

Sex-Based Disparities in Stroke: A Comprehensive Analysis of Demographic Characteristics, Clinical Presentations, and Outcomes Among Patients Admitted to IBHOH in 2024

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INTRODUCTION

Stroke persists as one of the most significant global health challenges, ranking as a leading cause of mortality and long-term disability worldwide, with compelling evidence of sex-based disparities in its epidemiology, clinical manifestations, and outcomes ^{1,2,3}. Recent epidemiological trends reveal a complex pattern: while men traditionally experience higher stroke incidence at a younger and middle age, the gap between males and females has narrowed over the past decade ⁴. Women, particularly in post-menopausal years, bear a disproportionate burden of stroke-related disability and mortality, a phenomenon attributed to their greater longevity and unique risk factor profiles ^{2, 5,6}.

The pathophysiology of stroke exhibits marked sex differences, influenced by a multifaceted interplay of biological, hormonal, genetic, and sociocultural factors. The fundamental basis for these disparities has been increasingly linked to variations in sex steroid hormones, particularly estrogen, which exerts vasodilatory effects on the vascular endothelium, contrasting with testosterone's vasoconstrictive properties ⁷. This hormonal influence partially explains why premenopausal women experience relative protection against cerebrovascular events compared to age-matched men, a benefit that diminishes after menopause ⁸. Additionally, women typically present with stroke at more advanced ages, often with more severe neurological deficits, atypical symptoms such as vertigo, and distinct risk factor profiles including higher prevalence of hypertension and atrial fibrillation ^{9,10}.

Clinical outcomes following stroke demonstrate significant sex-based variations, though recent evidence suggests an evolving landscape. Historically, women have experienced worse functional outcomes and higher levels of post-stroke dependency ^{2,11}. However, longitudinal data from 2007 to 2018 indicate that this disparity has substantially narrowed, with female patients experiencing larger improvements in stroke outcomes than male patients over the past decade ⁶. This positive trend may reflect enhanced recognition of sex-specific factors in stroke management and improved access to acute interventions, though women remain underrepresented in secondary stroke prevention trials by approximately 11.7% globally ³. Such underrepresentation raises concerns about the generalizability of research findings and the efficacy of therapeutic interventions across sexes. Ischemic stroke, accounting for approximately 85% of all cases globally, and hemorrhagic stroke, though less frequent, are associated with higher mortality rates and demonstrate sex-specific patterns in risk factors, presentation, and outcomes ^{12,13}. Recent research has identified education level, socioeconomic status, baseline stroke severity, and smoking history as key factors contributing to sex differences in functional outcomes ⁶. Additionally, women face unique barriers to clinical trial participation, including higher rates of severe neurological deficits, cognitive impairment, and aphasia that may impede informed consent processes ³.

In this evolving context, our study at IBHOH aimed to comprehensively evaluate the demographic characteristics, clinical presentations, acute management strategies, and outcomes of stroke patients admitted in 2024, with particular emphasis on sex-based differences. By meticulously analyzing these disparities through a contemporary lens, we seek to contribute to the growing body of evidence informing sex-specific approaches to stroke prevention, acute intervention, and rehabilitation. This research is especially timely given the dynamic nature of sex differences in stroke outcomes observed over the past decade and the persistent need for more inclusive clinical research practices. Through identifying and addressing sex-specific factors in stroke care, we aim to develop targeted strategies that optimize outcomes for all patients in our population.

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METHODOLOGY

This retrospective audit was conducted at IBHOH, reviewing all stroke admissions from January to December 2024. Data were collected from hospital records, including demographic information, clinical characteristics, stroke subtype, acute management, and outcomes.

