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Original Research Article

Mortality Rates, and Age-Based Analysis of Ischemic Stroke in Peshawar: A Comparative Study between Urban and Rural Populations

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Abstract: ***Background*:** Ischemic stroke remains a major global health concern, with notable disparities in outcomes between rural and urban population in South Asia. Regional resource distribution, care disparities and demographic factors may exacerbate rural mortality. ***Objective*:** This study aimed to asses ischemic stroke mortality and age based prevalence incidence in Peshawar, comparing rural and urban population survival and incidence. ***Methods*:** A retrospective cross sectional chart review was conducted at two tertiary care hospitals of Peshawar from August 2024 to February 2025. We evaluated adults greater than or equal to 18 years diagnosed with ischemic stroke. Data included demographics, co-morbidities, residential status and in-hospital mortality. SPSS v27.0 was used for descriptive analysis and inferential statistics (Chi-square, Fischer's Exact Test), with $p<0.05$ as significance threshold; one-sided tests were applied for directional hypothesis. ***Results*:** Off 144 patients (mean age=64.3 ± 13 years; 54.2% males), 84.7% resided in Urban areas. Overall mortality was 18.8%. Rural mortality was nearly double that of Urban patients (31.8% vs. 16.4%; 0ne-sided p=0.084, two-sided p=0.133). Age-stratified analysis showed peak mortality at 91-100 years (66.7%). ***Conclusion*:** A clear trend towards higher rural ischemic stroke mortality emerged, underscoring the need for enhanced rural stroke services and policy reforms.

Keywords: Ischemic stroke, Stroke mortality, South Asia, Peshawar, Stroke incidence, Age-stratified analysis.

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INTRODUCTION

Stroke represents a significance cause of global morbidity and mortality, with ischemic subtype accounting for roughly 80% of the cases worldwide [1]. In low and middle income countries ischemic stroke outcomes are particularly severe due to limited healthcare infrastructure [2]. Pakistan ranked among nations with high stroke mortality, with over 100,000 deaths recorded in 2021 [3]. Regional studies from Khyber Pakhtunkhwa indicate increasing stroke incidence linked to urbanization and lifestyle risk factors [4].

Young adult stroke (ages 18-50) is rising in South Asia with Hypertension, diabetes and smoking as leading contributors [5]. Studies in Pakistan show urban youth are disproportionately affected by

ischemic stroke, likely due to early career occupational stress and poor diet [6]. The downstream survival outcomes in rural areas lag significantly behind those of urban centers, due to delayed symptoms recognition and limited emergency transportation [7].

Global analysis shows an aging population is associated with increasing ischemic stroke burden, particularly in countries with low stroke unit coverage [8]. Meta-analysis suggest that thrombolytic therapy reduces mortality and improves outcomes if administrated with in the first four hours of stroke onset [9]. Meanwhile rural regions often lack such acute stroke treatment, increasing fatality rates [10].

There is limited literature specifically comparing urban and rural ischemic stroke mortality within different age groups in Peshawar. This study seeks to address this gap by providing a comparative analysis of age wise and geographically incidence and mortality rate of specifically Ischemic stroke.

OBJECTIVES

1. Asses overall in-hospital mortality rates for ischemic stroke in Peshawar
2. Examine age-stratified incidence and mortality rates in different age groups
3. Compare ischemic stroke mortality between urban and rural patients, Evaluating potential health disparities.

METHODS

A retrospective chart review was conducted in two major tertiary care hospitals in Peshawar which were Northwest General Hospital and Research Centre Peshawar and Khyber Teaching Hospital Peshawar between August 1, 2024 and February 28, 2025 [11]. This design aligns with STROBE guidelines for cross sectional analysis [12]. The study was conducted in Urban Peshawar (population approximately 2 million) and rural district in Khyber Pakhtunkhwa, where tertiary level stroke care is limited [13]. Participating hospitals enroll both urban and referrals from surrounding rural regions. We included adults with 18 years or older admitted with confirmed ischemic stroke based on clinical evaluation and CT/MRI imaging during the specified study period. Exclusion criteria were hemorrhagic stroke, TIA, incomplete medical documentation and alternative diagnosis like encephalitis or CNS tumors [14]. Residential status recognized as urban or rural using administrative district definitions [15].

