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Original Article

Frequency and Associated Risk Factors of Stroke Among Neurological Disorders in Rawalpindi and Islamabad

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ABSTRACT

Background: Stroke is a major contributor to neurological morbidity, disability, and healthcare burden, particularly in low- and middle-income settings where modifiable vascular and metabolic risk factors remain highly prevalent. Objective: To determine the frequency of stroke among adult patients with neurological disorders in selected hospitals and clinics of Rawalpindi and Islamabad and to describe the risk-factor profile of patients diagnosed with ischemic or hemorrhagic stroke. Methods: A descriptive cross-sectional study was conducted over six months among 377 adult neurological patients recruited from selected healthcare facilities. Demographic characteristics, neurological diagnosis, stroke status, stroke subtype, episode history, and common vascular risk factors were recorded using a structured questionnaire and available medical documentation. Data were analyzed using SPSS version 26, with categorical variables summarized as frequencies and percentages and age summarized as mean ± standard deviation. Results: The mean age of participants was 53.53 ± 15.80 years; 217 (57.56%) were male and 236 (62.60%) were urban residents. Stroke was identified in 149 participants, giving a frequency of 39.52%. Among stroke cases, 105 (70.47%) had ischemic stroke and 44 (29.53%) had hemorrhagic stroke. One-time stroke was reported by 117 (78.52%) patients, while recurrent episodes were reported by 32 (21.47%). Hypertension was the most frequent risk factor among stroke patients (80.54%), followed by obesity (58.39%), diabetes mellitus (56.38%), family history of stroke (44.30%), smoking history (35.57%), high cholesterol (30.20%), and heart disease (28.19%). Conclusion: Stroke represented the largest diagnostic category among neurological patients in this facility-based sample, with ischemic stroke predominating and a high burden of modifiable cardiometabolic risk factors among stroke cases. Keywords: Stroke, ischemic stroke, hemorrhagic stroke, neurological disorders, hypertension, diabetes mellitus, obesity, Pakistan.

INTRODUCTION

Neurological disorders represent a major and expanding contributor to morbidity, disability, health-service utilization, and long-term rehabilitation needs across both high-income and low- and middle-income countries. These disorders affect the central and peripheral nervous systems and may impair motor, sensory, cognitive, autonomic, and functional domains through vascular, degenerative, metabolic, infectious, traumatic, autoimmune, or structural mechanisms. Among these conditions, stroke remains one of the most clinically important neurological disorders because of its abrupt onset, high case fatality, long-term disability burden, recurrence risk, and substantial social and economic consequences for patients, families, caregivers, and health systems. Stroke is classically defined as a rapidly developing focal or global neurological deficit of vascular origin, lasting more than 24 hours or resulting in death,

and is broadly categorized into ischemic and hemorrhagic subtypes, with ischemic stroke generally representing the larger proportion of cases in most clinical populations (1).

The global burden of stroke remains substantial despite advances in acute care, neuroimaging, secondary prevention, and rehabilitation. In Pakistan and other South Asian settings, the burden is particularly concerning because stroke frequently occurs in the context of delayed presentation, limited preventive screening, variable access to specialized stroke services, and a high background prevalence of modifiable cardiometabolic risk factors. Population-level data from Pakistan have indicated a meaningful stroke burden, while regional evidence from South-East Asia highlights the combined influence of demographic ageing, hypertension, diabetes mellitus, tobacco exposure, obesity, physical inactivity, dyslipidemia, environmental exposures, and uneven access to preventive care on stroke occurrence and outcomes (2,3). Recent global analyses further suggest that although age-standardized rates may show improvement in some regions, the absolute number of stroke cases and the disability burden remain high, particularly in younger and middle-aged populations in settings undergoing rapid epidemiological and lifestyle transition (4).

Stroke risk is multifactorial and includes both non-modifiable and modifiable determinants. Increasing age, male sex in many age groups, ethnicity, family history, and genetic susceptibility are recognized non-modifiable contributors, while hypertension, diabetes mellitus, dyslipidemia, obesity, smoking, atrial fibrillation, ischemic heart disease, sedentary lifestyle, and unhealthy dietary patterns are potentially modifiable targets for prevention. Hypertension is consistently regarded as the most important modifiable risk factor because chronic elevation of blood pressure accelerates endothelial injury, arterial remodeling, atherosclerosis, small-vessel disease, and vascular rupture, thereby increasing the risk of both ischemic and hemorrhagic stroke (5,6). Diabetes mellitus further increases stroke risk through chronic hyperglycemia, endothelial dysfunction, pro-inflammatory mechanisms, platelet activation, and accelerated atherosclerosis, while dyslipidemia and obesity frequently coexist with hypertension and diabetes and contribute to an adverse vascular-risk profile. Smoking compounds this risk by promoting oxidative stress, vascular inflammation, thrombosis, and atherosclerotic progression (6).

Sex- and setting-related differences in stroke risk have also been reported. Men often show higher exposure to behavioral risk factors such as smoking and unhealthy lifestyle patterns, whereas women may experience changing vascular risk after menopause and may carry a higher cumulative burden in older age because of greater longevity (7). Urban residence may also influence stroke risk through changes in physical activity, diet, stress exposure, obesity, and access patterns to healthcare services, although these mechanisms must be interpreted cautiously unless directly measured within a study. Evidence from African, Asian, and multinational studies has repeatedly shown that hypertension, diabetes, dyslipidemia, obesity, smoking, cardiovascular disease, and family history are common among stroke patients and are especially relevant in low-resource settings where early detection and long-term risk-factor control remain inconsistent (8,9). Physical activity has also emerged as an important protective factor, with recent population-based evidence suggesting that moderate and vigorous activity patterns are associated with lower stroke risk, whereas sedentary behavior and metabolic risk clustering may contribute to greater vascular burden (9,10).