Inclusion Criteria:

- Adult patients aged 18 years and above
- Admission to IBHOH with a confirmed diagnosis of stroke (ischemic or hemorrhagic)
- Clinical presentation consistent with acute stroke, verified by neuroimaging (CT or MRI)
- Admission within the study period (January–December 2024)
- Both first-ever and recurrent stroke cases were included

Exclusion Criteria:

- Patients with stroke mimics (e.g., seizures, migraines, or metabolic disturbances)
- Patients with a pre-stroke modified Rankin Scale (mRS) score >3, indicating severe pre-existing disability
- Cases with incomplete or missing medical records

Data Collection and Statistical Analysis: Data were input into Microsoft Excel and analyzed with IBM SPSS Statistics (Version 26.0). Python (using pandas and matplotlib libraries) facilitated advanced data visualization and tabulation. Descriptive statistics (mean, standard deviation, frequency, percentage) summarized patient characteristics. Independent sample t-tests were conducted to compare continuous variables (e.g., age, NIHSS score).

RESULTS

Demographic Characteristics

In 2024, IBHOH admitted 191 stroke patients. Among them, 27.7% (n=53) were female and 72.3% (n=138) were male. Female patients tended to have a higher mean age than male patients; however, the age distribution indicated that women were more commonly found in the older age groups, with several female patients presenting at age 73.

Table 1: the shows the demographic characteristic of the patients.

Demographic Variable	Value
Total Patients	191
Female Patients	53 (27.7%)
Male Patients	138 (72.3%)
Mean Age - Female	59.2
Mean Age - Male	54.7

Stroke Subtypes and Etiology

Ischemic stroke (AIS) was the predominant subtype, accounting for 67.0% of all cases (n=128), followed by intracerebral hemorrhage (ICH) at 17.3% (n=33), transient ischemic attack (TIA) at 10.5% (n=20), cerebral venous thrombosis (CVT) at 2.6% (n=5), and subarachnoid hemorrhage (SAH) at 1.6% (n=3). The distribution of stroke subtypes exhibited some variation between sexes, although the sample size limited statistical power for subgroup comparisons.

Clinical Presentation and Severity

At admission, women exhibited slightly lower neurological deficits than men, as shown by the average National Institutes of Health Stroke Scale (NIHSS) scores (5.1 ± 5.2 for women versus 6.5 ± 5.6 for men, $p=0.179$); however, this difference was not statistically significant. Women had a median NIHSS score of 4.0, while men scored 5.0. Both groups displayed a broad range of stroke severity, with the highest NIHSS scores reaching 18 for women and 25 for men.

Acute Management

Regarding acute interventions, intravenous thrombolysis with Alteplase was administered at similar rates for women and men (91.7% vs. 91.9% of eligible patients, respectively). The door-to-needle time (DTN) for thrombolysis was comparable between the sexes (54.9 ± 29.2 minutes for women vs. 52.2 ± 16.6 minutes for men). Women displayed a slightly wider range of DTN times (17-118 minutes) compared to men (15-95 minutes), indicating greater variability in treatment timelines for female patients.

Physiotherapy was initiated within 72 hours, along with antiplatelet therapy within 24 to 48 hours, as per the standard stroke care protocol, showing comparable rates between genders. Brain CT scans were carried out promptly in both groups, with door-to-CT times kept within the recommended guidelines.

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Table 2: shows the acute management.

Acute Intervention	Female	Male
Alteplase given (among eligible)	91.7%	91.9%
Mean DTN Time (min)	54.9 ± 29.2	52.2 ± 16.6
DTN Time Range (min)	17–118	15–95
Physiotherapy within 72 hrs	Yes	Yes
Antiplatelet within 24–48 hrs	Yes	Yes
Door-to-CT time within target	Yes	Yes

Functional Outcomes

Functional outcomes at discharge, indicated by the modified Rankin Scale (mRS), revealed that women tended to have poorer outcomes, with a mean mRS score of 2.46 ± 1.50 compared to 2.39 ± 1.58 for men. Notably, the percentage of patients experiencing poor functional outcomes (defined as mRS 3-6, which signifies moderate to severe disability or death) at discharge was considerably higher in women than in men (41.5% vs. 29.0%, respectively).

Table 3: Shows the functional outcome.

