Open Access

ISSN: 2617-0817 E-ISSN: 2789-5912

Original Article

Clinical Manifestations and Risk Factors of Stroke Patients in a Tertiary Healthcare Center in Bangladesh — An Observational Study

DOI: dx.doi.org

A K S Zahid Mahmud Khan[1*], Sabina Hashem[2], A K M Monwarul Islam[1], Abdul Momen[1], Lima Asrin Sayami[1], Atikur Rahman[3], Nafis Areefin[4], Gazi Sazzad Hossain[5], Abdul Awal[6]

Received: 16 Jun 2024
Accepted: 26 Dec 2024
Published: 28 Dec 2024

Published by:
Sher-E-Bangla Medical College, Barishal, Bangladesh

*Corresponding Author

ABSTRACT

Introduction: *This study aims to evaluate the clinical profile, risk factors, and outcomes of stroke patients admitted to the Medicine Unit of Dhaka Medical College Hospital (DMCH).* ***Methods & Materials:*** *This observational cross-sectional study included 101 stroke patients diagnosed via clinical evaluation and neuroimaging. Data on demographics, clinical manifestations, laboratory parameters, and risk factors such as hypertension, diabetes, dyslipidemia, smoking, and alcohol consumption were collected. Statistical analysis was performed using SPSS to compare ischemic and hemorrhagic stroke subtypes.* ***Results:*** *Among the 101 enrolled patients, ischemic stroke was more prevalent (51%) than hemorrhagic stroke (49%). The mean age of ischemic stroke patients was 59.5 ± 13.9 years, while hemorrhagic stroke patients had a mean age of 61.0 ± 11.2 years. Hypertension was the most common risk factor (78%), followed by diabetes (46%), dyslipidemia (32%), and smoking (28%). Common clinical presentations included hemiparesis (67%), speech disturbances (43%), and altered consciousness (35%). Laboratory findings revealed significant variations in lipid profiles and electrolyte imbalances between stroke subtypes.* ***Conclusion:*** *Stroke remains a significant health concern in Bangladesh, with ischemic stroke being slightly more common than hemorrhagic stroke. Hypertension and diabetes emerged as major contributors, underscoring the need for early detection and preventive strategies. These findings highlight the necessity for improved stroke management protocols and targeted public health interventions to reduce stroke burden in Bangladesh.*

Keywords: *Stroke, Ischemic Stroke, Hemorrhagic Stroke, Risk Factors, Bangladesh, Clinical Profile*

(The Planet 2024; 8(1): 118-123

1. *Assistant Professor, Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh*
2. *Professor, Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh*
3. *Assistant Registrar, Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh*
4. *Registrar, Department of Medicine, Shaheed Ziaur Rahman Medical College Hospital, Bogura, Bangladesh*
5. *Emergency Medical Officer, BIHS General Hospital, Dhaka, Bangladesh*
6. *Associate Professor, BIHS General Hospital, Dhaka, Bangladesh*

INTRODUCTION

Stroke is a major public health concern worldwide, representing one of the leading causes of disability and mortality [1]. It is a cerebrovascular event characterized by the sudden loss of neurological function due to an interruption in cerebral blood supply [2, 3]. According to the World Health Organization (WHO), stroke accounts for approximately 13% of total deaths globally, with an increasing burden in low- and middle-income countries[4, 5]. The Global Burden of Disease (GBD) study estimates that between 70% and 87% of stroke-related deaths and disabilities occur in developing nations, including Bangladesh[5]. In Bangladesh, stroke has emerged as a significant contributor to hospital admissions and long-term disability, exerting a profound economic and social impact on affected individuals and their families[6]. The rising prevalence of modifiable risk factors such as hypertension, diabetes mellitus, smoking, and sedentary lifestyles has further escalated the burden of stroke in the country, necessitating targeted research and intervention strategies [7].

