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Frequency of Hypertension among Ischemic Stroke Patients

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ABSTRACT

Background: Ischemic stroke has proven to be a serious cause of morbidity and mortality in the global patient populace. Hypertension has emerged as a prominent risk factor for the development of recurrent ischemic strokes. The establishment of the prevalence of hypertension in ischemic stroke patients will help in developing strategies to effectively manage the condition. **Objective:** To determine the frequency of hypertension among patients presenting with ischemic stroke. **Study Design:** Cross sectional study. **Duration and Place of Study:** This study was conducted from December 2023 to June 2024 in the Department of General Medicine Saidu Group of Teaching Hospitals Swat. **Methodology:** A total of 128 patients of either gender aged 28 to 70 years with confirmed ischemic stroke were included. Diagnosis of ischemic stroke was based on clinical assessment and computed tomography scan of brain without contrast. Blood pressure was measured using a sphygmomanometer and hypertension was defined as systolic blood pressure ≥140 mmHg and or diastolic blood pressure ≥90 mmHg or history of antihypertensive medication use. Data were analyzed using Statistical Package for Social Sciences version 26. **Results:** The mean age of patients was 48.20 ± 12.41 years. Out of 128 ischemic stroke patients 96 patients 75.00% were found to have hypertension. Hypertension was significantly more common in patients aged above 50 years as compared to younger patients with a p value of 0.002. A borderline significant association was observed between hypertension and diabetes with a p value of 0.051. **Conclusion:** Hypertension is highly prevalent among patients with ischemic stroke and remains a major modifiable risk factor.

INTRODUCTION

Ischemic stroke is a type of stroke that occurs as a result of cerebrovascular accident because of the obstruction of cerebral blood flow by an arterial thrombus.[1] Additionally, neuronal tissues have a constant demand for oxygen and glucose for the maintenance of cell viability; hence, ischemic stroke results in sudden loss of function of the affected part of the brain due to the obstructions caused by the thrombus.[2] Typically, patients experience sudden unilateral weakness of the limbs, facial weakness with loss of speech and speech articulation, visual disturbances with loss of vision of parts of the retina of the affected eye, dizziness due to loss of balance of the affected parts of the brain because of damage caused by reduced cerebral blood flow.[3] Furthermore, ischemic stroke results in neuronal damage; therefore, rehabilitation programs are required by patients to recover and manage the effects of ischemic stroke.[4]

Ischemic stroke is a consequence of vascular and cardiac disorders that disrupt the brain's microcirculatory flow of blood.[5] Atherosclerosis is a major etiological component, whereby lipids and calcifications build up in arterial walls and may subsequently give rise to plaque instability, leading to thrombosis and obstruction of blood flow.[6] Small vessel disease is a further etiological consideration, particularly in the presence of chronic diabetes and hypertensive states.[7] Cardioembolic stroke results as a consequence of a cerebral migration of a heart-thrombosed lesion, with atrial fibrillation a significant contributing factor.[8] Other etiologies include carotid artery stenosis, arterial dissection, coagulopathies, inflammatory conditions of the arteries, and dehydration, which may also contribute in some particular cases.[9]

It is common for a high degree of hypertension to exist alongside admission for an ischemic stroke, and it plays a pivotal role in the development of an ischemic stroke and in stroke recurrence.[10] Chronic arterial pressure injury to the endothelial layer of arteries is a consequence of high arterial pressure, which promotes atherosclerotic changes and leads to the thickening of small caliber arteries, hence reducing blood flow to the brain.[11] Immediately following an ischemic stroke, high arterial pressure is common owing to stress responses and a previously uncontrolled condition.[12] While high arterial pressure is a risk for the exacerbation of cerebral edema and may contribute to an increased risk of hemorrhage after management, reducing

it drastically may compromise the perfusion of the brain.[13] A study reported the frequency of hypertension was 83.1% among ischemic stroke patients.[14]

The importance of this study is evident in Swat, particularly in light of the increasing number of cases of ischemic stroke, in addition to a considerable number of patients presenting to healthcare facilities on a delayed schedule. High blood pressure is exceptionally common in the region, particularly in light of the poor regulation of this condition due to a lack of knowledge and available healthcare facilities. In the context of a scarcity of information regarding Swat, it is imperative to develop evidence from that region to help define the prevalence of high blood pressure in cases with ischemic stroke.

