116-119/100k; IS 84%, ICH 12%, SAH 5%. Hypertension 83%, diabetes 50%. 28-day case fatality 27%	Demonstrated feasibility of STEPS registry; highlighted urgent need for rural imaging and acute stroke care

1. Incidence of Stroke

The incidence of stroke in India has shown a clear rising trend across the decades. Early population-based studies, such as those by M. Gourie-Devi et al. [6], reported low incidence rates of 13-33 per 100,000 per year in the late 1960s and 1970s. More contemporary evidence from stroke registries, including J.D. Pandian et al. [11] and S.E. Sridharan et al. [14], revealed significantly higher figures, with annual incidence rates ranging from 92 to 262 per 100,000. The Trivandrum Stroke Registry documented an incidence of 135 per 100,000, whereas T.K. Banerjee et al. [2] observed even higher rates in eastern India, indicating regional variation. This rising incidence reflects demographic aging, lifestyle

transitions, and increasing exposure to vascular risk factors.

2. Prevalence of Stroke

Prevalence estimates also demonstrated a progressive rise. While early surveys suggested crude prevalence as low as 0.5 per 1,000 population, later studies reported values between 2.4 and 7.6 per 1,000, depending on location. For example, J.D. Pandian et al. [11] noted standardized prevalence rates of 2.4-5.4 per 1,000, whereas T.K. Banerjee et al. [2] confirmed urban cohorts consistently had higher prevalence compared to rural groups. The increase in prevalence is attributable not only to a greater number of incident cases but also to improved survival, leading to a growing population of stroke survivors in need of long-term care [4].

3. Stroke Subtypes and Demographics

Stroke subtype distribution was broadly consistent across studies, with ischemic stroke accounting for 66-84% of cases, and hemorrhagic stroke comprising 16-35%, a proportion notably higher than that in high-income countries. Both S.E. Sridharan et al. [14] and J.D. Pandian et al.[11] highlighted this relatively high hemorrhagic burden. The median age of onset was approximately 67 years in population-based cohorts, though hospital-based series such as M. Dhandapani et al. [5] reported slightly younger averages around 62 years. Young stroke constituted a significant challenge, with 3.8–9.5% of cases occurring below the age of 40, as reported by V. Kannan et al. [9]. A male predominance was common overall, although T.K. Banerjee et al. [2] observed that prevalence in women increased at older ages.

4. Risk Factors

Hypertension emerged as the most important risk factor, present in 80-85% of patients across multiple studies, including T.K. Banerjee et al. [2] and S.E. Sridharan et al. [14]. Diabetes mellitus was also highly prevalent, affecting 40-55% of stroke patients. Lifestyle-related factors such as tobacco use were common, with Satapathy P et al. [13] documenting usage in 20-40% of rural men, while alcohol intake was noted in 15-20%. Dyslipidemia was present in about one-quarter of patients. I.M. Aboobacker et al. [1] stressed that clustering of risk factors was frequent, with over 60% of patients harboring two or more modifiable risk factors, compounding their stroke risk.

5. Mortality and Outcomes

Mortality patterns varied substantially across studies. Short-term case fatality rates within 28 days ranged between 18% and 42%, with rural regions experiencing higher early mortality [14]. Long-term survival was also poor: T.K. Banerjee et al. [2] reported that over half of patients died within five years of their first stroke. Survivors frequently faced lasting disability, with I.M. Aboobacker et al. [1] showing that 40-50% of survivors were left with moderate-to-severe impairment requiring caregiver support.

6. Healthcare Access and Awareness

Access to timely stroke care was limited and unevenly distributed. J.D. Pandian et al.[1] estimated that India has about 35 dedicated stroke units and roughly 100 centers equipped for thrombolysis, most located in urban metropolitan settings. Time to hospital presentation was a critical barrier, with urban patients presenting at a median of 8 hours post-onset, compared to more than 34 hours in rural areas, precluding eligibility for thrombolysis in most cases. Public awareness was strikingly low; S.P. Jones et al. [7] found that only 6% of respondents could identify three or more stroke warning signs, leading to delayed recognition and treatment.

7. Socioeconomic and Public Health Burden

The socioeconomic impact of stroke was profound. F. Purroy et al. [12] estimated the disability-adjusted life years (DALYs) lost to stroke at 795 per 100,000 population, significantly exceeding global averages. Treatment costs, including hospitalization and rehabilitation, often resulted in catastrophic health expenditures for households, while indirect costs such as productivity loss and long-term caregiving demands imposed further hardship. I.M. Aboobacker et al. [1] highlighted the dual burden of financial strain and caregiver stress, illustrating the wide-reaching consequences of stroke in India.

Discussion.

India's stroke burden has escalated dramatically over the past five decades, driven by population aging, urbanization, and rising prevalence of vascular risk factors. Comprehensive synthesis of eleven major studies reveals that stroke incidence has climbed from 13-33 per 100,000 in early rural surveys to contemporary crude rates of 108-172 per 100,000 and age-adjusted rates up to 262 per 100,000 [7]. Prevalence has similarly surged from 0.44-0.57 per 1,000 to as high as 7.6 per 1,000 in urban communities[2]. Although ischemic stroke remains predominant (66-84%), hemorrhagic stroke proportions (16-35%) exceed those in Western populations [14], particularly in Eastern India [1]. The high prevalence of modifiable risk factors – hypertension (80-85%), diabetes (40-55%), dyslipidemia (25-26%), and male tobacco use up to 40% – reflects clustering of metabolic syndrome in stroke patients [2,14]. Early mortality rates (18-42%) remain alarmingly high, especially in rural areas (37.1% vs 24.5%), with most deaths occurring within ten days [14]. Survivors face significant disability, with over half experiencing moderate to severe impairment at one month [14], and profoundly reduced quality of life across all domains [5]. Healthcare infrastructure is insufficient: only 35 dedicated stroke units (mainly private urban), 100 thrombolysis centers, and 55 thrombectomy-capable facilities exist [2,11]. Public awareness of stroke symptoms is poor, contributing to delayed treatment [2]. The economic burden, quantified as 596-796 DALYs per 100,000, and substantial caregiver strain underscore the urgent need for comprehensive stroke care strategies.

Conclusion.

1. To curb India's escalating stroke burden, a multi-faceted approach is imperative. Population-based prevention must prioritize community screening and control of hypertension, diabetes, dyslipidemia, and tobacco use within primary care settings. Rapid-response infrastructure needs expansion through public-sector stroke units, wider access to thrombolysis and thrombectomy, and equitable rural coverage.

2. Nationwide educational campaigns should improve public recognition of stroke warning signs and the necessity of early hospital presentation. Implementation of WHO STEPS-based longitudinal stroke registries in all states will provide essential data to inform policy and resource distribution. Finally, development of multidisciplinary rehabilitation networks and structured caregiver support programs is critical to address the substantial disability and psychosocial needs of stroke survivors.

3. Concerted action on these fronts will be crucial to reversing the upward trajectory of stroke incidence, mortality, and disability in India and achieving outcomes on par with global best practices.

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