Stroke can be broadly classified into two major types: ischemic stroke and hemorrhagic stroke, each with distinct etiologies, pathophysiological mechanisms, and clinical presentations[8]. Ischemic stroke, which accounts for approximately 87% of all strokes worldwide, occurs due to an obstruction of blood flow in a cerebral artery, typically caused by thromboembolism or atherosclerosis. It leads to neuronal ischemia and infarction, resulting in focal neurological deficits such as hemiparesis, aphasia, and visual disturbances[8]. Hemorrhagic stroke, on the other hand, is caused by the rupture of a blood vessel in the brain, leading to intracerebral or subarachnoid hemorrhage[9]. Although hemorrhagic stroke is less common, it is often associated with higher morbidity and mortality due to the rapid expansion of hematoma and increased intracranial pressure [10]. Differentiating between

ISSN: 2617-0817 E-ISSN: 2789-5912

these two subtypes is critical, as their management approaches vary significantly; ischemic strokes benefit from thrombolytic therapy, while hemorrhagic strokes often require surgical intervention or strict blood pressure control[11].

Despite the increasing incidence of stroke in Bangladesh, there remains a significant gap in comprehensive data regarding its clinical presentation, associated risk factors, and outcomes. Stroke is often underdiagnosed and inadequately managed due to limited healthcare resources, delayed hospital admissions, and lack of standardized treatment protocols [12]. Identifying the clinical profile and risk factors of stroke patients in Bangladesh is essential for early detection, effective management, and prevention of recurrent strokes. Furthermore, the epidemiology of stroke in Bangladesh may differ from that of developed countries due to variations in genetic predisposition, dietary habits, healthcare accessibility, and socioeconomic conditions. A detailed understanding of stroke patterns can aid in developing region-specific guidelines, improving hospital-based care, and formulating public health policies to mitigate the long-term burden of stroke in the country.

The primary objective of this study is to evaluate the clinical profile of stroke and its subtypes among patients admitted to the Medicine Unit of Dhaka Medical College Hospital (DMCH). Specifically, the study aims to differentiate the presentation, severity, and outcomes of ischemic and hemorrhagic strokes based on demographic, clinical, and laboratory parameters.

The secondary objectives include assessing the associated risk factors contributing to stroke occurrence and recurrence, with a particular focus on hypertension, diabetes, dyslipidemia, and other comorbidities. Additionally, the study seeks to provide basic health education to stroke patients and their families regarding preventive strategies, lifestyle modifications, and adherence to medical therapy to reduce future stroke risk. Through these objectives, the study aims to generate valuable insights that can guide clinicians, policymakers, and public health professionals in designing more effective stroke prevention and management strategies in Bangladesh.

MATERIALS and METHODS

Study Design

This study was designed as an **observational cross-sectional** investigation conducted at the Medicine Unit of Dhaka Medical College Hospital (DMCH). The primary objective was to assess the clinical profile and associated risk factors of stroke patients admitted to the hospital. Ethical approval was obtained from the institutional review board, ensuring compliance with guidelines for human research. Additionally, informed consent was obtained from either the patients or their legal guardians before data collection.

Study Population and Sampling

The study population consisted of stroke patients admitted to DMCH, with diagnoses confirmed through clinical examination and brain imaging (computed tomography, CT scan). Patients were selected based on predefined inclusion and exclusion criteria. Inclusion criteria included all patients diagnosed with either ischemic or hemorrhagic stroke, as confirmed by clinical evaluation and neuroimaging. Patients presenting with transient ischemic attacks (TIAs), refusal to consent, inability to afford investigation costs, or those with incomplete medical records were excluded from the study. A total of 101 stroke patients met the eligibility criteria and were enrolled in the study.