METHODOLOGY

This cross-sectional study was carried out in the General Medicine Department of Saidu Group of Teaching Hospitals Swat, from 01-12-2023 to 01-06-2024. Approval for the study was obtained from the hospital ethical board (48-ERB/023) as well as the research department of CPSP before initiation of data collection, and all study procedures were conducted according to institutional ethical standards. The sample size was calculated using the WHO sample size calculator. A total of 128 patients were enrolled by taking an anticipated proportion of hypertension of 83.1% among ischemic stroke patients,[14] with a confidence level of 95% and a margin of error of 6.5%. Patients were recruited through consecutive non-probability sampling.

Patients of either gender with age between 28–70 years and diagnosed cases of ischemic stroke were included. Patients who were pregnant or lactating and those with epilepsy were excluded from the study. Ischemic stroke was considered in patients presenting with acute neurological deficit such as weakness on left or right side persisting for more than 24 hours along with findings on CT scan brain without contrast showing hypo-dense area in brain parenchyma. Written informed consent was taken from all eligible patients or their attendants after explaining the purpose, benefits, and possible risks of the study prior to enrollment. A detailed medical history was obtained and physical examination was performed for all patients. Confirmation of ischemic stroke was done through clinical assessment and CT scan of brain without contrast. During CT imaging, the patient was placed in supine position with head kept in midline on the movable table, which passed through the scanner while the X-ray tube rotated around the head, and images were obtained to identify hypo-dense regions in brain parenchyma. Ischemic stroke was identified as acute neurological deficit lasting more than 24 hours with CT scan brain without contrast showing hypo-dense area in brain tissue.

The blood pressure measurement was carried out with the help of a sphygmomanometer and stethoscope together. The cuff was placed on the upper arm, and the stethoscope on top of the brachial artery. The cuff was inflated above the palpable radial pulse by at least 30mmHg, followed by a gradual deflation at 2-3mmHg/sec. The onset of the first Korotkoff sound marked the systolic blood pressure, and the point of disappearance of Korotkoff sounds marked the diastolic blood pressure. Both systolic and diastolic pressures were measured accordingly. Hypertension was said to be present if either the systolic blood pressure was ≥140mmHg and/or diastolic blood pressure was ≥90mmHg, or there was a history of treatment with anti-hypertensive medications in the past five years.

Data were entered and analyzed using SPSS version 23. Numerical variables were expressed as mean ± standard deviation. Categorical variables were presented as frequencies and percentages. Stratification of hypertension was done with respect to age, BMI, gender, duration of ischemic stroke, diabetes, smoking and residence area. Post-stratification chi-square test was applied and a p-value ≤0.05 was taken as statistically significant. Findings were presented in the form of tables and charts.

RESULTS

The mean age of participants were 48.20 ± 12.41 years with mean weight of 73.04 ± 8.92 kg and mean height of 1.67 ± 0.08 m. The body mass index was calculated as 27.02 ± 2.87 Kg/m^2. The mean duration of ischemic stroke was found to be 11.01 ± 5.80 days. Regarding gender distribution, majority of patients were males which comprised 94 patients (73.4%) while females were 34 patients (26.6%). Economic status revealed that 9 patients (7.0%) belonged to upper class, 62 patients (48.4%) were from middle class and 57 patients (44.5%) were in lower class category. Residential distribution showed that 71 patients (55.5%) were residing in rural areas whereas 57 patients (44.5%) belonged to urban areas. Diabetes was present in 71 patients (55.5%) and absent in 57 patients (44.5%). Smoking habit was reported by 56 patients (43.8%) while 72 patients (56.3%) were non-smokers (as shown in Table 1).

Table 1

Patient Demographics and Clinical Characteristics

Demographics		Mean ± SD
Age (years)		48.20 ± 12.41
Weight (kg)		73.04 ± 8.92
Height (m)		1.67 ± 0.08
BMI (Kg/m^2)		27.02 ± 2.87
Ischemic Stroke Duration (days)		11.01 ± 5.80
Gender	Male n (%)	94 (73.4%)
	Female n (%)	34 (26.6%)
Economic Status	Upper Class n (%)	9 (7.0%)
	Middle Class n (%)	62 (48.4%)
	Lower Class n (%)	57 (44.5%)
Residence Area	Rural n (%)	71 (55.5%)
	Urban n (%)	57 (44.5%)
Diabetes	Yes n (%)	71 (55.5%)
	No n (%)	57 (44.5%)
Smoking	Yes n (%)	56 (43.8%)
	No n (%)	72 (56.3%)

The frequency of hypertension among ischemic stroke patients was determined where 96 patients (75.00%) were found to have hypertension while 32 patients (25.00%) were not having hypertension out of total 128 patients (as shown in Table 2).