Although stroke epidemiology and risk factors have been widely studied globally, locally relevant evidence from Rawalpindi and Islamabad remains limited, particularly among patients presenting with neurological disorders in hospital and clinic settings. Most available evidence either describes broad national patterns or focuses on selected stroke cohorts without estimating the proportion of stroke within mixed neurological presentations. This distinction is important because neurological outpatient and hospital populations often include patients with neuropathy, migraine, Parkinson's disease, dementia, epilepsy, and other disorders, and determining the frequency of stroke within this clinical denominator can help identify the extent to which cerebrovascular disease contributes to neurological-service demand. Furthermore, describing the distribution of common vascular and metabolic risk factors

among confirmed stroke cases can support targeted screening, health education, secondary prevention, and referral pathways in local clinical practice.

The present study was therefore designed to determine the frequency of stroke among adult patients with neurological disorders attending selected hospitals and clinics in Rawalpindi and Islamabad and to describe the distribution of common modifiable and non-modifiable risk factors among patients identified with ischemic or hemorrhagic stroke. The study was guided by the research question: among adult patients presenting with neurological disorders in selected healthcare facilities of Rawalpindi and Islamabad, what is the frequency of stroke, and what is the clinical and risk-factor profile of patients diagnosed with ischemic or hemorrhagic stroke?

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted to estimate the frequency of stroke among adult patients presenting with neurological disorders and to describe the risk-factor profile of patients diagnosed with ischemic or hemorrhagic stroke. The cross-sectional design was selected because the primary objective was to measure the proportion of stroke within a defined neurological-patient sample during a fixed study period and to summarize demographic, clinical, and vascular-risk characteristics at the time of data collection. The study was conducted over six months after approval of the research synopsis and ethics review process, with data collected from selected hospitals and clinics in Rawalpindi and Islamabad, including Railway General Hospital, PAF Hospital Islamabad, Doctor Therapy Clinic Gulshan Abad, and Doctor Therapy Clinic Bahria Enclave/G-9.

The study population comprised adult patients aged 18 years or above who presented with a diagnosed neurological disorder during the study period and were able to understand and respond to the study questions. Participants of both sexes and from both urban and rural residential backgrounds were considered eligible if they provided informed consent. Patients were classified according to their documented neurological diagnosis, including stroke, neuropathy, migraine, Parkinson's disease, dementia, epilepsy, and other relevant neurological disorders recorded during clinical assessment or available medical documentation. For the stroke subgroup, eligible cases included patients diagnosed with ischemic or hemorrhagic stroke on the basis of clinical diagnosis supported by medical record review and neuroimaging documentation where available. Patients with transient ischemic attack, trauma-related stroke, iatrogenic stroke following major surgery, angiography, or carotid endarterectomy, disturbed level of consciousness preventing valid response, severe cognitive impairment preventing participation, or unwillingness to provide consent were excluded.

A sample size of 377 participants was calculated using Raosoft sample-size calculator, assuming an expected prevalence of 50% to provide the maximum required sample under uncertainty, a 95% confidence level, and a 5% margin of error. A non-probability convenience sampling technique was used because eligible neurological patients were recruited from selected clinical sites during the available data-collection period. To reduce selection inconsistency, eligible adult neurological patients attending the selected facilities during data collection were approached, screened according to the eligibility criteria, informed about the purpose and voluntary nature of the study, and enrolled after written informed consent. This approach allowed estimation of the proportion of stroke within the recruited neurological-patient sample while maintaining a consistent denominator for frequency calculation.

Data were collected using a self-structured questionnaire developed after reviewing relevant literature and standard stroke risk-factor assessment domains, including demographic characteristics, clinical neurological diagnosis, stroke status, stroke subtype, stroke episode history, and common vascular and metabolic risk factors. The demographic section included age in completed years, sex, residence, education level, and occupation. The clinical section recorded whether the participant had been diagnosed with a neurological disorder, the type of neurological disorder, whether a physician or healthcare professional had diagnosed stroke, the type of stroke where known or documented, and the

number of stroke episodes. The risk-factor section recorded history of hypertension, diabetes mellitus, heart disease, high cholesterol, obesity, smoking habit, and family history of stroke. Stroke was operationally defined as a documented clinical diagnosis of ischemic or hemorrhagic cerebrovascular event, while stroke subtype was categorized as ischemic or hemorrhagic according to available clinical or imaging documentation. Recurrent stroke was recorded according to participant report and medical record availability as one episode, two episodes, or three or more episodes.

Data collection was performed through direct participant interview and review of available medical records. After consent, trained data collectors obtained demographic and clinical information using the questionnaire in a private setting to maintain confidentiality. Where available, medical records were reviewed to verify stroke diagnosis, stroke subtype, comorbidities, and relevant clinical history. Risk factors such as hypertension, diabetes mellitus, heart disease, high cholesterol, obesity, smoking history, and family history of stroke were recorded as present or absent based on participant report and/or available documentation. To improve data integrity, questionnaires were checked for completeness at the time of collection, responses were coded before entry, and identifiable information was kept separate from the analytical dataset. Participant confidentiality was maintained by assigning codes rather than using names in the data file.

The primary outcome variable was the frequency of stroke among recruited neurological patients, calculated as the number of participants diagnosed with stroke divided by the total number of enrolled neurological patients. Secondary descriptive variables included stroke subtype, number of stroke episodes, demographic profile, and distribution of common risk factors among stroke patients. Age was treated as a continuous variable and summarized using mean and standard deviation. Sex, residence, education level, neurological diagnosis, stroke subtype, stroke episode category, and risk-factor variables were treated as categorical variables and summarized using frequencies and percentages. Because the available manuscript dataset reports risk factors only among stroke cases, these variables were interpreted as a descriptive risk-factor profile rather than definitive statistical associations with stroke. If complete risk-factor data for both stroke and non-stroke neurological patients are available, comparative analysis should include chi-square test or Fisher's exact test for categorical variables, independent-samples t test or Mann–Whitney U test for continuous variables according to distribution, and crude odds ratios with 95% confidence intervals for the association between individual risk factors and stroke status. Multivariable logistic regression may be used to adjust for clinically important confounders such as age, sex, and residence if the distribution of events and model assumptions are adequate.

