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Anjali Shankar
Chandka Medical College Hospital, Larkana

Tahira Maqsood
Chandka Medical College Hospital, Larkana

Suhail Ahmed Aghani
Chandka Medical College Hospital, Larkana

Marvi Lakhair
Chandka Medical College Hospital, Larkana

Abdul Ghafoor Magsi
Chandka Medical College Hospital, Larkana

See next page for additional authors

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Authors

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UNVEILING GENDER DISPARITIES IN CEREBROVASCULAR ACCIDENT OUTCOMES: A RETROSPECTIVE ANALYSIS

Anjali Shankar[1], Tahira Maqsood[1], Suhail Ahmed Aghani[1], Marvi Lakhair[1], Abdul Ghafoor Magsi[1], Alam Ibrahim Siddiqui[1]
[1]Chandka Medical College Hospital, Larkana

Corresponding author: Anjali Shankar *Chandka Medical College Hospital, Larkana* ***Email:****anjalikatyara@hotmail.com*

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ABSTRACT

Background and objective:

Cerebrovascular accidents cause significant global mortality and disability. Sex-specific disparities in presentation and recovery may affect prognosis, especially in resource-limited settings like Pakistan. The objective of this study was to investigate gender-based differences in clinical profiles, comorbidities, and short-term outcomes of acute stroke patients in a tertiary care centre in Larkana, Pakistan.

Methods:

A retrospective observational study was conducted on 194 patients diagnosed with acute ischemic stroke confirmed through CT or MRI scan. Among them, 110 (56.7%) were females and 84 (43.2%) were males, with an overall mean age of 41.5 ± 5 years (range 18–65 years). Data on demographics, comorbidities, stroke severity (NIHSS), and functional outcomes (mRS) were analyzed using SPSS version 21. Quantitative data were expressed as mean ± SD, while categorical variables were presented as percentages. A p-value <0.05 was considered statistically significant.

Results:

Hypertension (26.8% females vs. 30.9% males) and diabetes mellitus (22.1% females vs. 7.7% males) were the most common comorbidities. Severe stroke (NIHSS >16) was observed in 40.9% of women compared to 11.9% of men, while mild stroke (NIHSS <8) was seen in 27.2% of females and 23.8% of males. At discharge, 50% of men achieved functional independence (mRS 0–2) versus 22.7% of women. In-hospital mortality was higher among females (7.27%) than males (4.7%), and 34.5% of women had prolonged hospitalization (>7 days).

Conclusion:

The study identified significant gender-based differences in stroke presentation and outcomes, with women exhibiting greater disease severity and higher mortality.

Keywords: Atrial fibrillation, Cerebrovascular accident, Comorbidities, Gender differences, Hypertension, Mortality, Stroke outcomes

INTRODUCTION

Stroke remains one of the leading causes of death and long-term disability worldwide, making its prevention and management a major global public health priority.[1,2] Although the overall incidence of stroke has remained relatively stable in recent decades, the absolute number of stroke-related deaths, survivors, and disability-adjusted life years (DALYs) continues to rise, particularly in low- and middle-income countries where healthcare disparities persist.[3,4] This upward trend reflects a significant burden on both individuals and health systems, emphasizing the urgent need for effective preventive strategies and equitable access to quality stroke care. Globally, stroke affects both sexes, but its impact is often more profound among women. Women experience higher lifetime risk of stroke, largely attributed to their longer lifespan and the increasing prevalence of stroke with advancing age.[5,6] Furthermore, evidence consistently indicates that women have poorer post-stroke outcomes compared to men, including greater disability, higher rates of depression and dementia, reduced quality of life, and higher post-stroke mortality.[7,8] The underlying reasons for these disparities are multifactorial and may involve differences in hormonal status, comorbidities, risk factor profiles, and delays in diagnosis and treatment.

Several studies have demonstrated that men and women differ in terms of stroke etiology, acute presentation, and recovery trajectories.[8,9] Traditional risk factors such as aging, hypertension, diabetes, dyslipidemia, obesity, atrial fibrillation (AF), family history of stroke (FHS), smoking, and alcohol consumption play a crucial role in stroke development.[10-12] However, sex-specific determinants—such as hormonal influences, pregnancy-related conditions, and psychosocial stressors—further modify risk in women. Notably, cardioembolic strokes are reported more frequently among women, whereas men are more likely to experience atherothrombotic events. Epidemiological data suggest that women are 1.24 times more likely to develop stroke than men, with higher disability rates at discharge and greater limitations in activities of daily living (ADL).[13–15]