Table 2
Frequency of Hypertension Among Ischemic Stroke Patients

Hypertension	Frequency	% age
Yes	96	75.00%
No	32	25.00%
Total	128	100%

For age groups, among patients aged ≤50 years, 44 patients (63.8%) had hypertension and 25 patients (36.2%) did not have hypertension, while in age group >50 years, 52 patients (88.1%) had hypertension and 7 patients (11.9%) were without hypertension with statistically significant p-value of 0.002. Gender wise distribution showed that among males, 68 patients (72.3%) had hypertension and 26 patients (27.7%) did not have hypertension, whereas among females, 28 patients (82.4%) had hypertension and 6 patients (17.6%) did not have hypertension with p-value of 0.248 which was not statistically significant. BMI stratification revealed that among patients with BMI ≤25 Kg/m^2, 30 patients (71.4%) had hypertension and 12 patients (28.6%) did not have hypertension, while among patients with BMI >25 Kg/m^2, 66 patients (76.7%) had hypertension and 20 patients (23.3%) did not have hypertension with p-value of 0.514. Economic status analysis showed that in upper class, 7 patients (77.8%) had hypertension and 2 patients (22.2%) did not have hypertension, in middle class, 43 patients (69.4%) had hypertension and 19 patients (30.6%) did not have hypertension, and in lower class, 46 patients (80.7%) had hypertension and 11 patients (19.3%) did not have hypertension with p-value of 0.367 using Fischer Exact Test. Residential status demonstrated that among rural residents, 56 patients (78.9%) had hypertension and 15 patients (21.1%) did not have hypertension, while among urban residents, 40 patients (70.2%) had hypertension and 17 patients (29.8%) did not have hypertension with p-value of 0.259. Diabetes status showed that among diabetic patients, 58 patients (81.7%) had hypertension and 13 patients (18.3%) did not have hypertension, whereas among non-diabetic patients, 38 patients (66.7%) had hypertension and 19 patients (33.3%) did not have hypertension with p-value of 0.051 which was approaching statistical significance. Smoking status revealed that among smokers, 40 patients (71.4%) had hypertension and 16 patients (28.6%) did not have hypertension, while among non-smokers, 56 patients (77.8%) had hypertension and 16 patients (22.2%) did not have hypertension with p-value of 0.411 (as shown in Table 3).

Table 3
Association of Hypertension with Demographic Factors

Demographic Factors		Hypertension		p-value
		Yes n(%)	No n(%)	
Age (years)	≤50	44 (63.8%)	25 (36.2%)	0.002
	>50	52 (88.1%)	7 (11.9%)	
Gender	Male	68 (72.3%)	26 (27.7%)	0.248
	Female	28 (82.4%)	6 (17.6%)	
BMI (Kg/m^2)	≤25	30 (71.4%)	12 (28.6%)	0.514
	>25	66 (76.7%)	20 (23.3%)	
Economic Status	Upper Class	7 (77.8%)	2 (22.2%)	0.367*
	Middle Class	43 (69.4%)	19 (30.6%)	
	Lower Class	46 (80.7%)	11 (19.3%)	
Residential Status	Rural	56 (78.9%)	15 (21.1%)	0.259
	Urban	40 (70.2%)	17 (29.8%)	
Diabetes	Yes	58 (81.7%)	13 (18.3%)	0.051
	No	38 (66.7%)	19 (33.3%)	
Smoking	Yes	40 (71.4%)	16 (28.6%)	0.411
	No	56 (77.8%)	16 (22.2%)	

*Fischer Exact Test

DISCUSSION

The findings show a high prevalence of hypertension in patients with ischemic stroke, with 96 patients (75.00%) being affected. This can be attributed to the fact that hypertension is a chronic condition that causes endothelial dysfunction and atherosclerosis in the cerebral vessels, leading to decreased cerebral blood flow and consequently ischemic stroke. Hypertension causes permanent damage to the arterial walls, leading to plaque formation that may be prone to rupture or thrombosis in the intracranial arteries. There was a significant association between age and hypertension (p = 0.002), with patients above 50 years having a higher prevalence of hypertension (52/59; 88.1%) compared to those below 50 years (44/69; 63.8%). This is in tandem with the fact that increasing age is associated with stiffening of the arteries and a loss of elasticity due to degenerative changes in the smooth muscle and the accumulation of collagen in the arterial wall. Aging is also associated with decreased baroreceptor sensitivity and decreased renal function, leading to hypertension. Diabetes: This risk factor had a trend of significance (p = 0.051), wherein the prevalence of hypertension was higher in patients with diabetes compared to those without the condition (58/71: 81.7% and 38/57: 66.7%, respectively). The mechanism associated with this risk factor is the development of insulin resistance, which increases the secretion of renin and the activity of the sympathetic nervous system, resulting in the development of hypertension. Hyperglycemia also increases the production of reactive oxygen species and triggers endothelial inflammation of the blood vessels, resulting in the development of hypertension and atherosclerosis, which increases the risk of ischemia.