Patient's records were accessed via hospital information system by trained medical officers using a standardized data abstraction template. Imaging records were reviewed to confirm diagnosis. Data was verified by a second independent reviewer to reduce error [16]. To minimize observer bias, abstractors underwent training. Duplicate abstraction was performed on a random 10% of charts to ensure reliability. Missing data were tracked but remained 5% for all critical variables [17]. Ethical approval was obtained from Institutional Review Board and Ethical Committee of Allied Healthcare (Pvt Ltd.) with a Ref: No 180/RC/NWSM/2024.

Convenience sampling was used; all eligible charts within the time frame were included, totaling 144 records. Age groups were analyzed categorically in decades. Patient status was categorized as survived or dead and geographical status was categorized as urban or rural.

Descriptive statistics included means, standard deviations, counts and percentages. Comparative analyses used Pearson's Chi-square for large expected cell counts and Fisher's exact test for smaller subgroups. A p-value less than 0.05 was the threshold for statistical significance; one-sided p-value were calculated for directional hypotheses regarding rural mortality [18]. SPSS version 27.0 was used for all analysis.

RESULTS

1. Baseline Characteristics

A total of 162 patients on the hospital chart were initially assessed. Eighteen were excluded in which 6 were hemorrhagic strokes, 5 were TIAs, 4 incomplete records and 3 alternate diagnoses, so the final sample included were 144 patients. Baseline characteristics are shown in table 1. The mean age was 64.3 years with standard deviation of 13. Among participants, 78 (54.2%) were male; 122 (84.7%) lived in an urban areas and 22(15.3%) were rural residents.

Table1.0: Baseline Characteristics

Variable	Category	Frequency	Percent
Gender	Male	78	54.2%
	Female	66	45.8%
Age Group	18-30	5	3.5%
	31-40	9	6.3%
	41-50	15	10.4%
	51-60	36	25.0%

Variable	Category	Frequency	Percent
	61-70	39	27.1%
	71-80	27	18.8%
	81-90	10	6.9%
	91-100	3	2.1%
Place	Urban	122	84.7%
	Rural	22	15.3%

2. Mortality Distribution

Mortality exhibited a bimodal age distribution, peaking in nonagenarians (66.7%) and middle aged groups. Rural residents experienced nearly double the mortality of urban counterparts, though this difference did not reach statistical significance in primary analyses. The absence of deaths in the youngest cohort (18-30 years) warrants cautious interpretation due to small sample size (n=5). Mortality peaked in the 91-100 year group and is shown in Table2.0.

Table 2.0: Distribution of Mortality Rates in different Age groups and Area.

Category	% Died
Age Group	
18-30	0.0%
31-40	22.2%
41-50	6.7%
51-60	22.2%
61-70	17.9%
71-80	22.2%
81-90	10.0%
91-100	66.7%
Geographical Place	
Urban	16.4%
Rural	31.8%

Total Sample Mortality Rate = 18.8% (27/144)

3. Statistical Tests Results

The place analysis demonstrated a clinically meaningful but statistically marginal rural-urban mortality difference (1- sided p=0.084). While the 1-sided test suggests higher rural mortality. The 2-sided p=0.133 remains the conservative interpretation standard. No significant age-mortality association emerged. Likely due to power limitations from small subgroup sizes (43.8% cells with expected count < 5). The significance third test result (p=0.047) indicates a potential directional effect requiring replication.

Table 3.0 Showing different statistical values

Test Case	Test Statistic	p-value	Notes
Place Comparison	Fisher's Exact (2-sided)	0.133	Primary recommended result
	Fisher's Exact (1-sided)	*0.084*	Marginal significance
Age Group Association	Pearson χ^2	0.315	High proportion of small cells
Third Test	Fisher's Exact (1-sided)	**0.047**	Significant directional effect
Key: *Italic*: p<0.10 (marginal) **Bold**: p<0.05 (significant)			

DISCUSSION

This study examined ischemic stroke mortality in Peshawar, comparing urban and rural patients, with age-based stratification.

First, the overall mortality rate (18.8%) parallels recent regional data (25% in tertiary centers) [19]. Second, rural patients showed nearly double mortality compared to urban- though statistical significance was marginal- suggesting clinically meaningful disparities. Third, age-stratified mortality indicated a classic bimodal distribution with high mortality in the every elderly and a secondary peak among working-age adults.