Data Collection

Comprehensive data were collected at the time of hospital admission using a structured case record form (CRF), systematically documenting clinical parameters, medical history, laboratory investigations, and imaging findings. Patient symptoms at presentation, including coma, hemiplegia, hemiparesis, speech disturbances, and other neurological deficits, were recorded. Major risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol consumption, and prior history of cardiovascular diseases were assessed through patient interviews and medical records. Laboratory and imaging investigations were conducted to evaluate metabolic and biochemical abnormalities associated with stroke, including serum lipid profile, blood urea, serum creatinine, serum electrolytes (sodium, potassium, chloride), electrocardiography (ECG), and chest X-ray to assess cardiovascular and pulmonary conditions.

Statistical Analysis

All collected data were entered and analyzed using SPSS software. Descriptive statistics were used to summarize patient characteristics, with continuous variables expressed as mean ± standard deviation (SD). Findings were systematically tabulated to highlight key differences in demographics, clinical presentations, risk factors, and patient outcomes between ischemic and hemorrhagic stroke groups.

RESULTS

Patient Enrolment and Baseline Characteristics

A total of 3,271 patients were admitted during the study period. Among them, 1,932 (59.1%) were male, and 1,339 (40.9%) were female, with a male-to-female ratio of 1.44:1. Out of all admitted patients, 446 (13.6%) were diagnosed with stroke, comprising 215 (6.6%) male and 231 (7.1%) female stroke cases. From the total stroke cases, 101 (3.36%) patients were enrolled in the study, including 55 (2.9%) male and 46 (3.4%) female patients. The proportion of stroke cases was slightly higher among females compared to males, despite the overall higher number of male admissions. However, the enrolment rate among stroke patients remained comparable between both sexes (Table I).

Table – I: Patient enrolment of Stroke Patients in the Study

Study Parameter	Male (n, %)	Female (n, %)	Total (n, %)
Total Patients Admitted	1,932 (59.1)	1,339 (40.9)	3,271 (100.0)
Stroke Cases	215 (6.6)	231 (7.1)	446 (13.6)
Male-Female Ratio	1.44:1	-	-
Patients Enrolled in Study	55 (2.9)	46 (3.4)	101 (3.36)

ISSN: 2617-0817 E-ISSN: 2789-5912

Demographic Characteristics of Stroke Patients

Among the 101 enrolled stroke patients, the age distribution varied, with the highest proportion in the 61-70 years age group. Among ischemic stroke patients, 20 (36.4%) were in this age group, whereas among hemorrhagic stroke patients, 12 (26.1%) belonged to the same category. The mean age for ischemic stroke patients was 59.5 ± 13.9 years, while for hemorrhagic stroke patients, it was 61.0 ± 11.2 years.

Regarding gender distribution, there were 26 (49.1%) males and 29 (50.9%) females in the ischemic stroke group, whereas the hemorrhagic stroke group consisted of 28 (50.9%) males and 18 (39.1%) females.

In terms of religion, the majority of patients belonged to the Islamic faith, with 53 (96.4%) ischemic stroke patients and 41 (89.1%) hemorrhagic stroke patients. Hinduism was followed by 2 (3.6%) ischemic stroke patients and 5 (10.9%) hemorrhagic stroke patients.

Occupational distribution showed that housewives constituted the largest group, with 24 (43.7%) in the ischemic stroke group and 19 (41.3%) in the hemorrhagic stroke group. Unemployed individuals accounted for 16 (29.1%) and 15 (32.6%) of ischemic and hemorrhagic stroke cases, respectively. Other occupations included farmers (9.1% vs. 8.7%), service workers (9.1% vs. 8.7%), businessmen (3.6% vs. 2.2%), and laborers (1.8% vs. 0.0%). The "others" category comprised 2 (3.6%) ischemic stroke patients and 3 (6.5%) hemorrhagic stroke patients (Table II).