The frequency of hypertension in present study was 75.00% (96 patients) which is comparable with findings of Lahano AK *et al.* [15] who reported 80.2% hypertension in stroke patients and Ammad B *et al.* [16] who documented 67.4% hypertension among ischemic stroke patients. However, this frequency is lower than Amanullah *et al.* [17] who found 100% hypertension in their cohort and Haider I *et al.* [18] who reported 42.2% hypertension. The higher frequency in Amanullah *et al.* [17] study can be attributed to their strict inclusion criteria requiring all patients to be hypertensive at admission with mean BP of 180/100 mmHg, while lower frequency in Haider I *et al.* [18] might be due to different diagnostic criteria or population characteristics. The present findings also align with Samad M *et al.* [19] who observed 68.3% hypertension in stroke patients, suggesting that hypertension remains dominant risk factor across Pakistani population.

The significant association between age and hypertension with p-value of 0.002 in current study, where older patients >50 years showed 88.1% (52 patients) hypertension compared to 63.8% (44 patients) in younger patients ≤50 years, is consistent with Nasim H *et al.* [20] who found hypertension significantly more frequent in patients

>40 years (43.5% vs 7.6%, p=0.013). This similarity demonstrates that age-related vascular changes and arterial stiffening universally increases hypertension risk regardless of geographical location. Similarly, Khan AU *et al.* [21] reported that 67% of newly diagnosed hypertensive patients were in 30-50 years age group, further supporting age-related progression of hypertension.

The borderline significant association between diabetes and hypertension with p-value of 0.051 in present study, where diabetic patients showed 81.7% (58 patients) hypertension compared to 66.7% (38 patients) in non-diabetics, is supported by Haider I *et al.* [18] who identified diabetes as significant determinant of hypertension (p≤0.000) and Samad M *et al.* [19] who found 85% hypertension among diabetic patients (p<0.01). The metabolic syndrome linking diabetes and hypertension through insulin resistance and endothelial dysfunction explains this consistent association across studies. However, Ammad B *et al.* [16] found no significant association between diabetes and hyperlipidemia in hypertensive stroke patients, suggesting that relationship between metabolic factors may vary depending on specific outcomes measured.

There are several limitations to this study, which should be acknowledged. First, this study was done in one institution, namely in one hospital, which limits the generalizability of the results to the whole population. The sample size was composed of only 128 participants, which can be small in detecting some associations. Since it was cross-sectional, it cannot give information on temporal associations of hypertension with ischemic stroke. Other variables like smoking and the duration of hypertension were asked in this study through self-report, which can lead to biases. This study did not check for outcomes in hypertensive patients with ischemic stroke after some time.

CONCLUSION

This research concludes that the prevalence of hypertension in ischemic stroke patients is very high and a major modifiable risk factor in ischemic stroke cases. Age is a significant risk factor for the development of hypertension, with a higher prevalence of the latter in the older group when compared to the young group of patients, showing that increasing age potentiates the vulnerability to hypertensive-related complications. Diabetes mellitus has a borderline significant association with hypertension, showing the interactive role of this pair in the pathogenesis of ischemic stroke.

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Ethical Approval: This research was approved by the Ethical Committee. All activities of the study were done by following the committee rules and the Helsinki Declaration.

Patients' Consent: Before joining the study all patients signed a written consent form. They were informed that their personal data would remain confidential and they were free to withdraw from the study at any time.