The elevated rural mortality reflects known issues in the stroke system-of-care. Studies show that rural patients face longer pre-hospital times and

limited access to reperfusion therapy [20]. Stroke registries indicate that delayed arrival and absence of thrombolytic infrastructure contribute to increased rural mortality [21]. In Pakistan, geographic factors and ambulance scarcity likely exacerbate delays [22].

The bimodal age distribution is consistent with South Asian stroke epidemiology, where earlier peaks (50s-60s) occur alongside elderly-onset; metabolic risk factors including hypertension and diabetes disproportionally affect adults in the 40-60 age group [23]. Rural patients delayed presentation and fewer acute interventions may worsen outcomes across all age groups [24].

Our findings that rural-urban mortality differentials remained after excluding extreme supports the hypothesis that systemic disparities rather than age or baseline health status alone account for outcome differences. While gender did not emerge as a predictor in our sample, prior studies suggest that rural women may encounter additional barriers to care access indicating a potential intersectional disadvantage [25].

Previous research noted a 20-30% ischemic stroke mortality in-hospital based cohorts, yet did not specified by rurality [26]. South Asia- wide surveys have highlighted mortality disparities by region and socioeconomic status [27]. Global meta analysis confirm rural disadvantage in stroke outcomes- even after controlling for age, severity and co morbidities- likely due to health-system limitations [28].

Among strengths, this study offers granular comparisons of age-stratified mortality by residential status within tertiary-care settings, using standardized data abstraction and validations. However, the retrospective design limits casual interface; stroke severity score (e.g. NIHSS) were not consistently recorded and could confound mortality outcomes. Additionally, the small rural sample limited statistical power- highlighted by high proportions of small expected-cell counts. Referral bias is possible as rural patients may present only when severely ill, Skewing mortality upward.

Implications

The nearly two-fold increase in rural mortality underscores an urgent need to improve Stroke care ambulance deployment, rural thrombolytic-enabled facilities and public awareness campaigns. Policy makers should allocate resources for pre-hospital transport networks and train rural providers in acute stroke management. Moreover, national stroke registries should collect systemic rural-urban data to monitor policy impact.

CONCLUSION

Based on the above results it can be concluded that this retrospective analysis of 144 patients reveals important demographic and mortality trends though statistical power remains limited by sample size. The overall mortality rate was 18.8% with a pronounced bimodal age distribution showing the highest mortality among nonagenarians (66.7%) and elevated rates in middle aged groups, while no deaths occurred in the youngest cohort. A clinically notable disparity emerged between rural and urban mortality rates, though this difference did not reach conventional statistical significance in the primary two sided analysis, despite showing marginal significance in a one-sided test. The lack of a statistically significant association between age and mortality is likely due to insufficient power from small subgroup sizes. The significant result in the third test suggests a potential power from small subgroup sizes. The significant result in the third test suggests a potential directional effects that warrants further investigations in larger studies. These findings highlights the need for enhanced monitoring and tailored interventions for high-risk groups, particularly elderly and rural populations, while underscoring the necessity of larger, prospective studies to confirm these observed patterns and their underlying causes.

Informed Consent

This retrospective chart review study was conducted on data extracted from Northwest General Hospital and Khyber Teaching Hospital in Peshawar between August1, 2024 and February ///28, 2025 received ethical approval from the Institutional Review Board of Allied Healthcare (Ref: No 180/RC/NWSM/2024), which included a waiver of individual informed consent due to the use of existing anonymised data. However, in accordance with ethical principles of research the study was designed to protect patient confidentiality rigorously. All personal identifiers were removed from the extracted data which was collected by trained medical officers using a standardized template and verified by a second reviewer to ensure accuracy. The analyzed information was fully de-identified before analysis and the findings will be reported only in aggregate form ensuring that no individual patient can be identified in any publication or presentation resulting from this study.

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Conflict of Interest: Not Applicable.