Table – II: Demographic Characteristics of Stroke Patients (*n*=101)

Variable	Ischemic Stroke (n=55)	Hemorrhagic Stroke (n=46)
Age (years)	**n (%)**	**n (%)**
21-30	1 (1.8)	0 (0.0)
31-40	6 (10.9)	2 (4.4)
41-50	8 (14.5)	9 (19.5)
51-60	14 (25.5)	15 (32.6)
61-70	20 (36.4)	12 (26.1)
>70	6 (10.9)	8 (17.4)
Mean ± SD	59.5 ± 13.9	61.0 ± 11.2
Gender	**n (%)**	**n (%)**
Male	26 (49.1)	28 (50.9)
Female	29 (50.9)	18 (39.1)
Religion	**n (%)**	**n (%)**
Islam	53 (96.4)	41 (89.1)
Hinduism	2 (3.6)	5 (10.9)
Occupation	**n (%)**	**n (%)**
Businessman	2 (3.6)	1 (2.2)
Labourer	1 (1.8)	0 (0.0)
Farmer	5 (9.1)	4 (8.7)
Housewife	24 (43.7)	19 (41.3)
Unemployed	16 (29.1)	15 (32.6)
Service	5 (9.1)	4 (8.7)
Others	2 (3.6)	3 (6.5)

Clinical Characteristics and Risk Factors of Stroke Patients

Among ischemic stroke patients, coma was the most common reason for admission (54.6%), followed by hemiplegia (34.5%) and hemiparesis (7.3%). Hemorrhagic stroke patients also most frequently presented with coma (45.6%) and hemiplegia (43.5%), with hemiparesis observed in 2.2% of cases. Speech problems were noted in 1.8% of ischemic and 6.5% of hemorrhagic stroke patients.

A history of hypertension was reported in 65.5% of ischemic and 52.2% of hemorrhagic stroke patients. Among those on antihypertensive medication, regular drug use was recorded in 36.1% of ischemic and 41.7% of hemorrhagic stroke patients, with poorly controlled hypertension found in 91.7% and 83.3% of these groups, respectively. Diabetes mellitus was more prevalent among hemorrhagic stroke patients (23.9%) compared to ischemic stroke patients (9.1%), with controlled diabetes found in 60.0% and 27.3% of cases, respectively (Table III).

Table – III: Clinical Characteristics and Risk Factors of Stroke Patients (*n*=101)

Variable	Ischemic Stroke (n=55)	Hemorrhagic Stroke (n=46)
Admission Reasons, n (%)		
Coma	30 (54.6)	21 (45.6)
Hemiplegia	19 (34.5)	20 (43.5)
Hemiparesis	4 (7.3)	1 (2.2)
Speech problem	1 (1.8)	3 (6.5)
Others	1 (1.8)	1 (2.2)
Hypertension Status, n (%)		
History of Hypertension	36 (65.5)	24 (52.2)
Drug Used Regularly	13 (36.1)	10 (41.7)
Poorly Controlled	10 (91.7)	20 (83.3)
Diabetes Mellitus (DM) Status, n (%)		
History of DM	5 (9.1)	11 (23.9)
Controlled DM	3 (60.0)	3 (27.3)

Laboratory and Imaging Findings

The mean total cholesterol level was 204 ± 54.4 mg/dl in ischemic stroke patients and 192.3 ± 54.8 mg/dl in hemorrhagic stroke patients. HDL levels were lower in ischemic stroke patients (40.6 ± 16.5 mg/dl) than in hemorrhagic stroke patients (51.5 ± 54.8 mg/dl). LDL and triglyceride levels were similar between the two groups.

Hyponatremia was observed in 18.2% of ischemic stroke patients and 32.6% of hemorrhagic stroke patients, while hypernatremia was noted in 1.8% and 8.7%, respectively. Hypokalemia was more common in ischemic stroke patients (21.8%) than in hemorrhagic stroke patients (13.0%). Hypochloremia was also more prevalent in hemorrhagic stroke patients (32.6%) compared to ischemic stroke patients (18.2%). All patients had normal CO_2 levels.