REFERENCES

1. Majumder D. Ischemic stroke: pathophysiology and evolving treatment approaches. *Neurosci Insights*. 2024; 19:26331055241292600. https://doi.org/10.1177/26331055241292600
2. Pisani DF, Blondeau N. Deciphering the brain glucose metabolism: a gateway to innovative stroke therapies. *J Cereb Blood Flow Metab*. 2025;45(9):1635-1653. https://doi.org/10.1177/0271678X251346277
3. Liu Y, Tang Q, Wu X, Peng X, Xu X. Diagnostic challenges in emergency stroke: a case series. *Quant Imaging Med Surg*. 2025;15(3):2592-2604. https://doi.org/10.21037/qims-24-1640
4. Gunduz ME, Bucak B, Keser Z. Advances in stroke neurorehabilitation. *J Clin Med*. 2023;12(21):6734. https://doi.org/10.3390/jcm12216734
5. Wang L, Ma L, Ren C, Zhao W, Ji X, Liu Z, *et al.* Stroke–heart syndrome: current progress and future outlook. *J Neurol*. 2024;271(8):4813-4825. https://doi.org/10.1007/s00415-024-12480-4
6. Jovin DG, Sumpio BE, Greif DM. Manifestations of human atherosclerosis across vascular beds. *JVS Vasc Insights*. 2024;2:100089. https://doi.org/10.1016/j.jvsvi.2024.100089
7. Osman A, Kanaan A, Azeroual S, Abubakr M, Jwayyed J, Bhutta R. Hypertension and cerebral small vessel disease: a review of the pathophysiology, progression, and prevention. *Cureus*. 2025;17(9):e92760. https://doi.org/10.7759/cureus.92760
8. Palaiodimou L, Tsivgoulis G. Cardioembolic breakthrough stroke: when anticoagulation fails, is left atrial appendage closure the next step? *Eur J Neurol*. 2025;32(10):e70387. https://doi.org/10.1111/ene.70387
9. Kosyakovsky J, Rossitto CP, Antonios JP, Renedo D, Stapleton CJ, Sansing LH, *et al.* Clot composition and ischemic stroke etiology: a contemporary narrative review. *J Clin Med*. 2025;14(17):6203. https://doi.org/10.3390/jcm14176203
10. Qiao Y, Fayyaz AI, Ding Y, Ji X, Zhao W. Recent advances in the prevention of secondary ischemic stroke: a narrative review. *Brain Circ*. 2024;28(10):283-295. https://doi.org/10.4103/bc.bc_159_24
11. Colombari E, Biancardi VC, Colombari DSA, Katayama PL, de Medeiros FC, Aitken AV, *et al.* Hypertension, blood-brain barrier disruption and changes in intracranial pressure. *J Physiol*. 2025;603(8):2245-2261. https://doi.org/10.1113/JP285058
12. Yu S, Liu C. Advancing post-stroke blood pressure management: an individualized BP strategy for function optimization. *Ann Med*. 2025;57(1):2583327. https://doi.org/10.1080/07853890.2025.2583327
13. Camps-Renom P, Guasch-Jiménez M, Martínez-Domeño A, Prats-Sánchez L, Ramos-Pachón A, Álvarez-Cienfuegos J, *et al.* A randomized trial on hemodynamic optimization of cerebral perfusion after successful endovascular therapy in patients with acute ischemic stroke (HOPE). *Cerebrovasc Dis*. 2024;54(4):559-566. https://doi.org/10.1159/000540606
14. Jing L, Tian Y, Ren G, Zhang L, Shi L, Dai D, *et al.* Epidemiological features of hypertension among ischemic survivors in northeast China: insights from a population-based study. *Public Health*. 2021;21(1):1-10. https://doi.org/10.1186/s12889-021-11692-x
15. Lahano AK, Chandio MA, Bhatti MI. Frequency of common modifiable risk factors for stroke. *Gomal J Med Sci*. 2014;12(4):222-226.

16. Ammad B, Malik A, Muhammad RS, Javed M, Imtiaz H. Frequency of hyperlipidaemia in patients coming with ischemic stroke in tertiary care hospital Karachi. *Pak J Neurol Sci*. 2023;18(2):Art.5. https://doi.org/10.56310/pjns.v18i02.265
17. Amanullah, Shah N, Rehman S, Ataullah S. Frequency of cerebral infarction and haemorrhage in the patients of stroke. *J Ayub Med Coll Abbottabad*. 2009;21(4):102-105.
18. Haider I, Rahman SU, Badshah A, Ullah M, Fayyaz M, Mohammad W. Risk factors for hypertension in patients with stroke presenting to tertiary care hospital. *J Gandhara Med Dent Sci*. 2023;10(4):17-20. https://doi.org/10.37762/jgmds.10-4.469
19. Samad M, Khan M, Nawaz R. Frequency of hypertension in ischemic and hemorrhagic strokes: a cross-sectional study at a tertiary care hospital of Multan, South-Punjab Pakistan. *J Med Physiol Biophys*. 2018;43:57-62.
20. Nasim H, Butt NI, Ashfaq F, Anwar A, Aftab S, Muaaz M. Frequency of modifiable risk factors in ischemic stroke patients at a tertiary care hospital in Lahore Pakistan. *Pak J Med Res*. 2023;62(2):53-58. https://doi.org/10.37076/pjmr.62.2.2023.42689
21. Khan AU, Hussain M, Amjad K. Frequency of undiagnosed hypertension in patients presenting with stroke. *Pak Armed Forces Med J*. 2016;66(2):250-253.