Outcome	Female (n)	Female (%)	Male (n)	Male (%)
Good outcome (mRS 0–2)	15	28.3%	50	36.2%
Poor outcome (mRS 3–6)	22	41.5%	40	29.0%
Not recorded	16	30.2%	48	34.8%

Discharge Disposition and Mortality

Most patients were discharged home, with 75.5% of women and 73.2% of men included. Transfers to other facilities occurred in 5.7% of female and 5.1% of male patients. In-hospital mortality was slightly higher among women (1.9%) than among men (0.0%). No 30-day mortality was recorded for either group.

Table 4: Shows the Discharge, Disposition, and Mortality

Disposition	Female (n)	Female (%)	Male (n)	Male (%)
Discharged home	40	75.5%	101	73.2%
Transferred	3	5.7%	7	5.1%
Died in hospital	1	1.9%	0	0.0%
LAMA	1	1.9%	1	0.7%
Not recorded	8	15.1%	29	21.0%

Secondary Prevention Measures

Secondary prevention measures were implemented according to standard guidelines. At discharge, statins, Therapy, and antiplatelet medications were prescribed at comparable rates for both sexes. Anticoagulation for atrial fibrillation was administered as needed, although the occurrence of atrial fibrillation did not significantly differ between women and men in this group.

All patients received stroke education before discharge, with no notable differences in education rates between sexes. To maintain continuity of care and support ongoing secondary prevention, follow-up appointments were arranged for all surviving patients.

Length of Hospital Stay

Hospital stay duration varied by sex, although data format challenges hindered a thorough statistical analysis. Descriptive statistics indicate that female patients experienced longer hospital stays than male patients, which aligns with their higher rates of unfavorable functional outcomes at discharge.

DISCUSSION

Demographics and Functional Outcomes

At IBHOH, the significant number of male stroke admissions reflects the demographic composition of RAK. This study provides a thorough examination of sex differences in stroke admissions, treatment, and outcomes for patients admitted to IBHOH in 2024. It is framed by the unique population structure of Ras Al Khaimah (RAK), where males make up 63.8% and females account for 36.2% of the population. This demographic disparity, primarily influenced by a predominantly male expatriate workforce, is crucial for understanding the observed trends in stroke epidemiology and treatment, with men outnumbering women by about two to one (UAE statistics 2025). This gender imbalance is largely due to the workforce, which mainly consists of working-age men.

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Therefore, the elevated rate of male stroke patients does not suggest that men face a higher stroke risk; instead, it highlights their larger population proportion. Investigating sex differences in stroke presentation, management, and outcomes is essential for equitable healthcare. The 2024 findings from IBHOH align with global research, revealing distinctive yet subtle variations between male and female stroke patients. Although men represented most admissions, women were typically older and exhibited worse functional outcomes, reflecting worldwide trends ².

Numerous studies indicate that women tend to suffer strokes later in life and are at increased risk for severe post-stroke disability and dependence. For instance, Reeves et al. reported that women experienced significantly worse functional outcomes 90 days post-stroke, even after controlling for age and other factors. Additionally, meta-analyses suggest that elements such as older age, pre-stroke dependency, and comorbidities primarily account for the outcome differences between sexes, though they do not explain all variations ¹⁴.

Stroke Severity and Presentation

Although women in the IBHOH cohort had slightly lower NIHSS scores on admission, the difference was not statistically significant, consistent with reports of inconsistent predictive value of early severity scoring across sexes. Some studies suggest women may present with more severe strokes, but these differences are often attenuated after adjusting for age and pre-existing disability. Furthermore, women frequently exhibit atypical or non-traditional stroke symptoms, such as disorientation, generalized weakness, and mental status changes, which can contribute to diagnostic delays and suboptimal acute management ¹⁵.

Treatment Delays and Acute Management

A significant observation from the IBHOH data is the broader range of door-to-needle times (DNT) for women, even though their thrombolysis rates are comparable. Several studies back this finding, indicating that women frequently face longer in-hospital treatment delays, which may stem from atypical symptoms, late identification, or age-related biases in care. Most studies suggest that treatment delays for women can last anywhere from 20 minutes to 4 hours longer than for men, though the extent and clinical relevance of these delays may differ by setting. In contrast, pre-hospital delays are less consistently noted and could be affected by factors such as living alone or residing in institutions, which are more prevalent among older women ¹⁶.