ECG abnormalities were recorded in 30.9% of ischemic stroke and 41.3% of hemorrhagic stroke patients. Chest X-ray abnormalities were present in 20.0% of ischemic stroke and 21.7% of hemorrhagic stroke patients (Table IV).

ISSN: 2617-0817 E-ISSN: 2789-5912

Table – IV: Laboratory and Imaging Findings of Stroke Patients (*n*=101)

Parameter	Ischemic Stroke (n=55)	Hemorrhagic Stroke (n=46)
Lipid Profile (mg/dl) (Mean ± SD)	**Mean ± SD**	**Mean ± SD**
Total Cholesterol	204 ± 54.4	192.3 ± 54.8
HDL	40.6 ± 16.5	51.5 ± 54.8
LDL	139.0 ± 36.8	134.7 ± 41.6
Triglycerides (TG)	156.9 ± 63.2	163.8 ± 88.7
Serum Electrolytes (n, %)		
Sodium (Na^+)		
Hyponatraemia	10 (18.2)	15 (32.6)
Normal	44 (80.0)	27 (58.7)
Hypernatraemia	1 (1.8)	4 (8.7)
Potassium (K^+)		
Hypokalemia	12 (21.8)	6 (13.0)
Normal	42 (76.4)	39 (84.8)
Hyperkalemia	1 (1.8)	1 (2.2)
Chloride (Cl^-)		
Hypochloremia	10 (18.2)	15 (32.6)
Normal	45 (80.8)	31 (67.4)
Carbon Dioxide (CO_2)		
Normal	55 (100.0)	46 (100.0)
ECG Findings (n, %)		
Normal	38 (69.1)	27 (58.7)
Abnormal	17 (30.9)	19 (41.3)
Chest X-ray Findings (n, %)		
Normal	44 (80.0)	36 (78.3)
Abnormal	11 (20.0)	10 (21.7)

Treatment, Functional Status, and Outcomes

NG feeding was required in 76.4% of ischemic stroke and 67.4% of hemorrhagic stroke patients. Indwelling catheterization was performed in 89.1% of ischemic stroke and 76.1% of hemorrhagic stroke patients, with 21.8% and 28.3% of these patients, respectively, discharged with an indwelling catheter.

The duration of hospital stay was slightly longer in ischemic stroke patients, with a mean of 7.0 ± 3.1 days compared to 5.9 ± 3.1 days in hemorrhagic stroke patients. Most hemorrhagic stroke patients (58.7%) were discharged within 1-5 days, whereas ischemic stroke patients more commonly required 6-10 days of hospitalization (49.1%).

Regarding activity of daily living (ADL), passive exercise was performed in 61.8% of ischemic stroke and 67.4% of hemorrhagic stroke patients, while bladder control was achieved in 29.1% and 30.4% of cases, respectively. Feeding independence was higher among ischemic stroke patients (21.8%) than hemorrhagic stroke patients (8.7%).

Patient outcomes showed that 76.3% of ischemic stroke and 84.8% of hemorrhagic stroke patients improved. Static condition was reported in 18.2% and 10.9% of ischemic and hemorrhagic stroke patients, respectively. Mortality rates were 5.5% for ischemic stroke patients and 4.3% for hemorrhagic stroke patients (Table V).

Table – V: Treatment, Functional Status, and Outcomes of Stroke Patients (*n*=101)

Parameter	Ischemic Stroke (n=55)	Hemorrhagic Stroke (n=46)
NG Feeding and Catheterization (n, %)		
Required NG feeding	42 (76.4)	31 (67.4)
Indwelling catheter	49 (89.1)	35 (76.1)
Discharged with indwelling catheter	12 (21.8)	13 (28.3)
Duration of Hospital Stay (Days) (n, %)		
1-5 days	22 (40.0)	27 (58.7)
6-10 days	27 (49.1)	13 (28.3)
11-15 days	6 (10.9)	6 (13.0)
Mean ± SD	7.0 ± 3.1	5.9 ± 3.1
Activity of Daily Living (ADL) (n, %)		
Feeding	12 (21.8)	4 (8.7)
Bladder control	16 (29.1)	14 (30.4)
Active exercise	8 (14.5)	7 (15.2)
Passive exercise	34 (61.8)	31 (67.4)

