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PREVALENCE AND ASSOCIATED RISK FACTORS OF STROKE AMONG PATIENTS UNDERGOING BRAIN CT AT A TERTIARY CARE HOSPITAL, PESHAWAR

Dr. Muhammad Arshad

Assistant Professor of Radiology, University of Haripur. Email: phool2110@gmail.com

Humaira Jamal

MS in Human Nutrition & Dietetics. Email: hurikhan862@gmail.com

Rimsha Ashfaq

Masters in Health Management, New Vision University, Georgia. Email: rimshaashfaq555@gmail.com

Arslan Taj

Medical Imaging Technologist at Eastridge Prime Care (Project of FFH). Email: arslan.taj126@gmail.com

Inam Ullah

Lecturer Department of Allied Health Sciences,IQRA National University Swat Campus. Email: inamu536@gmail.com

Muhammad Arslan Zafar

Lecturer, Department of Radiology/MIT Niazi Medical & Dental College, Sargodha, Pakistan. Email: muhammadarslan172117@gmail.com

Ahmad Kareem

Lecturer, at Sarhad University of Sciences & Information Technology Islamabad Campus. Email: ahmad3376228@gmail.com

Sharifullah

Lecturer MIT Faculty of Allied Health Sciences, Gomal University Dera Ismail Khan. Email: sharifullahwazir250@gmail.com

Sharifullah*

Lecturer MIT Faculty of Allied Health Sciences, Gomal University Dera Ismail Khan. Corresponding Author Email: sharifullahwazir250@gmail.com

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Corresponding Emails & Authors*

Sharifullah

sharifullahwazir250@gmail.com

Abstract

Background: Stroke is a leading cause of mortality and long-term disability worldwide, with a growing burden in Pakistan. Brain computed tomography (CT) is essential for the early diagnosis and differentiation of ischemic and hemorrhagic stroke. This study aimed to determine the prevalence of stroke and identify the associated risk factors among patients undergoing brain CT at a tertiary care hospital in Peshawar. **Methodology:** This descriptive cross-sectional study was conducted at Rehman Medical Institute, Peshawar, over four months (July–October 2023), after approval from the Institutional Research Ethics Committee. Using a non-probability consecutive sampling technique, 150 patients of either gender, aged 18–60 years, presenting with clinical features of stroke and confirmed on brain CT, were enrolled. A pre-designed questionnaire recorded demographic data, stroke type, affected region, and known risk factors (hypertension, diabetes mellitus, smoking, and atrial fibrillation). Data were analyzed using SPSS version 22; frequencies and percentages were computed for categorical variables. **Results:** Of 150 patients, 117 (78.0%) had ischemic stroke, 14 (9.3%) had hemorrhagic stroke, and 19 (12.7%) had features of both. Of 85 male patients, 67 (78.8%) had ischemic and 6 (7.1%) had hemorrhagic stroke; of 65 female patients, 50 (76.9%) had ischemic and 8 (12.3%) had hemorrhagic stroke. Stroke prevalence increased with age, with the highest burden (74.7%) in patients aged 46–60 years. Hypertension was the most prevalent risk factor (94.0%), followed by diabetes mellitus (58.0%), smoking (16.0%), and atrial fibrillation (3.3%). **Conclusion:** Ischemic stroke was markedly more prevalent than hemorrhagic stroke in this population, with prevalence rising sharply after 45 years of age and a slightly higher burden among males. Hypertension and diabetes mellitus were the leading modifiable risk factors, underscoring the need for targeted screening and control programs in this age group.

Keywords: Stroke; Prevalence; Risk Factors; Computed Tomography; Hypertension.

INTRODUCTION

Stroke, or cerebrovascular accident, is a sudden loss of brain function resulting from disruption of cerebral blood supply, and it may manifest as hemiparesis, hemiplegia, aphasia, or hemianopia.1 It is a leading global cause of death and the foremost neurological cause of morbidity and mortality, with an estimated three million stroke-related deaths reported from developing nations; while incidence has declined in Western countries, it continues to rise across Asia.1,2 Stroke is broadly classified into

ischemic and hemorrhagic subtypes. Ischemic stroke, caused by thrombotic or embolic occlusion of cerebral vasculature, accounts for approximately 75% of cases, whereas hemorrhagic stroke results from rupture of a cerebral blood vessel and accounts for 10–20% of cases, carrying disproportionately higher morbidity from edema and raised intracranial pressure.2-4

