FREQUENCY OF RISK FACTORS LEADING TO STROKE IN PATIENTS ADMITTED TO MARDAN MEDICAL COMPLEX: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Stroke remains a leading cause of mortality and long-term disability worldwide, with ischemic stroke comprising the majority of cases. Identification and assessment of modifiable risk factors are essential to inform effective prevention and management strategies, particularly in resource-limited settings where local data remain scarce.

Objective: To determine the frequency and distribution of key risk factors among stroke patients admitted to Mardan Medical Complex.

Methods: A hospital-based cross-sectional study was conducted over six months in the Department of Medicine, Mardan Medical Complex. A total of 162 stroke patients aged 18–75 years were enrolled using non-probability consecutive sampling. Data were collected through structured proformas, including demographics, clinical history, laboratory investigations, and neuroimaging. Risk factors such as hypertension, diabetes mellitus, smoking, hypercholesterolemia, and family history of coronary artery disease were assessed based on standardized diagnostic criteria. Data analysis was performed using SPSS v23. Categorical variables were reported as frequencies and percentages; continuous variables as mean ± SD. Chi-square and Fisher's exact tests were used for post-stratification analysis.

Results: The mean age was 61.2 ± 10.4 years, with 56.8% male participants. Ischemic stroke accounted for 79.6% of cases. Hypertension (66.7%) was the most prevalent risk factor, followed by smoking (39.5%), diabetes mellitus (32.1%), hypercholesterolemia (23.5%), and family history of CAD (11.7%). Nearly 29% had a history of previous stroke. Risk factors were more prevalent among ischemic stroke patients compared to hemorrhagic.

Conclusion: Hypertension, smoking, and diabetes mellitus were the leading modifiable risk factors for stroke in this cohort. Strengthening early detection and risk factor control measures is crucial for reducing stroke incidence and improving patient outcomes.

Keywords: Cerebrovascular Accident, Diabetes Mellitus, Hemorrhagic Stroke, Hypertension, Ischemic Stroke, Pakistan, Risk Factors, Smoking, Stroke Prevention, Stroke Recurrence.

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INTRODUCTION

Stroke, as defined by the World Health Organization, is a clinical syndrome characterized by the rapid development of focal or global neurological dysfunction lasting more than 24 hours or resulting in death, with no apparent cause other than a vascular origin (1). It is a major public health concern globally, ranking as the third leading cause of death and the most significant contributor to long-term disability. Approximately 5 million deaths are attributed to stroke each year, underscoring its devastating impact on individuals and healthcare systems worldwide (2). In industrialized nations, stroke remains among the top three causes of mortality, reflecting its persistent burden despite advances in medical care. The pathophysiology of stroke involves the interruption of blood supply to the brain due to either a blockage or rupture of cerebral blood vessels. This leads to oxygen deprivation and subsequent neuronal death in the affected area (3). Stroke is broadly classified into two types: ischemic and hemorrhagic. Ischemic stroke accounts for nearly 80% of all cases and is often erroneously perceived as a single disease entity, despite arising from varied underlying mechanisms such as large artery atherosclerosis, cardio embolism, or small vessel occlusion (3,4). Hemorrhagic stroke, although less common, is often more severe and is caused by bleeding either into the brain tissue (intracerebral) or into the surrounding subarachnoid space. Understanding the risk factors associated with stroke is essential for prevention and management. Many risk factors are shared between ischemic and hemorrhagic stroke, although some distinctions exist. Hypertension, for instance, is a major contributor to both types but is particularly significant in hemorrhagic stroke due to its role in vessel rupture (5).