Data were coded and analyzed using SPSS version 26. Descriptive statistics were used to summarize all demographic and clinical variables. Frequencies and percentages were calculated for categorical variables, while mean and standard deviation were calculated for age. The stroke frequency was calculated using the full sample of 377 neurological patients as the denominator, while ischemic and hemorrhagic stroke proportions were calculated using the stroke subgroup as the denominator. Missing values were assessed during data cleaning, and variables with complete available data were analyzed using valid denominators. Results were prepared in numbered tables with clear denominators to ensure transparency and reproducibility.

Ethical approval was obtained from the institutional ethical review process of Riphah International University and permission was obtained from the respective study settings before data collection. All participants were informed about the purpose of the study, voluntary participation, confidentiality of responses, and their right to withdraw from the study without penalty. Written informed consent was obtained before enrollment. No invasive procedure was performed as part of the study. Data were stored securely, used only for research purposes, and reported in aggregate form so that individual participants could not be identified.

RESULTS

A total of 377 adult patients with neurological disorders were included in the analysis. The mean age of the participants was 53.53 ± 15.80 years. Of the total sample, 217 participants were male, representing 57.56% of the study population, while 160 were female, representing 42.44%. Urban residents accounted for 236 participants, corresponding to 62.60%, whereas 141 participants, corresponding to 37.40%, were from rural areas. The educational profile showed that secondary education was the most frequently reported category, followed by primary education, higher education, and no formal education.

Table 1. Demographic Characteristics of the Study Participants (N = 377)

Variable	Category / Statistic	n	%	95% CI
Age, years	Mean ± SD	377	53.53 ± 15.80	
Gender	Male	217	57.56	52.52–62.45
Gender	Female	160	42.44	37.55–47.48
Residence	Urban	236	62.60	57.61–67.33
Residence	Rural	141	37.40	32.67–42.39
Education level	No formal education	34	9.02	
Education level	Primary education	94	24.93	
Education level	Secondary education	160	42.44	
Education level	Higher education	89	23.61	

The distribution of neurological diagnoses showed that stroke was the most frequently recorded neurological disorder in the sample. Among 377 participants, 149 were diagnosed with stroke, giving a stroke frequency of 39.52% with a 95% confidence interval of 34.72% to 44.54%. Neuropathy was the second most frequent diagnosis, observed in 124 participants or 32.89%, followed by migraine in 79 participants or 20.95%. Parkinson's disease, dementia, and epilepsy were less frequent, accounting for 3.45%, 1.86%, and 1.33% of the sample, respectively. These findings indicate that cerebrovascular disease represented the largest diagnostic category among the recruited neurological patients.

Table 2. Distribution of Neurological Disorders Among Study Participants (N = 377)

Neurological Diagnosis	n	%	95% CI
Stroke	149	39.52	34.72–44.54
Neuropathy	124	32.89	28.34–37.79
Migraine	79	20.95	17.15–25.35
Parkinson's disease	13	3.45	2.03–5.81
Dementia	7	1.86	0.90–3.78
Epilepsy	5	1.33	0.57–3.07
Total	377	100.00	—

Among the 149 participants diagnosed with stroke, ischemic stroke was the predominant subtype. Ischemic stroke was documented in 105 patients, representing 70.47% of stroke cases, while hemorrhagic stroke was documented in 44 patients, representing 29.53%. The 95% confidence interval for ischemic stroke was 62.70% to 77.21%, indicating that approximately two-thirds to three-quarters of stroke cases in this clinical sample were ischemic in nature. Hemorrhagic stroke represented nearly one-third of stroke cases, with a 95% confidence interval of 22.79% to 37.30%.

Table 3. Stroke Subtypes Among Patients Diagnosed With Stroke (n = 149)

Stroke Subtype	n	%	95% CI
Ischemic stroke	105	70.47	62.70–77.21
Hemorrhagic stroke	44	29.53	22.79–37.30
Total	149	100.00	—

Regarding stroke episode history, most stroke patients reported a single stroke episode. Of the 149 stroke patients, 117 had experienced stroke once, representing 78.52% of the stroke subgroup. Twenty-eight patients, representing 18.79%, reported two stroke episodes, while four patients, representing 2.68%, reported three or more episodes. These findings suggest that although first-ever stroke was the dominant presentation, approximately one in five stroke patients had a history of recurrent stroke episodes.

Table 4. Number of Stroke Episodes Among Patients Diagnosed With Stroke (n = 149)

Number of Stroke Episodes	n	%	95% CI
One episode	117	78.52	71.26–84.36
Two episodes	28	18.79	13.33–25.82
Three or more episodes	4	2.68	1.05–6.70
Total	149	100.00	—

The distribution of vascular and metabolic risk factors among stroke patients showed a high burden of modifiable risk factors. Hypertension was the most frequently reported risk factor, present in 120 of 149 stroke patients, corresponding to 80.54% with a 95% confidence interval of 73.45% to 86.09%. Obesity was present in 87 patients, representing 58.39%, while diabetes mellitus was present in 84 patients, representing 56.38%. A family history of stroke was reported by 66 patients, corresponding to 44.30%. Smoking history was present in 53 patients, corresponding to 35.57%, while high cholesterol and heart disease were reported in 30.20% and 28.19% of stroke patients, respectively. The corrected percentage for patients without smoking history was 64.43%, replacing the previously inconsistent value.