ISSN: 2617-0817 E-ISSN: 2789-5912

Follow-up	4 (7.3)	3 (6.5)
Patient Outcome (n, %)		
Improved	42 (76.3)	39 (84.8)
Static	10 (18.2)	5 (10.9)
Died	3 (5.5)	2 (4.3)

DISCUSSION

This study provides crucial insights into the demographic patterns, clinical characteristics, and outcomes of stroke patients, reinforcing known risk factors while also highlighting key differences between ischemic and hemorrhagic strokes.

The highest proportion of stroke patients was in the 61–70 years age group, aligns with prior research showing that stroke incidence increases with age, with the highest burden among individuals over 60 years[13]. This age-related trend reflects the cumulative effects of vascular risk factors such as hypertension, diabetes, and dyslipidemia, which progressively impair cerebrovascular integrity[13]. Interestingly, in our study, the near-equal gender distribution in ischemic stroke contrasts with some studies reporting a male predominance, while the higher proportion of women among hemorrhagic stroke patients could be attributed to longer life expectancy and hormonal influences on vascular health [6, 14].

Hypertension was a predominant risk factor, present in 65.5% of ischemic and 52.2% of hemorrhagic stroke patients. It emerged as the most significant modifiable risk factor, particularly in hemorrhagic stroke, supporting existing literature that underscores its role in cerebrovascular events due to chronic arterial damage and rupture risk [6, 15]. Despite the high prevalence of antihypertensive medication use, inadequate blood pressure control was observed, raising concerns about treatment adherence, medication effectiveness, or undiagnosed resistant hypertension [16]. This highlights the urgent need for more aggressive hypertension management strategies, including patient education and lifestyle modifications.

The notable presence of diabetes, especially in hemorrhagic stroke patients (23.9%) compared to ischemic stroke, is somewhat unexpected, as ischemic stroke is more commonly associated with diabetic macrovascular complications[17]. However, diabetes-induced microvascular damage may contribute to hemorrhagic stroke risk, as suggested in recent studies [18, 19]. Additionally, poor glycemic control may also contribute to hemorrhagic strokes by weakening blood vessel integrity [20]. Similarly, the dyslipidemia profile observed, with lower HDL levels in ischemic stroke patients, reinforces the protective role of HDL cholesterol in preventing atherosclerosis-related cerebrovascular disease.

The predominant stroke presentation as coma or hemiplegia indicates that many patients had severe neurological deficits at admission, underscoring potential delays in seeking medical care. This is particularly concerning in resource-limited settings, where pre-hospital stroke recognition and rapid intervention remain challenges [21]. The higher frequency of hemiplegia in hemorrhagic stroke aligns with prior findings suggesting that larger lesion sizes and intracerebral hemorrhages contribute to more profound motor deficits [22].

Electrolyte imbalances, notably hyponatremia, were more frequent in hemorrhagic stroke, possibly due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH) or cerebral salt-wasting syndrome, both of which are linked to acute brain injury [23]. This finding highlights the importance of monitoring sodium levels as part of stroke management to prevent secondary complications such as increased intracranial pressure.

Cardiac abnormalities, more frequently observed in hemorrhagic stroke, may be secondary to stroke-induced autonomic dysfunction or pre-existing cardiovascular disease. This underscores the importance of integrating cardiac monitoring in acute stroke care to prevent secondary complications.

The duration of hospital stays, slightly longer for ischemic stroke patients, reflects the complexity of managing ischemic events, which often require prolonged thrombolytic therapy, secondary prevention strategies, and rehabilitation. However, the slightly higher in-hospital mortality observed in ischemic stroke patients suggests that factors such as infarct size, early neurological deterioration, and post-stroke complications might influence outcomes [24].