Hypercholesterolemia contributes primarily to ischemic stroke through atherosclerosis of both extracranial and intracranial vessels, much like its role in coronary artery disease (6). Modifiable risk factors such as hypertension, diabetes mellitus, smoking, hypercholesterolemia, heart disease, and alcohol consumption play a substantial role in stroke pathogenesis and are commonly targeted in public health interventions. On the other hand, non-modifiable factors including age, sex, and genetic predisposition also influence stroke risk (7). Particularly in younger populations, the pattern and impact of risk factors may differ significantly compared to older individuals, necessitating age-specific preventive strategies (8). Diabetes mellitus promotes a pro-thrombotic state by elevating blood levels of factors such as fibrinogen and von Willebrand factor and by increasing platelet adhesiveness, thereby heightening stroke risk (9,10). Epidemiological studies have identified hypertension as the most prevalent risk factor among stroke patients, present in about 60% of cases, followed by smoking (44.4%), diabetes mellitus (25.5%), hypercholesterolemia (18.8%), and heart disease (7.7%) (11). Despite the high burden of stroke in regions like Pakistan, there is a notable paucity of local data exploring the prevalence and distribution of these risk factors. This gap in the literature highlights the urgent need for focused epidemiological studies to inform context-specific prevention and management strategies. Addressing this gap, the present study aims to determine the frequency of modifiable and non-modifiable risk factors among stroke patients admitted to Mardan Medical Complex. By identifying the most common contributing factors within this population, the study seeks to provide essential insights that can guide clinical practice, inform public health policies, and lay the groundwork for future research initiatives.

METHODS

This study employed a cross-sectional design and was conducted in the Department of Medicine, Mardan Medical Complex, over a period of six months following the approval of the synopsis. A total of 162 stroke patients were included using a non-probability consecutive sampling technique. The sample size was calculated based on the prevalence of a history of heart disease as a risk factor for stroke (7.7%) with a 5% margin of error and 95% confidence interval, using the WHO software "Sample Size Determination in Health Studies" (8). Ethical approval was obtained from the institutional review board of Mardan Medical Complex prior to data collection. Informed written consent was obtained from all participants or their attendants after a thorough explanation of the study's objectives, procedures, risks, and benefits. Patients of either gender aged 18 to 75 years who were admitted with a clinical diagnosis of stroke, as per the defined operational criteria, were eligible for inclusion. Patients with a history of head trauma, brain space-occupying lesions, hypoglycemic brain injury, or previous diagnoses of meningitis or encephalitis were excluded to avoid confounding etiologies unrelated to vascular stroke. Following consent, eligible patients were enrolled from the hospital's indoor department. Demographic data including age, sex, body mass index (BMI), residence, educational level, occupation, and socioeconomic status were documented using a structured and pre-tested proforma. Each participant underwent comprehensive clinical and laboratory evaluation.

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Stroke type (ischemic or hemorrhagic) was confirmed through neuroimaging studies such as computed tomography (CT) and magnetic resonance imaging (MRI), as clinically indicated. Risk factors including hypertension, diabetes mellitus, smoking, hypercholesterolemia, and a history of heart disease were assessed using standardized diagnostic criteria. Laboratory investigations comprised random plasma glucose, fasting blood glucose, HbA1c, fasting serum cholesterol levels, and electrocardiogram (ECG) for cardiac evaluation (12,13). All assessments were performed during the hospitalization period and data were recorded prior to patient discharge or death. Data entry and analysis were performed using IBM SPSS version 23. The distribution of continuous variables such as age and BMI was assessed using the Shapiro-Wilk test. Normally distributed variables were reported as mean ± standard deviation (SD), while non-normally distributed data were described using median and interquartile range (IQR). Categorical variables, including gender, type of stroke, and various risk factors, were summarized as frequencies and percentages. Stratification of risk factors was carried out based on age groups, gender, and stroke subtype to explore potential effect modifiers. Post-stratification analysis was conducted using the chi-square test or Fisher's exact test, where appropriate. A p-value of less than 0.05 was considered statistically significant, and the findings were presented in the form of tables and graphical illustrations for better interpretability.