Table 5. Risk-Factor Profile Among Patients Diagnosed With Stroke (n = 149)

Risk Factor	Present, n (%)	95% CI for Present (%)	Absent, n (%)	95% CI for Absent (%)
Hypertension	120 (80.54)	73.45–86.09	29 (19.46)	13.91–26.55
Diabetes mellitus	84 (56.38)	48.35–64.08	65 (43.62)	35.92–51.65
Heart disease	42 (28.19)	21.58–35.89	107 (71.81)	64.11–78.42
High cholesterol	45 (30.20)	23.40–37.99	104 (69.80)	62.01–76.60
Obesity	87 (58.39)	50.36–66.00	62 (41.61)	34.00–49.64
Smoking history	53 (35.57)	28.33–43.53	96 (64.43)	56.47–71.67
Family history of stroke	66 (44.30)	36.56–52.32	83 (55.70)	47.68–63.44

*Association testing was not performed because the available aggregated manuscript data report risk factors only among stroke patients. To calculate p-values, odds ratios, or adjusted associations, the same risk-factor variables must be available for both stroke and non-stroke neurological participants.

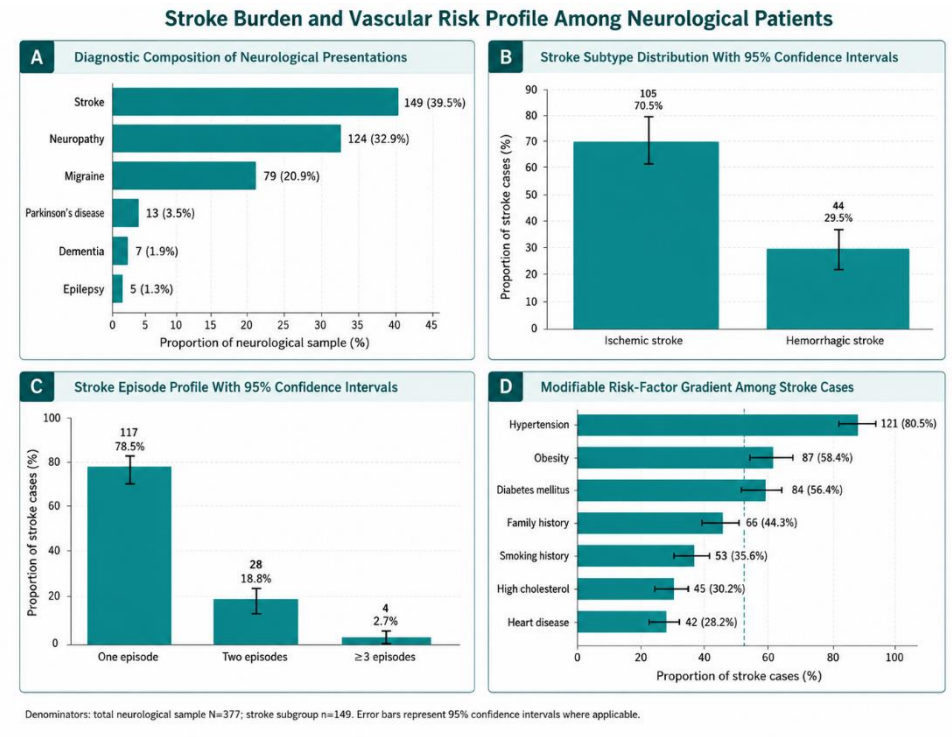

Figure 1 Stroke Burden and Vascular Risk Profile Among Neurological Patients

The panelled figure shows that stroke constituted the largest diagnostic category among neurological presentations, accounting for 149 of 377 cases (39.52%), followed by neuropathy (32.89%) and migraine (20.95%). Within the stroke subgroup, ischemic stroke predominated at 105 of 149 cases (70.47%; 95% CI: 62.70–77.21), while hemorrhagic stroke accounted for 44 cases (29.53%; 95% CI: 22.79–37.30). Most

stroke patients reported a single episode (117/149; 78.52%), although recurrent stroke was present in 32 patients (21.47%). The vascular risk-factor gradient demonstrated a high modifiable-risk burden, led by hypertension (120/149; 80.54%), obesity (87/149; 58.39%), and diabetes mellitus (84/149; 56.38%), indicating that cardiometabolic risk clustering is clinically prominent among stroke cases in this neurological-patient sample.

Overall, the results show that stroke accounted for 149 of 377 neurological presentations, giving a frequency of 39.52% in the recruited clinical sample. Ischemic stroke was the dominant subtype, affecting 105 of 149 stroke patients, while hemorrhagic stroke accounted for 44 cases. The burden of modifiable risk factors among stroke patients was high, particularly hypertension, obesity, and diabetes mellitus, which were present in 80.54%, 58.39%, and 56.38% of stroke cases, respectively. Because the current dataset does not provide risk-factor frequencies among the 228 non-stroke neurological patients, these findings should be interpreted as a descriptive risk-factor profile among stroke cases rather than statistical evidence of independent association with stroke.

DISCUSSION

The present study estimated the frequency of stroke among adult patients presenting with neurological disorders in selected hospitals and clinics of Rawalpindi and Islamabad and described the clinical and vascular risk-factor profile of patients diagnosed with ischemic or hemorrhagic stroke. Stroke was the most frequent neurological diagnosis in the recruited clinical sample, accounting for 149 of 377 participants, corresponding to a frequency of 39.52% with a 95% confidence interval of 34.72% to 44.54%. This finding indicates that cerebrovascular disease represented a substantial proportion of neurological presentations in the included healthcare settings. Although this estimate should not be interpreted as a community prevalence because the study was facility-based and used non-probability sampling, it highlights the prominent contribution of stroke to neurological service demand in the local clinical context. The finding is consistent with broader evidence showing that stroke remains a leading cause of neurological morbidity, long-term disability, and healthcare burden, particularly in low- and middle-income settings where preventive screening and risk-factor control remain uneven (2,3).