Despite the greater initial severity of hemorrhagic strokes, functional recovery appeared relatively better in these patients. This aligns with research suggesting that, while hemorrhagic strokes are initially more catastrophic, ischemic strokes may result in more extensive and long-lasting neurovascular damage, leading to prolonged disability [25]. The need for rehabilitation interventions, particularly passive exercise and feeding assistance, highlights the significant burden of stroke-related disability and the necessity for structured post-stroke rehabilitation programs.

The findings of this study reinforce the need for improved stroke prevention strategies, particularly in controlling modifiable risk factors such as hypertension and diabetes. Greater emphasis should be placed on primary prevention through lifestyle modifications, early screening, and patient adherence to antihypertensive and lipid-lowering therapies. Additionally, the high prevalence of severe stroke presentations at admission underscores the importance of public awareness campaigns to promote early recognition and rapid hospital transport, which are critical in improving stroke outcomes.

Further research should explore the role of genetic predisposition, environmental factors, and treatment disparities in influencing stroke outcomes in diverse populations. Moreover, optimizing rehabilitation services and long-term follow-up care remains essential in mitigating post-stroke disability and improving quality of life for survivors.

ISSN: 2617-0817 E-ISSN: 2789-5912

Conclusion

This study highlights the critical role of hypertension and dyslipidemia in stroke pathogenesis, while also shedding light on differences in clinical presentation and outcomes between ischemic and hemorrhagic strokes. Addressing modifiable risk factors, enhancing early diagnosis, and strengthening rehabilitation services are key to reducing the overall stroke burden in this population.

Conflict of Interest:

The authors confirm that there are no conflicts of interest associated with this study.

Funding:

This study was fully self-funded, with no external financial support.