Globally, stroke incidence rose from 11.6 million in 2010 to 13.7 million in 2016, with the majority of both ischemic and hemorrhagic events occurring in low- and middle-income countries.9,10 In Pakistan, reliable population-based data remain scarce; available estimates suggest a prevalence of approximately 4.8%, with markedly higher stroke rates among middle-aged adults compared to Western populations.6,18-20 Established non-modifiable risk factors include advancing age, gender, family history, and prior stroke, while hypertension, diabetes mellitus, dyslipidemia, smoking, atrial fibrillation, obesity, and sedentary lifestyle constitute the principal modifiable risk factors — hypertension being the single largest contributor to stroke burden nationally.7,20

Non-contrast brain CT remains the first-line imaging modality for suspected stroke owing to its wide availability and high sensitivity for intracranial hemorrhage, and it reliably differentiates ischemic from hemorrhagic stroke within hours of symptom onset, guiding timely intervention.24 Despite the growing burden of stroke in Khyber Pakhtunkhwa, locally generated data correlating stroke subtype, demographic distribution, and modifiable risk factors among patients undergoing brain CT remain limited. This study was therefore designed to determine the prevalence of stroke and its subtypes, and to evaluate their association with age, gender, and established risk factors among patients undergoing brain CT at a tertiary care hospital in Peshawar.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in the Department of Radiology at Rehman Medical Institute, Peshawar, over a four-month period from July 2023 to October 2023, following approval from the Institutional Research Ethics Committee. A sample size of 150 was calculated using the WHO sample size calculator, based on an expected stroke prevalence of 12.4%, a 95% confidence level, and a 5% margin of error, using the formula $n = Z^2P(1-P)/d^2$, where n is the required sample size, Z is the statistic corresponding to the desired confidence level, P is the expected prevalence, and d is the desired precision.

A non-probability consecutive sampling technique was used to enroll patients of either gender, aged between 18 and 60 years, presenting with clinical features suggestive of stroke and referred for brain CT. Patients who presented with stroke-like symptoms but showed no corresponding CT findings of infarct or hemorrhage were

excluded. Written informed consent was obtained from all participants after explaining the purpose and scope of the study. Data were collected using a pre-designed, self-structured questionnaire comprising ten items covering patient demographics (age, gender), presenting clinical features (sudden unilateral numbness, loss of consciousness, visual disturbance, speech difficulty, and unilateral pain), stroke type on CT (ischemic, hemorrhagic, or both), affected cerebral region, and the presence of known risk factors, namely hypertension, diabetes mellitus, smoking, and atrial fibrillation.

Data were entered and analyzed using SPSS version 22. Descriptive statistics — frequencies, percentages, mean, median, and mode — were computed for categorical variables and are presented as tables and charts. Patients were stratified by gender and by three age groups (18–32, 32–46, and 46–60 years) to assess the distribution of stroke subtype and associated risk factors.

RESULTS

One hundred and fifty stroke patients were included in this study, aged between 18 and 60 years. Of these 150 patients, 117 (78.0%) were suffering from ischemic stroke, 14 (9.3%) were suffering from hemorrhagic stroke, and the remaining 19 (12.7%) had features of both ischemic and hemorrhagic stroke (Table I, Figure 1).

Table I: *Distribution of stroke types among study participants (n=150)*

Type of Stroke	Frequency	Percent
Ischemic stroke	117	78.0%
Hemorrhagic stroke	14	9.3%
Both ischemic and hemorrhagic stroke	19	12.7%
Total	**150**	**100.0%**