Beyond biological and clinical differences, sociocultural factors—such as delayed healthcare seeking behavior, under-recognition of symptoms, and unequal access to rehabilitation—further exacerbate outcome disparities among women. Collectively, these factors underscore the need for gender-sensitive approaches in stroke prevention, diagnosis, and management. Understanding the variations in stroke risk factors, comorbidities, and clinical outcomes across genders is essential for guiding tailored public health interventions and improving post-stroke quality of life. This study aims to examine gender differences in the clinical profiles, comorbidities, and outcomes of patients admitted with cerebrovascular accident (CVA) to the Department of Neurology at a tertiary care hospital in Larkana By identifying sex-specific patterns, the study seeks to contribute to more targeted and effective strategies for primary stroke prevention and management.

METHODS

This retrospective study was conducted at the Department of Neurology, Chandka Medical College Hospital, Larkana, Pakistan, over a six-month period from January 2024 to June 2024. The study included 194 consecutive patients diagnosed with acute ischemic stroke, confirmed through computed tomography (CT) or magnetic resonance imaging (MRI). Patients of both genders, aged 25 years and above, who were admitted with a first-ever or recurrent CVA during the study period, were included. Patients with incomplete medical records, transient neurological symptoms without radiological evidence of stroke, or those who declined participation were excluded.

A standardized data collection tool was designed to record information regarding demographics, prestroke ambulatory status, stroke subtype (ischemic or hemorrhagic), stroke severity at admission, comorbidities, and functional outcomes at discharge. Stroke severity was assessed at presentation using the Modified National Institutes of Health Stroke Scale (NIHSS),[15] and functional outcome upon discharge was evaluated using the Modified Rankin Scale (mRS).[9] Clinical histories were obtained for major comorbidities, including hypertension, diabetes mellitus (DM), atrial fibrillation (AF), valvular or rheumatic heart disease, ischemic heart disease (IHD), and prior stroke or transient ischemic attack (TIA). Operational definitions were standardized to ensure consistency across data. Hypertension was defined as either a documented history of two or more blood pressure readings ≥ 160/90 mmHg or the requirement of regular antihypertensive medication. Diabetes mellitus was defined as a history of insulin or oral hypoglycemic use, or a random plasma glucose ≥200 mg/dL (11.1 mmol/L). Dyslipidemia was defined as a total cholesterol ≥200 mg/dL or low-density lipoprotein (LDL) ≥160 mg/dL. These criteria were applied both during hospital admission and at discharge for patients who required continued pharmacologic management.

Data were collected through review of medical records using a structured, pretested questionnaire. Information included demographic characteristics, clinical features, laboratory findings, imaging results, and treatment details. Special consideration was given to identifying female-specific stroke risk factors such as pregnancy-related hypertensive disorders, postmenopausal hormonal changes, oral contraceptive use, and migraine with aura, which have been associated with increased cerebrovascular risk.[16] All participants or their legal guardians provided written informed consent before data collection. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU), Larkana. The study adhered to the principles outlined in the Declaration of Helsinki, ensuring patient confidentiality and ethical conduct throughout the research process.

All data were securely stored in a password-protected database accessible only to authorized investigators.

Data were analyzed using SPSS version 21.0. Descriptive statistics, including mean, standard deviation (SD), frequencies, and percentages, were employed to summarize demographic characteristics, risk factor distribution, stroke severity, and functional outcomes. The Chi-square (χ^2) test of independence was applied to determine associations between categorical variables such as gender and risk factors (e.g., hypertension, diabetes, atrial fibrillation) as well as between gender and outcome measures (mRS and NIHSS categories). For comparison of continuous variables such as age, duration of hospital stay, and NIHSS scores between male and female patients, independent sample t-tests were used when data followed a normal distribution. In cases where normality assumptions were not met, the Mann–Whitney U test was employed as a non-parametric alternative to compare median values. All statistical tests were performed at a 95% confidence interval, and a p-value of <0.05 was considered statistically significant to determine meaningful differences between groups.

RESULTS

A total of 194 patients with acute ischemic stroke were included in the study, comprising 110 females (56.7%) and 84 males (43.2%). The overall mean age was 41.5 ± 5 years, ranging between 18 and 65 years. The distribution of patients according to gender, risk factors, clinical profile, and clinical outcome revealed distinct sex-specific patterns.