Ischemic stroke was the predominant subtype in the present study, observed in 105 of 149 stroke patients, representing 70.47%, while hemorrhagic stroke accounted for 44 patients, representing 29.53%. This distribution is broadly consistent with the established pattern that ischemic stroke is usually more common than hemorrhagic stroke in most clinical and population-based datasets, although the proportion of hemorrhagic stroke may be relatively higher in some Asian and low-resource settings because of uncontrolled hypertension, delayed diagnosis, and limited preventive care (1,3). The observed hemorrhagic proportion of nearly one-third of stroke cases is therefore clinically relevant and reinforces the importance of early detection and sustained management of blood pressure in high-risk adults. The predominance of ischemic stroke also supports the need for systematic identification of metabolic, cardiac, and lifestyle-related risk factors, including diabetes mellitus, dyslipidemia, obesity, smoking, and heart disease, because these factors contribute to atherosclerotic and thromboembolic vascular mechanisms (5,6).

Most patients with stroke in this study reported a single stroke episode, with 117 of 149 cases representing one-time stroke events. However, 28 patients reported two episodes and four patients reported three or more episodes, indicating that recurrent stroke affected 32 of 149 stroke patients, or approximately 21.47% of the stroke subgroup. This recurrent burden is clinically important because secondary prevention after an index stroke is a major determinant of long-term outcomes. Previous multicenter evidence has shown that recurrent stroke is commonly linked with persistent or inadequately controlled vascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, and family history of cardiovascular disease (8). In the present study, recurrence could not be modeled statistically because individual-level comparative data were not available; nevertheless, the observed proportion of patients

with repeated events suggests a need for structured follow-up, medication adherence support, lifestyle counseling, and rehabilitation-linked risk-factor surveillance after the first stroke event.

Hypertension was the most frequent risk factor among stroke patients, present in 120 of 149 cases, corresponding to 80.54%. This high proportion is clinically meaningful because hypertension is consistently recognized as the most important modifiable risk factor for both ischemic and hemorrhagic stroke. Chronic elevation of blood pressure contributes to endothelial injury, arterial stiffness, atherosclerosis, small-vessel disease, and vessel rupture, thereby increasing the likelihood of cerebral infarction and intracerebral hemorrhage (5,6). In the local context, the high frequency of hypertension among stroke patients may reflect delayed screening, poor treatment adherence, inadequate lifestyle modification, excessive dietary salt intake, obesity, and limited long-term follow-up. The finding supports the practical need for routine blood-pressure screening among neurological patients, especially those with headache, dizziness, weakness, neuropathic complaints, or prior vascular history, because early recognition and control of hypertension may reduce both first-ever and recurrent stroke risk.

Diabetes mellitus and obesity were also highly prevalent among stroke patients, affecting 84 of 149 patients and 87 of 149 patients, respectively. These findings indicate that cardiometabolic risk clustering was common within the stroke subgroup. Diabetes mellitus increases vascular risk through chronic hyperglycemia, endothelial dysfunction, oxidative stress, platelet activation, inflammation, and accelerated atherosclerosis, while obesity contributes indirectly through hypertension, insulin resistance, dyslipidemia, and systemic inflammation (6). The close numerical proximity of obesity and diabetes in this study suggests that metabolic health should be treated as a core component of stroke prevention in neurological settings rather than as a separate chronic-disease concern. Although the present analysis cannot determine whether obesity or diabetes independently increased the odds of stroke because non-stroke comparator risk-factor data were unavailable, their high frequency among stroke cases identifies them as important targets for clinical counseling and integrated prevention services.

Smoking history was present in 53 of 149 stroke patients, representing 35.57%, while high cholesterol and heart disease were reported in 45 and 42 patients, respectively. Smoking contributes to stroke pathophysiology through endothelial dysfunction, inflammation, thrombosis, increased blood viscosity, and progression of atherosclerosis (6). Dyslipidemia and heart disease further increase the risk of ischemic stroke through plaque formation, arterial narrowing, cardiac embolism, and impaired vascular integrity. The frequency of family history of stroke was also notable, reported by 66 of 149 patients, or 44.30%, suggesting that inherited susceptibility, shared environmental exposure, and family-level lifestyle patterns may contribute to the observed risk profile. These findings support a prevention model that combines individual clinical screening with family-based education regarding blood pressure control, diabetes prevention, smoking cessation, healthy diet, physical activity, and early recognition of stroke warning signs.

The demographic pattern showed a greater proportion of males than females in the total neurological sample, with males accounting for 57.56% of participants. Male predominance in stroke-related clinical samples has been reported in several previous studies and may reflect higher exposure to behavioral risks such as smoking, occupational stress, lower preventive healthcare use, or differences in vascular biology across age groups (7). However, the present study did not provide stroke-specific sex-stratified risk estimates; therefore, sex differences cannot be interpreted as an independent association with stroke. Urban residents accounted for 62.60% of the total sample, which may reflect the catchment population and accessibility of the selected hospitals and clinics rather than a true urban excess of stroke burden. Urbanization may plausibly contribute to sedentary lifestyle, dietary transition, obesity, diabetes, hypertension, and stress exposure, but these mechanisms require direct measurement before being considered study findings (3,10).

The study has several strengths. It addresses a locally relevant clinical question, uses a clearly defined neurological-patient denominator after revision, and provides a practical description of stroke frequency

and risk-factor distribution in healthcare settings of Rawalpindi and Islamabad. The findings are useful for clinicians, physiotherapists, rehabilitation professionals, and primary-care teams because they show that stroke forms a large part of neurological caseload and that most stroke patients carry multiple modifiable vascular and metabolic risks. The inclusion of stroke subtype and episode history also improves clinical interpretability because it distinguishes ischemic from hemorrhagic stroke and identifies a meaningful proportion of recurrent events.