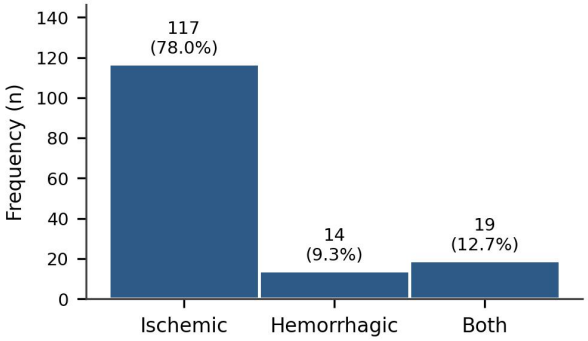
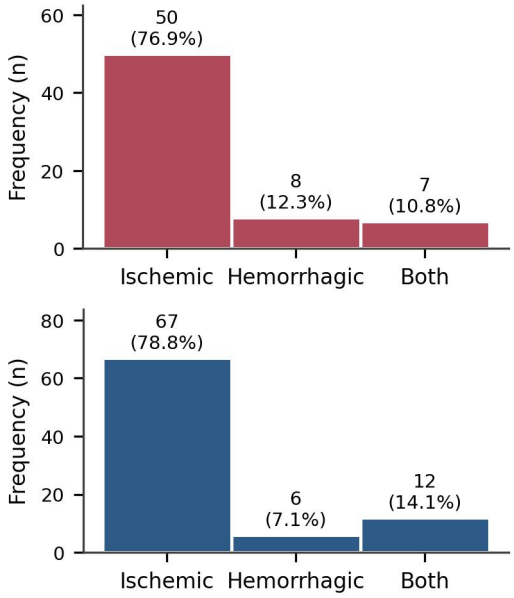


Figure 1. Frequency distribution of stroke types (Ischemic, Hemorrhagic, and Both) among study participants.

Of the 150 patients, 85 were male and 65 were female. Among the 85 male patients, 67 (78.82%) had ischemic stroke, 6 (7.05%) had hemorrhagic stroke, and 12 (14.11%) had both ischemic and hemorrhagic features. Among the 65 female patients, 50 (76.92%) had ischemic stroke, 8 (12.30%) had hemorrhagic stroke, and 7 (10.76%) had both ischemic and hemorrhagic features (Table II, Figures 2 and 3).

Table II: *Gender-wise distribution of stroke type*

Gender	n	Ischemic Stroke	Hemorrhagic Stroke	Both Ischemic & Hemorrhagic
Male	85	67 (78.82%)	6 (7.05%)	12 (14.11%)
Female	65	50 (76.92%)	8 (12.30%)	7 (10.76%)
Total	**150**	**117 (78.0%)**	**14 (9.33%)**	**19 (12.70%)**



Figures 2 & 3. Gender-wise distribution of stroke type among female (left) and male (right) patients.

Patients were divided into three age groups: Group A (18–32 years), Group B (32–46 years), and Group C (46–60 years), to assess the age-related prevalence of stroke. Stroke prevalence increased progressively with age: 20 (13.3%) patients fell within the 18–32-year group, 21 (14.0%) within the 32–46-year group, and 109 (72.7%) within the 46–60-year group, confirming that stroke burden was concentrated among older patients (Table III, Figure 4).

Table III: *Age-wise distribution of stroke patients*

Age Group (years)	Frequency	Percent
18 – 32	20	13.3%
32 – 46	21	14.0%
46 – 60	109	72.7%
Total	**150**	**100.0%**

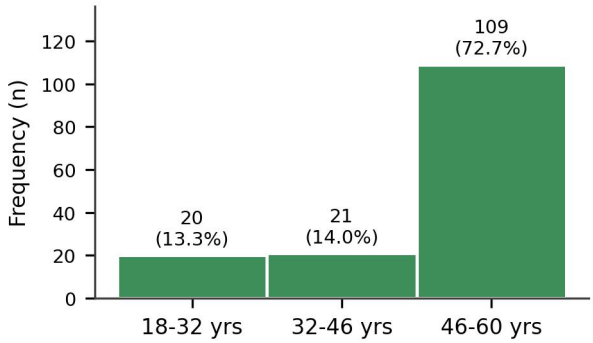


Figure 4. Age-related prevalence of stroke across the three study age groups.

Among the risk factors assessed, hypertension was the most prevalent, present in 141 (94.0%) of the 150 patients, followed by diabetes mellitus in 87 (58.0%) patients. Smoking was reported in 24 (16.0%) patients, while atrial fibrillation was the least common risk factor, present in only 5 (3.3%) patients (Table IV).

Table IV: *Frequency of associated risk factors of stroke (n=150)*

Risk Factor	Frequency	Percent
Hypertension	141	94.0%
Diabetes mellitus	87	58.0%
Smoking	24	16.0%
Atrial fibrillation	5	3.3%

Hypertension and diabetes mellitus were thus identified as the two leading risk factors for stroke in this study population, together accounting for the majority of the modifiable risk burden, while smoking and atrial fibrillation contributed a comparatively minor role.