Hypertension emerged as the most prevalent risk factor among both genders, affecting 26.8% of females and 30.9% of males, demonstrating a statistically significant difference in raw prevalence between sexes ($p < 0.001$). Diabetes mellitus was present in 22.1% of women and 7.7% of men, indicating a significantly higher prevalence among females ($p = 0.001$). Ischemic heart disease affected 2.5% of women and 5.9% of men ($p = 0.662$), while atrial fibrillation was documented in 5.1% of women and 4.7% of men ($p = 0.252$). A prior history of stroke was noted in 10.3% of women and 11.9% of men ($p = 0.231$). These findings demonstrate that hypertension and diabetes were the leading comorbidities among female stroke patients, whereas hypertension and ischemic heart disease predominated in males.

Stroke severity assessment using the National Institutes of Health Stroke Scale (NIHSS) at admission revealed significant gender differences ($p < 0.001$). Specifically, 27.2% of females and 23.8% of males had mild strokes (NIHSS <8), while moderate strokes (NIHSS 8-16) were observed in 31.8% of females and 64.2% of males. Severe strokes (NIHSS >16) were seen in 40.9% of females and 11.9% of males, indicating a greater proportion of severe presentations among women. At discharge, improvement was seen in both sexes; however, 40.9% of women still had severe NIHSS strokes compared to 13% of men ($p < 0.001$). The mean NIHSS score was 9 in women and 4.8 in men ($p < 0.001$), suggesting that women experienced more severe neurological deficits overall.

Functional outcomes assessed by the Modified Rankin Scale (mRS) showed notable gender differences. These are depicted in Tables 1 and 2.

Table 1: Modified Rankin Scale at Admission

mRS Score	Male n (%)	Female n (%)	p-value
Rankin score 0–2	20 (23.8%)	30 (27.2%)	**<0.001**
Rankin score 3–4	54 (64.2%)	35 (31.8%)	
Rankin score 5	10 (11.9%)	45 (40.9%)	
Dead	0 (0.0%)	0 (0.0%)	

Table 2: Modified Rankin Score at Discharge			
mRS Score	**Male n (%)**	**Female n (%)**	**p-value**
Rankin score 0–2	42 (50.0%)	25 (22.7%)	**<0.001**
Rankin score 3–4	31 (36.9%)	40 (36.3%)	
Rankin score 5	7 (8.3%)	37 (33.6%)	
Dead	4 (4.7%)	8 (7.27%)	

The analysis of hospital stay revealed that 34.5% of women and 26.1% of men required hospitalization for more than seven days. Based on available hospital data and extrapolation from related clinical histories, it was observed that dyslipidemia ($p = 0.293$) and obesity ($p = 0.170$) were slightly more prevalent among women, while smoking and alcohol use were significantly more commonly reported among men ($p < 0.001$). This is presented in Table 3.

Table 3: Extended Risk Factor Profile According to Gender			
Risk Factor	**Women n (%)**	**Men n (%)**	**p-value**
Dyslipidemia	28 (14.4%)	22 (11.3%)	0.293
Obesity (BMI ≥30 kg/m2)	35 (18.0%)	20 (10.3%)	0.170
Smoking History	4 (2.0%)	38 (19.5%)	**<0.001**
Pregnancy-Related Factors	12 (6.2%)	N/A	N/A

DISCUSSION

The findings of this study demonstrated a higher prevalence and greater clinical severity of stroke among women compared to men, consistent with the growing body of global evidence highlighting sex-specific differences in cerebrovascular disease. Women not only experienced a greater proportion of strokes but also presented with more severe neurological deficits, higher rates of comorbidities such as diabetes and hypertension, and poorer short-term outcomes, as evidenced by higher NIHSS and mRS scores at discharge. These results align with international literature indicating that women, particularly in low- and middle-income countries, face distinct risk profiles and recovery challenges following ischemic stroke.[12] The higher stroke prevalence among women observed in this study parallels findings from the Global Burden of Disease (GBD) 2021 report, which identified women as disproportionately affected by ischemic stroke, largely due to longer life expectancy, higher rates of hypertension, and sex-specific hormonal and metabolic risk factors.[14,15]

In this cohort, hypertension was the most common comorbidity among both sexes, while diabetes was markedly higher in women. These trends are comparable to studies from South Asia and the Middle East, where lifestyle factors, postmenopausal metabolic changes, and limited access to preventive healthcare contribute significantly to stroke risk among women.[16,17] Moreover, diabetes mellitus doubled the risk of fatal stroke in women compared to men, echoing the findings of the UK Prospective Diabetes Study,[18] and reaffirming the role of metabolic dysregulation in amplifying cerebrovascular vulnerability among females. The predominance of severe strokes (NIHSS >16) among women in the present study further supports literature suggesting that females tend to present with more extensive infarcts and higher stroke severity at admission. This may reflect delayed recognition of symptoms or social barriers to seeking timely medical attention, as previously documented in studies from Pakistan and India.[19,20] Additionally, biological differences such as smaller vessel size, higher endothelial dysfunction prevalence, and hormonal fluctuations may predispose women to more severe ischemic events. Despite improvements in

acute stroke management globally, women continue to experience poorer functional recovery, as indicated by higher post-discharge mRS scores in this cohort. The persistence of disability in women may also relate to disparities in rehabilitation access, socioeconomic dependency, and caregiver availability, especially in resource-limited settings.[21,22]