The findings should be interpreted within important limitations. The study was conducted in selected healthcare facilities and used non-probability convenience sampling, which limits generalizability to the wider population of Rawalpindi, Islamabad, or Pakistan. Risk factors were reported only within the stroke subgroup in the available aggregate dataset, so the study cannot establish independent associations between risk factors and stroke without comparable data from non-stroke neurological participants. Some variables, including physical activity, diet, socioeconomic status, medication adherence, alcohol use, atrial fibrillation, stroke severity, disability level, treatment history, and rehabilitation outcomes, were not reported in sufficient detail. Diagnosis and risk-factor classification relied partly on participant report and available medical documentation, which may introduce recall or information bias. Despite these limitations, the study provides useful descriptive evidence that can inform future analytical studies with larger samples, standardized diagnostic verification, comparator groups, and multivariable modeling.

Overall, the study suggests that stroke is a major neurological presentation in the selected clinical settings and that patients with stroke frequently present with modifiable vascular and metabolic risk factors, particularly hypertension, obesity, and diabetes mellitus. These findings support the need for routine vascular-risk screening in neurological clinics, improved patient education, early referral pathways, and structured secondary prevention after stroke. Future research should collect complete risk-factor data for both stroke and non-stroke neurological patients so that crude and adjusted associations can be estimated using odds ratios, confidence intervals, and multivariable regression models.

CONCLUSION

Stroke was the most frequent neurological disorder identified in this facility-based sample from Rawalpindi and Islamabad, affecting 149 of 377 adult neurological patients, with ischemic stroke accounting for most cases. The stroke subgroup showed a high burden of modifiable vascular and metabolic risk factors, particularly hypertension, obesity, and diabetes mellitus, while recurrent stroke episodes were also present in approximately one-fifth of stroke patients. These findings emphasize the need for systematic screening, early diagnosis, sustained risk-factor control, smoking cessation support, lifestyle counseling, and rehabilitation-linked secondary prevention services in neurological and primary-care settings. Because the available analysis was descriptive, the findings should be interpreted as a clinical risk-factor profile rather than proof of independent association, and future studies should include comparator data from non-stroke neurological patients to determine adjusted predictors of stroke.

REFERENCES

1. Mukherjee S, Ali S, Hashmi S, Jahan S. History, origin and types of neurological disorders. In: Applications of stem cells and derived exosomes in neurodegenerative disorders. Singapore: Springer; 2023. p. 1-32.

2. Singh RJ, Chen S, Ganesh A, Hill MD. Long-term neurological, vascular, and mortality outcomes after stroke. Int J Stroke. 2018;13(8):787-96.

3. Ngarka L, Siewe Fodjo JN, Aly E, Masocha W, Njamnshi AK. The interplay between neuroinfections, the immune system and neurological disorders: a focus on Africa. Front Immunol. 2022;12:803475.

4. Nejad SH, Roffman JL, Kueppenbender K, Smith FA, Huffman JC, Stern TA. Patients with neurologic conditions II: movement disorders, multiple sclerosis, and other neurologic conditions. In: Massachusetts General Hospital Handbook of General Hospital Psychiatry. 6th ed. Philadelphia: Saunders Elsevier; 2010. p. 255-72.

5. Deleidi M, Jäggle M, Rubino G. Immune aging, dysmetabolism, and inflammation in neurological diseases. Front Neurosci. 2015;9:172.

6. Leibetseder A, Eisermann M, LaFrance WC Jr, Nobili L, von Oertzen TJ. How to distinguish seizures from non-epileptic manifestations. Epileptic Disord. 2020;22(6):716-38.

7. Chen T, Giri M, Xia Z, Subedi YN, Li Y. Genetic and epigenetic mechanisms of epilepsy: a review. Neuropsychiatr Dis Treat. 2017;13:1841-59.

8. Roy A, Chatterjee S. Epileptic seizures. In: MIMICS of Epileptic Seizures. 2020. p. 180.

9. Huff HV, Huff KR. Seizures and epilepsy. In: Berkowitz's Pediatrics: A Primary Care Approach. 6th ed. Itasca: American Academy of Pediatrics; 2020. p. 982.

10. Chaudhary UJ, Diehl B. The spectrum of seizures and epilepsies. In: Epilepsy: A Queen Square Textbook. 2026. p. 14-30.

11. Ramesh S, Arachchige ASPM. Depletion of dopamine in Parkinson's disease and relevant therapeutic options: a review of the literature. AIMS Neurosci. 2023;10(3):200.

12. Coleman JC. Rethinking Parkinson's Disease: The Definitive Guide to the Known Causes of Parkinson's Disease and Proven Reversal Strategies. Melbourne: Hybrid Publishers; 2020.

13. Dias V, Junn E, Mouradian MM. The role of oxidative stress in Parkinson's disease. J Parkinsons Dis. 2013;3(4):461-91.

14. Jankovic J, Lang AE. Diagnosis and assessment of Parkinson disease and other movement disorders. In: Bradley's Neurology in Clinical Practice. 2021;24:310-33.

15. Goldman JG. Non-motor symptoms and treatments in Parkinson's disease. Neurol Clin. 2025;43(2):291-317.

16. Zvěřová M. Clinical aspects of Alzheimer's disease. Clin Biochem. 2019;72:3-6.

17. Ávila-Villanueva M, Marcos Dolado A, Gómez-Ramírez J, Fernández-Blázquez M. Brain structural and functional changes in cognitive impairment due to Alzheimer's disease. Front Psychol. 2022;13:886619.

18. Leszek J, Mikhaylenko EV, Belousov DM, Koutsouraki E, Szczechowiak K, Kobusiak-Prokopowicz M, et al. The links between cardiovascular diseases and Alzheimer's disease. Curr Neuropharmacol. 2021;19(2):152-69.