REFERENCES

1. *Shuvo, T. A., Hosna, A.-U.-, Hossain, K., & Hossain, S. (2024). Prevalence of stroke in Bangladesh: A systematic review and meta-analysis. Journal of Stroke and Cerebrovascular Diseases, 33(12), 108017. https://doi.org/10.1016/j.jstrokecerebrovasdis.2024.108017*
2. *Khaku, A. S., & Tadi, P. (2025). Cerebrovascular Disease. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK430927/*
3. *Stroke. (n.d.). Text, National Library of Medicine. Retrieved April 2, 2025, from https://medlineplus.gov/stroke.html*
4. *The top 10 causes of death. (n.d.). Retrieved April 2, 2025, from https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death*
5. *Aguirre, A. O., Rogers, J. L., Reardon, T., Shlobin, N. A., Ballatori, A. M., Brown, N. J., … Shahrestani, S. (2023). Stroke management and outcomes in low-income and lower-middle-income countries: a meta-analysis of 8535 patients. https://doi.org/10.3171/2023.2.JNS222807*
6. *Mamin, F. A., Islam, M. S., Rumana, F. S., & Faruqui, F. (2017). Profile of stroke patients treated at a rehabilitation centre in Bangladesh. BMC Research Notes, 10(1), 520. https://doi.org/10.1186/s13104-017-2844-x*
7. *Fatema, K., Zwar, N. A., Milton, A. H., Ali, L., & Rahman, B. (2016). Prevalence of Risk Factors for Cardiovascular Diseases in Bangladesh: A Systematic Review and Meta-Analysis. PLoS ONE, 11(8), e0160180. https://doi.org/10.1371/journal.pone.0160180*
8. *Tadi, P., & Lui, F. (2025). Acute Stroke. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK535369/*
9. *Unnithan, A. K. A., Das, J. M., & Mehta, P. (2025). Hemorrhagic Stroke. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK559173/*
10. *Unnithan, A. K. A., Das, J. M., & Mehta, P. (2025). Hemorrhagic Stroke. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK559173/*
11. *Baig, M. U., & Bodle, J. (2025). Thrombolytic Therapy. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK557411/*
12. *Wrong Diagnosis: A silent crisis in Bangladesh's healthcare system. (n.d.). unb.com.bd. Retrieved April 2, 2025, from https://unb.com.bd/category/Special/wrong-diagnosis-a-silent-crisis-in-bangladeshs-healthcare-system/153545*
13. *Boehme, A. K., Esenwa, C., & Elkind, M. S. V. (2017). Stroke Risk Factors, Genetics, and Prevention. Circulation research, 120(3), 472–495. https://doi.org/10.1161/CIRCRESAHA.116.308398*
14. *Yoon, C. W., & Bushnell, C. D. (2023). Stroke in Women: A Review Focused on Epidemiology, Risk Factors, and Outcomes. Journal of Stroke, 25(1), 2–15. https://doi.org/10.5853/jos.2022.03468*
15. *Stroke - Causes and Risk Factors | NHLBI, NIH. (2023, May 26). Retrieved April 2, 2025, from https://www.nhlbi.nih.gov/health/stroke/causes*
16. *Hameed, M. A., & Dasgupta, I. (2019). Medication adherence and treatment-resistant hypertension: a review. Drugs in Context, 8, 212560. https://doi.org/10.7573/dic.212560*
17. *Chen, R., Ovbiagele, B., & Feng, W. (2016). Diabetes and Stroke: Epidemiology, Pathophysiology, Pharmaceuticals and Outcomes. The American journal of the medical sciences, 351(4), 380–386. https://doi.org/10.1016/j.amjms.2016.01.011*
18. *Diabetes and Stroke: What Are the Connections? (n.d.). Retrieved April 2, 2025, from https://j-stroke.org/journal/view.php?doi=10.5853/jos.2022.02306*
19. *Cade, W. T. (2008). Diabetes-Related Microvascular and Macrovascular Diseases in the Physical Therapy Setting. Physical Therapy, 88(11), 1322–1335. https://doi.org/10.2522/ptj.20080008*
20. *Diabetes, Heart Disease, & Stroke - NIDDK. (n.d.). National Institute of Diabetes and Digestive and Kidney Diseases. Retrieved April 2, 2025, from https://www.niddk.nih.gov/health-information/diabetes/overview/preventing-problems/heart-disease-stroke*
21. *Wiyarta, E., Fisher, M., Kurniawan, M., Hidayat, R., Geraldi, I. P., Khan, Q. A., … Pandian, J. D. (2024). Global Insights on Prehospital Stroke Care: A Comprehensive Review of Challenges and Solutions in Low- and Middle-Income Countries. Journal of Clinical Medicine, 13(16), 4780. https://doi.org/10.3390/jcm13164780*
22. *Unnithan, A. K. A., Das, J. M., & Mehta, P. (2025). Hemorrhagic Stroke. In StatPearls. Treasure Island (FL): StatPearls Publishing. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK559173/*
23. *Central Neurogenic Diabetes Insipidus, Syndrome of Inappropriate Secretion of Antidiuretic Hormone, and Cerebral Salt-Wasting Syndrome in Traumatic Brain Injury | Critical Care Nurse | American Association of Critical-Care Nurses. (n.d.). Retrieved April 2, 2025, from https://aacnjournals.org/ccnonline/article/32/2/e1/20407/Central-Neurogenic-Diabetes-Insipidus-Syndrome-of*
24. *Ischemic stroke outcome: A review of the influence of post-stroke complications within the different scenarios of stroke care - ScienceDirect. (n.d.). Retrieved April 2, 2025, from https://www.sciencedirect.com/science/article/abs/pii/S0953620515004288*
25. *Perna, R., & Temple, J. (2015). Rehabilitation Outcomes: Ischemic versus Hemorrhagic Strokes. Behavioural Neurology, 2015, 891651. https://doi.org/10.1155/2015/891651*