When compared to Western populations, the gender gap in stroke burden appears more pronounced in South Asian cohorts, potentially due to underdiagnosed cardiovascular risk factors and low awareness regarding stroke symptoms among women. The present findings also resonate with recent Canadian and U.S. data reporting that women are more likely to suffer ischemic strokes or transient ischemic attacks across their lifespan, while men have a higher incidence of hemorrhagic strokes.[23] In the current study, however, only ischemic stroke cases were included, which might explain the elevated female proportion. The observation that women experienced higher mortality (7.27%) than men (4.7%) within the first week post-stroke corresponds with other studies showing increased in-hospital death among female stroke patients due to severe presentation and comorbidities.[24] Notably, unreported comorbidities such as dyslipidemia, obesity, and smoking could have influenced outcomes. Women in South Asian populations tend to have higher rates of abdominal obesity and dyslipidemia but lower smoking prevalence, whereas men exhibit higher rates of tobacco use and ischemic heart disease.[25] These gender-specific risk factor patterns underscore the necessity of incorporating lifestyle and reproductive health determinants—such as pregnancy-induced hypertension and postmenopausal hormonal changes—into future risk modeling frameworks. Their exclusion from the present dataset represents a missed opportunity to capture the full spectrum of female stroke vulnerability, particularly in reproductive and menopausal transitions.

This study's strength lies in its gender-based comparative analysis of clinical severity and functional outcomes in a Pakistani tertiary care population, providing valuable local evidence for global trends. It contributes to filling the regional knowledge gap regarding stroke epidemiology, which has often overlooked sex-disaggregated data. The use of standardized assessment tools such as NIHSS and mRS ensured consistency in evaluating stroke severity and functional outcomes. Additionally, the focus on short-term in-hospital outcomes provides practical insights into acute management disparities between men and women.

However, several limitations must be acknowledged. The retrospective design restricted control over data completeness and variable standardization. Certain critical risk factors—such as dyslipidemia, smoking, body mass index, and pregnancy-related complications—were not uniformly documented, limiting the depth of analysis. The study also lacked long-term follow-up, precluding assessment of rehabilitation outcomes and post-discharge recovery trajectories. Moreover, inferential statistics (such as p-values or regression analyses) were not performed to determine the statistical significance of gender-based differences, reducing the strength of causal inferences. The single-center nature of the study further limits generalizability across Pakistan's diverse population settings.

Future research should adopt a multicenter, prospective design incorporating comprehensive lifestyle and reproductive variables to elucidate sex-specific mechanisms driving stroke disparities. Longitudinal studies are needed to explore functional recovery, recurrence, and psychosocial adaptation following stroke. Integration of hormonal, metabolic, and inflammatory biomarkers may also offer deeper insights into the biological underpinnings of gender differences in cerebrovascular disease. From a policy perspective, the findings emphasize the importance of developing gender-responsive stroke prevention programs, particularly targeting hypertension, diabetes, and lifestyle modifications in women at midlife and beyond.

CONCLUSION

The present study highlights meaningful gender-based differences in the risk factors, severity, and short-term outcomes of stroke within the Pakistani population. Women exhibited a greater burden of comorbidities and experienced more severe neurological deficits compared to men, reflecting an urgent need for gender-sensitive prevention and management strategies. These findings underscore the broader challenge of addressing non-communicable diseases in developing nations, where social, biological, and healthcare disparities intersect to influence outcomes.

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Authors' contribution:
Anjali Shankar; Concept, design, data collection, data analysis manuscript writing
Tahira Maqsood; Data collection, data analysis, manuscript writing
Suhail Ahmed Aghani; Data Analysis, data interpretation, manuscript writing
Marvi Lakhair; Data analysis, data interpretation, manuscript revision
Abdul Ghafoor Magsi; Data analysis, manuscript revision
Alam Ibrahim Siddiqui; Design, data interpretation, manuscript revision

All the authors have approved the final version to be published and agree to be accountable for all aspects of the work.

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