19. Budson AE, Solomon PR. Memory Loss, Alzheimer's Disease, and Dementia: A Practical Guide for Clinicians. Philadelphia: Elsevier Health Sciences; 2021.

20. Burgio L, Allen-Burge R, Stevens A, Davis L, Marson D. Caring for Alzheimer's disease patients: issues of verbal communication and social interaction. In: The Gerontological Prism. London: Routledge; 2018. p. 231-58.

21. Zéphir H. Progress in understanding the pathophysiology of multiple sclerosis. Rev Neurol. 2018;174(6):358-63.

22. Olsson T, Barcellos LF, Alfredsson L. Interactions between genetic, lifestyle and environmental risk factors for multiple sclerosis. Nat Rev Neurol. 2017;13(1):25-36.

23. Correale J, Gaitán M. Multiple sclerosis and environmental factors: the role of vitamin D, parasites, and Epstein-Barr virus infection. Acta Neurol Scand. 2015;132:46-55.

24. Koldanov N. Early typical and atypical multiple sclerosis symptoms [dissertation]. Kaunas: Lithuanian University of Health Sciences; 2022.

25. Patel D. Experiences of relapsing remitting multiple sclerosis and disease modifying treatment: a phenomenological inquiry [dissertation]. London: University of East London; 2021.

26. Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, et al. Diabetic neuropathy. Nat Rev Dis Primers. 2019;5(1):41.

27. Babel RA, Dandekar MP. A review on cellular and molecular mechanisms linked to the development of diabetes complications. Curr Diabetes Rev. 2021;17(4):457-73.

28. Yavuz DG. Classification, risk factors, and clinical presentation diabetic neuropathy. In: Diabetic Neuropathy. Amsterdam: Elsevier; 2022. p. 1-9.

29. Mauermann ML, Staff NP. Peripheral neuropathy: a review. JAMA. 2026;335(3):255-66.

30. Bianchi L, Volpato S. Muscle dysfunction in type 2 diabetes: a major threat to patient's mobility and independence. Acta Diabetol. 2016;53(6):879-89.

31. Murphy SJ, Werring DJ. Stroke: causes and clinical features. Medicine. 2020;48(9):561-6.

32. Warlow C. Epidemiology of stroke. Lancet. 1998;352 Suppl 3:S1-4.

33. Coupland AP, Thapar A, Qureshi MI, Jenkins H, Davies AH. The definition of stroke. J R Soc Med. 2017;110(1):9-12.

34. Markus H. Stroke: causes and clinical features. Medicine. 2008;36(11):586-91.

35. Adamson J, Beswick A, Ebrahim S. Is stroke the most common cause of disability? J Stroke Cerebrovasc Dis. 2004;13(4):171-7.

36. Sherin A, Ul-Haq Z, Fazid S, Shah BH, Khattak MI, Nabi F. Prevalence of stroke in Pakistan: findings from Khyber Pakhtunkhwa Integrated Population Health Survey 2016-17. Pak J Med Sci. 2020;36(7):1435-40.

37. Tiseo C. Epidemiology of ischemic stroke subtypes: results from the follow-up of a population-based registry [dissertation]. 2020.

38. Adebayo O, Akpa O, Asowata OJ, Fakunle A, Sarfo FS, Akpalu A, et al. Determinants of first-ever stroke severity in West Africans: evidence from the SIREN Study. J Am Heart Assoc. 2023;12(12):e027888.

39. Sacco RL, Kargman DE, Gu Q, Zamanillo MC. Race-ethnicity and determinants of intracranial atherosclerotic cerebral infarction: the Northern Manhattan Stroke Study. Stroke. 1995;26(1):14-20.

40. Ho FK, Gray SR, Welsh P, Gill JM, Sattar N, Pell JP, et al. Ethnic differences in cardiovascular risk: examining differential exposure and susceptibility to risk factors. BMC Med. 2022;20(1):149.

41. Miah MNA, Azhar MA, Rahman A, Halder D, Akteruzzaman M, Kundu NC. Risk factors of stroke in young and old age group: a comparative study. J Med. 2012;13(2):138-42.

42. Demel SL, Kittner S, Ley SH, McDermott M, Rexrode KM. Stroke risk factors unique to women. Stroke. 2018;49(3):518-23.

43. Xia W, Khalil RA. Hormone replacement therapy and cardiovascular health in postmenopausal women. Int J Mol Sci. 2025;26(11):5078.

44. Hankey GJ. Population impact of potentially modifiable risk factors for stroke. Stroke. 2020;51(3):719-28.

45. Choudhury MJH, Chowdhury MTI, Nayeem A, Jahan WA. Modifiable and non-modifiable risk factors of stroke: a review update. J Natl Inst Neurosci Bangladesh. 2015;1(1):22-6.

46. Lee EJ, Kim HJ, Bae JM, Kim JC, Han HJ, Park CS, et al. Relevance of common carotid intima-media thickness and carotid plaque as risk factors for ischemic stroke in patients with type 2 diabetes mellitus. AJNR Am J Neuroradiol. 2007;28(5):916-9.

47. Ozdemir H, Sagris D, Lip GY, Abdul-Rahim AH. Stroke in atrial fibrillation and other atrial dysrhythmias. Curr Cardiol Rep. 2023;25(5):357-69.

48. Iso H, Jacobs DR Jr, Wentworth D, Neaton JD, Cohen JD, Multiple Risk Factor Intervention Trial Research Group. Serum cholesterol levels and six-year mortality from stroke in 350,977 men screened for the Multiple Risk Factor Intervention Trial. N Engl J Med. 1989;320(14):904-10.

49. Alam S, Aijaz M. Complications of cardiovascular disease: the impact of diabetes, dyslipidemia, and metabolic disorders. World J Pharm Res. 2024;13:321-56.