DISCUSSION

Stroke remains a major global health concern and one of the leading causes of adult disability and mortality worldwide, with a disproportionately higher burden in low- and middle-income countries, including Pakistan, where stroke rates among middle-aged adults are reported to be five to ten times higher than in the United Kingdom or United States.18 In the present study, ischemic stroke accounted for the large majority of cases (78.0%), while hemorrhagic stroke and mixed presentations accounted for 9.3% and 12.7% respectively — consistent with the widely reported global pattern in which ischemic stroke constitutes approximately 75–85% of all strokes.2,9

Stroke prevalence in this cohort rose sharply with age, from 13.3% in patients aged 18–32 years to 72.7% in those aged 46–60 years, corroborating earlier Pakistani data showing that the greatest stroke burden occurs beyond the fifth decade of life and that advancing age remains the single strongest non-modifiable risk factor for stroke.6,20 A modest male predominance was observed (85 vs. 65 patients), with a somewhat higher proportion of ischemic stroke among males and a comparatively higher proportion of hemorrhagic stroke among females — a pattern broadly in keeping with previously reported sex-based differences in stroke subtype distribution, which have been attributed to hormonal, genetic, and vascular factors that differ between men and women.14-16

Consistent with regional and international literature identifying hypertension as the foremost modifiable risk factor for stroke, hypertension was present in 94.0% of patients in this study, followed by diabetes mellitus in 58.0%.7,20 Both conditions are established contributors to accelerated cerebrovascular atherosclerosis and small-vessel disease, and their high prevalence in this cohort mirrors the substantial burden of undiagnosed and inadequately controlled hypertension and diabetes reported across Pakistan's adult population.1,7 Smoking and atrial fibrillation contributed comparatively minor proportions of risk in this sample, though both remain independently modifiable and clinically relevant targets for stroke prevention.5,12

These findings reinforce the role of non-contrast brain CT as an accessible, rapid, first-line modality for confirming stroke and differentiating its subtype in a resource-limited tertiary care setting, allowing timely triage toward appropriate management.24 As a single-center, cross-sectional study with a modest sample size and reliance on self-reported risk-factor history, this study is limited in its generalizability and cannot establish causal or temporal associations between risk factors and stroke subtype; multicenter studies with longitudinal follow-up are needed to validate these findings across broader and more socioeconomically diverse populations.

CONCLUSION

Ischemic stroke was considerably more prevalent than hemorrhagic stroke among patients undergoing brain CT at this tertiary care hospital, with stroke prevalence rising markedly after 45 years of age and a slightly greater burden among male patients. Hypertension and diabetes mellitus emerged as the leading modifiable risk factors, highlighting the urgent need for structured screening, early detection, and control of these conditions — particularly among middle-aged and older adults — to reduce the growing burden of stroke in this population.

LIMITATIONS AND RECOMMENDATIONS

This was a single-center, cross-sectional study with a relatively small sample size and a single baseline assessment without follow-up, which may limit the generalizability of these findings. Larger, multicenter studies incorporating patients from diverse socioeconomic backgrounds are recommended to validate these results. Longitudinal follow-up of 3–6 months is also recommended to better characterize functional outcomes following stroke.

DECLARATIONS

Ethical Approval: This study was approved by the Institutional Research Ethics Committee of Rehman Medical Institute, Peshawar. Written informed consent was obtained from all participants prior to enrollment.

Conflict of Interest: The authors declare no conflict of interest.

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Authors' Contribution

Dr. Muhammad Arshad Conceptualization, study design, data collection, and manuscript writing.

Humaira Jamal Literature review, methodology design, and critical review of the manuscript.

Ahmad Kareem Supervision of data collection, clinical interpretation of results, and manuscript revision.

Rimsha Ashfaq/Inam Ullah Data collection, patient recruitment, and assistance with literature review.

Arslan Taj/ Muhammad Arslan Zafar Statistical analysis, data entry, and preparation of tables.

Sharifullah Corresponding author. Overall project coordination, final manuscript preparation, and submission. Critically revised and approved the final version of the manuscript

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