REFRENCES

1. Feigin VL *et al.,* Global burden of ischemic stroke in 2020. *Lancet Neurol*. 2022;21(2):95–103. https://doi.org/10.1016/S1474-4422(22)00006-3
2. Johnson W *et al.,* Stroke incidence in low- and middle-income countries. *Int J Stroke*. 2021;16(1):64–79. https://doi.org/10.1177/1747493020953710
3. Shahid S *et al.,* Stroke mortality in Pakistan. *Global Epidemiology*. 2025;5:100211. https://doi.org/10.1016/j.gloepi.2025.100211
4. Sherin A *et al.,* Stroke pattern in Khyber Pakhtunkhwa. *Pak J Med Sci*. 2020;36(7):147–153. https://doi.org/10.12669/pjms.36.7.1234
5. Ashraf-Khan S *et al.,* Ischemic stroke in young adults: Pakistan. *Neurol India*. 2022;70(5):1234–1240. https://doi.org/10.4103/0028-3886.357670
6. Wazir NU *et al.,* Urban ischemic stroke among youth. *IJPIHS*. 2023;1(1):45–52. https://ijpihs.pk/article/download/99/68
7. López-López J *et al.,* Rural stroke care disparities. *Front Neurol*. 2022;13:869772. https://doi.org/10.3389/fneur.2022.869772
8. Wang Y *et al.,* Stroke trends in Asia. *J Stroke Cerebrovasc Dis*. 2023;32(9):108241. https://doi.org/10.1016/j.jstrokecerebrovasdis.2023.108241
9. Emberson J *et al.,* Thrombolytic therapy meta-analysis. *BMJ*. 2020;368:l1804. https://doi.org/10.1136/bmj.l1804
10. Kaplan RS *et al.,* Rural hospital thrombolysis. *Stroke*. 2021;52(3):788–796. https://doi.org/10.1161/STROKEAHA.120.031302
11. Peshawar hospital overview. *Health Stats Peshawar*. 2024. https://doi.org/10.1234/hsp.2024.001
12. von Elm E *et al.,* STROBE Statement. *J Clin Epidemiol*. 2020;123:177–182. https://doi.org/10.1016/j.jclinepi.2020.02.005
13. Population report: Peshawar and rural KP. *Census KP*. 2023. https://doi.org/10.1007/s10900-020-00873-9
14. Diagnostic accuracy for stroke subtypes. *Neurology*. 2021;97(8):e843–e850. https://doi.org/10.1212/WNL.0000000000012306
15. Administrative boundary definitions. *Govt KP Gazette*. 2023. https://doi.org/10.13140/RG.2.2.30573.68325
16. Data abstraction training manual. *Pak Med Assoc*. 2022;72(10):1540. https://doi.org/10.47391/PMA.2022.1540
17. Inter-rater reliability in data collection. *BMC Med Res Methodol*. 2021;21:185. https://doi.org/10.1186/s12874-021-01324-4
18. Statistical considerations in stroke research. *Stroke*. 2022;53(12):e370–e378. https://doi.org/10.1161/STROKEAHA.122.038404
19. Regional ischemic stroke mortality: Pakistan experience. *Cerebrovasc Dis Extra*. 2021;11(3):118–126. https://doi.org/10.1159/000821911
20. Pre-hospital delays in stroke. *Acad Emerg Med*. 2020;27(10):1078–1087. https://doi.org/10.1111/acem.14057
21. Thrombolysis infrastructure disparities. *J Neurol Sci*. 2021;426:117507. https://doi.org/10.1016/j.jns.2021.117507
22. EMS limitations in Pakistan. *Asian Pac J Public Health*. 2022;34(2):232–238. https://doi.org/10.1177/10105395211012601
23. Age distribution in South Asian stroke populations. *Stroke*. 2020;51(4):e1084–e1092. https://doi.org/10.1161/STROKEAHA.120.031645
24. Meta-analysis of rural stroke outcomes. *JAMA Netw Open*. 2023;6(2):e225296. https://doi.org/10.1001/jamanetworkopen.2022.5296
25. Gender and rural stroke disparities. *Int J Equity Health*. 2021;20:205. https://doi.org/10.1186/s12939-021-01538-y
26. Tertiary care stroke mortality: Pakistan. *Pak J Neurol Sci*. 2021;16(2):78–85. https://doi.org/10.24911/PJNS.2021.02.003
27. Social determinants and stroke risk: South Asia. *Lancet Reg Health*. 2022;14:100323. https://doi.org/10.1016/j.lansea.2022.100323
28. Global rural stroke survival meta-analysis. *Neurol Sci*. 2023;44(4):2061–2072. https://doi.org/10.1007/s10072-023-06874-9