50. Denti L, Cecchetti A, Annoni V, Merli MF, Ablondi F, Valenti G. The role of lipid profile in determining the risk of ischemic stroke in the elderly: a case-control study. Arch Gerontol Geriatr. 2003;37(1):51-62.

51. Lamoria M, Yadav N, Ayana AM. Pathophysiology of atherosclerosis and its adverse effect: systematic review. 2024.

52. Jetten J, Haslam C, Pugliese C, Tonks J, Haslam SA. Declining autobiographical memory and the loss of identity: effects on well-being. J Clin Exp Neuropsychol. 2010;32(4):408-16.

53. Song YM, Kwon SU, Sung J, Ebrahim S, Smith GD, Sunwoo S, et al. Different risk factor profiles between subtypes of ischemic stroke: a case-control study in Korean men. Eur J Epidemiol. 2005;20:605-12.

54. Shinton R, Beevers G. Meta-analysis of relation between cigarette smoking and stroke. BMJ. 1989;298(6676):789-94.

55. Pellegrino MP, Moreira F, Conforto AB. Ischemic stroke. In: Neurocritical Care for Neurosurgeons: Principles and Applications. Cham: Springer; 2021. p. 517-34.

56. Caprio FZ, Lin C. Unusual causes of ischemic stroke and transient ischemic attack. In: Warlow's Stroke: Practical Management. 2019. p. 345-98.

57. Unnithan AKA, Das JM, Mehta P. Hemorrhagic stroke. In: StatPearls. Treasure Island: StatPearls Publishing; 2024.

58. Dorrance AM, Fink G. Effects of stroke on the autonomic nervous system. Compr Physiol. 2015;5(3):1241-63.

59. Tang EY, Amiesimaka O, Harrison SL, Green E, Price C, Robinson L, et al. Longitudinal effect of stroke on cognition: a systematic review. J Am Heart Assoc. 2018;7(2):e006443.

60. Lynch EB, Butt Z, Heinemann A, Victorson D, Nowinski CJ, Perez L, et al. A qualitative study of quality of life after stroke: the importance of social relationships. J Rehabil Med. 2008;40(7).

61. Kongkaew J, Sumdaengrit B, Siripitayakunkit A. Symptom experiences, symptom management strategies, and outcomes in patients with stroke. Pak J Life Soc Sci. 2025;23(1).

62. Sun B, Wang Z. A short review on advances in early diagnosis and treatment of ischemic stroke. Galen Med J. 2023;12:e2993.

63. Shafaat O, Sotoudeh H. Stroke imaging. In: StatPearls. Treasure Island: StatPearls Publishing; 2023.

64. David E, Grazhdani H, Aliotta L, Gavazzi LM, Foti PV, Palmucci S, et al. Imaging of carotid stenosis: where are we standing? Comparison of multiparametric ultrasound, CT angiography, and MRI angiography, with recent developments. Diagnostics. 2024;14(16):1708.

65. Zhang M, Long Z, Liu P, Qin Q, Yuan H, Cao Y, et al. Global burden and risk factors of stroke in young adults, 1990 to 2021: a systematic analysis of the Global Burden of Disease Study 2021. J Am Heart Assoc. 2025;14(10):e039387.

66. Gulzar S, Kiani BH, Akram RW, Hussein AM, Alamri A. Gender-based differences in stroke types and risk factors among young adults: a comparative retrospective analysis. J Clin Med. 2025;14(3):663.

67. Jiang C, Chen T, Xiang J, Pang Y. Association between physical activity levels and stroke risk among Chinese adults aged 45 and over based on CHARLS. Sci Rep. 2024;14(1):31739.

68. Wang R, Yin Y, Zhang H, Pan L, Zhu Y, Wang M, et al. Risk factors associated with the prevalence of neck and shoulder pain among high school students: a cross-sectional survey in China. 2023;24(1):641.

69. Rêgo A, Nannoni S, Scherz A, Eskandari A, Salerno A, Pereira M, et al. Undiagnosed major risk factors in acute ischaemic stroke patients: frequency, profile, stroke mechanisms and outcome. Eur J Neurol. 2024;31(1):e16011.

70. Pandian JD, Srivastava MVP, Aaron S, Ranawaka UK, Venketasubramanian N, Sebastian IA, et al. The burden, risk factors and unique etiologies of stroke in South-East Asia Region. Lancet Reg Health Southeast Asia. 2023;17.

71. Ghozy S, Zayan AH, El-Qushayri AE, Parker KE, Varney J, Kallmes KM, et al. Physical activity level and stroke risk in US population: a matched case-control study of 102,578 individuals. Ann Clin Transl Neurol. 2022;9(3):264-75.

72. Akpalu A, Sarfo FS, Akinyemi J, Wahab K, Komolafe M, Obiako R, et al. Frequency and factors associated with recurrent stroke in Ghana and Nigeria. J Neurol Sci. 2022;439:120303.

73. Mori T, Yoshioka K, Tanno Y. Non-alcoholic fatty liver disease frequency and associated factors at admission of acute stroke. Hepatol Int. 2022;16(1):81-8.

74. Sarfo FS, Akinyemi J, Akpalu A, Wahab K, Yaria J, Adebayo O, et al. Frequency and factors associated with post-stroke seizures in a large multicenter study in West Africa. J Neurol Sci. 2021;427:117535.

75. Dabilgou AA, Dravé A, Kyelem JMA, Ouedraogo S, Napon C, Kaboré J. Frequency and mortality risk factors of acute ischemic stroke in emergency department in Burkina Faso. Stroke Res Treat. 2020;2020(1):9745206.

76. Khedr EM, Abdelrahman AA, Desoky T, Zaki AF, Gamea A. Post-stroke depression: frequency, risk factors, and impact on quality of life among 103 stroke patients: hospital-based study. Egypt J Neurol Psychiatry Neurosurg. 2020;56(1):66.