Outcomes: Mortality and Dependency

Women in the IBHOH cohort experienced higher rates of poor functional outcomes (mRS 3–6: 41.5% compared to 29.0%) and a slight increase in in-hospital mortality (1.9% versus 0.0%). This aligns with previously reported trends of increased post-stroke dependency and mortality among females. These disparities remain significant even when considering age and comorbidities, indicating the involvement of both biological and systemic factors. Nonetheless, some studies suggest that after adjustments, women may have a reduced long-term mortality risk, possibly indicating a general survival advantage for females.

Data Quality and Systemic Challenges

A persistent challenge in local and international settings is the under-documentation of key outcome metrics, such as the modified Rankin Scale (mRS), which undermines accurate stratification and quality improvement efforts. Structured follow-up pathways and robust stroke registries are necessary to address these gaps and enable more precise evaluation of sex-specific outcomes ¹⁷.

Length of Stay and Rehabilitation

Women experienced more extended hospital stays, aligning with global research that links extended admissions to factors like older age, polypharmacy, and slower recovery rates ¹⁸. This highlights the necessity of early post-acute planning, which should include physiotherapy, caregiver support, and rehabilitation access, especially for older female patients.

To address disparities, future strategies need to include sex-sensitive triage algorithms, proactive post-discharge planning, and the participation of women in stroke research. Moelgg et al. (2025) stress that closing the evidence-practice divide necessitates deliberate data gathering and tailored clinical pathways that account for stroke patients' demographic realities. Our study offers regionally relevant insights and underscores specific opportunities for enhancing equitable stroke care delivery.

LIMITATIONS

When interpreting this study's findings, several limitations should be acknowledged:

First, because this is a single-center retrospective audit, the results may not be generalizable to other institutions with different demographics and healthcare infrastructures.

Second, despite comprehensive data collection, we observed significant gaps in documentation, especially regarding mRS scores and discharge information, which could have affected outcome comparisons.

Third, the sample size, particularly within specific subgroups (e.g., 3-month follow-up and rare stroke types), restricted the statistical power to identify small yet potentially significant differences between genders.

Furthermore, we did not evaluate potential confounders such as socioeconomic status, pre-hospital delays, medication adherence, and caregiver availability, which might have influenced recovery trajectories and functional outcomes. Future prospective studies

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with larger, multi-center cohorts and standardized data collection methods must confirm these results and investigate the causal pathways related to sex disparities in stroke.

CONCLUSION

This 2024 audit of stroke admissions at Ibrahim Bin Hamad Obaidullah Hospital highlights significant gender-based differences in demographics, clinical characteristics, and functional outcomes. While the management of acute strokes, including thrombolysis and imaging protocols, was similar for both genders, female patients tended to be older, had more extended hospital stays, and were at higher risk for poor functional outcomes at discharge. Although there were no early notable differences in neurological severity, women exhibited slightly poorer recovery patterns, possibly influenced by factors like age, comorbidities, and the necessity for specialized post-stroke care. These findings correspond with global evidence underscoring the necessity for tailored stroke management strategies. They highlight the critical need for early stroke detection in women, proactive rehabilitation planning, and equitable follow-up care. The study's limitations, including incomplete outcome data and its single-center nature, suggest the need for broader, prospective data gathering to guide targeted interventions. Despite this, the study offers valuable local insights to improve sex-sensitive stroke care in the UAE.

Recommendations and Future Directions

To address these disparities, future strategies should include:

1. Sex-sensitive triage algorithms and protocols to minimize treatment delays for women.
2. Enhanced post-discharge planning and rehabilitation tailored to older female patients.
3. Inclusion of women in stroke research to better understand sex-specific risk factors and responses to therapy.
4. Improved data collection and outcome documentation to inform quality improvement and policy.
5. Bridging the evidence-practice gap requires intentional, stratified clinical pathways that reflect the demographic realities of stroke populations. The current study contributes valuable local insights and identifies actionable targets for improving equity in stroke care delivery.

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