RESULTS

The study enrolled a total of 162 stroke patients admitted to Mardan Medical Complex over a six-month period. The mean age of the participants was 61.2 ± 10.4 years, with the majority being male (56.8%). The average BMI was 26.7 ± 3.9 kg/m². A large proportion of participants belonged to the middle socioeconomic class (50.6%), with 58% being employed at the time of admission. Rural residents constituted 54.9% of the sample. Educational status revealed that 41.4% had attained middle-level education, while 25.3% had only primary education. Out of the total sample, ischemic strokes were significantly more common, accounting for 79.6% of cases, while hemorrhagic strokes comprised 20.4%. The majority of stroke events occurred within the first seven days prior to hospital admission (69.8%). A history of previous stroke was reported in 29.0% of the patients. Hypertension emerged as the most prevalent risk factor, present in 66.7% of the participants. Smoking was the second most common risk factor (39.5%), followed by diabetes mellitus (32.1%), hypercholesterolemia (23.5%), and a family history of coronary artery disease (11.7%). These findings were consistent across both genders and stroke subtypes, although ischemic stroke patients exhibited a slightly higher burden of modifiable risk factors such as diabetes and hypercholesterolemia. The results are displayed in detailed tabular format and illustrated with charts. The bar chart demonstrates the distribution of the most common risk factors, with hypertension being the dominant contributor. The pie chart further highlights the proportion of stroke types, visually reinforcing the predominance of ischemic strokes in the study population.

Table 1: Demographic Characteristics of Stroke Patients (n = 162)

Variable	Frequency (%)
Age (mean ± SD)	61.2 ± 10.4
Gender	
Male	92 (56.8%)
Female	70 (43.2%)
BMI (mean ± SD)	26.7 ± 3.9
Socioeconomic Status	
Lower	48 (29.6%)
Middle	82 (50.6%)
Upper	32 (19.8%)
Occupation Status	
Employed	94 (58.0%)

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Variable	Frequency (%)
Unemployed	68 (42.0%)
Residence	
Rural	89 (54.9%)
Urban	73 (45.1%)
Education	
Primary	41 (25.3%)
Middle	67 (41.4%)
Higher	54 (33.3%)

Table 2: Risk Factors of Stroke

Risk Factor	Yes n (%)	No n (%)
Hypertension	108 (66.7%)	54 (33.3%)
Diabetes Mellitus	52 (32.1%)	110 (67.9%)
Smoking	64 (39.5%)	98 (60.5%)
Hypercholesterolemia	38 (23.5%)	124 (76.5%)
Family History of CAD	19 (11.7%)	143 (88.3%)

Table 3: Types of Strokes

Stroke Type	Frequency (%)
Ischemic	129 (79.6%)
Hemorrhagic	33 (20.4%)

Table 4: Duration of Stroke Before Admission

Duration	Frequency (%)
< 7 Days	113 (69.8%)
≥ 7 Days	49 (30.2%)

Table 5: Previous History of Stroke

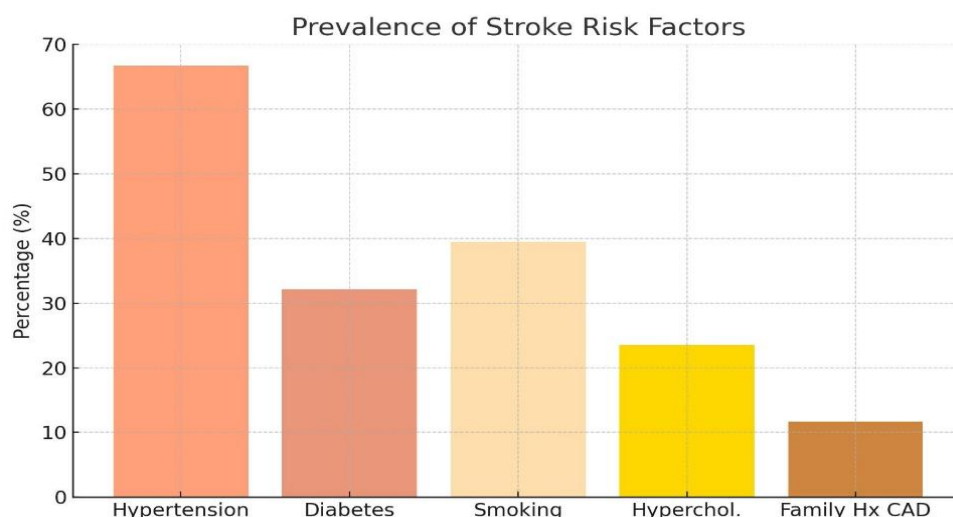| Previous Stroke	Frequency (%)
Yes	47 (29.0%)
No	115 (71.0%)

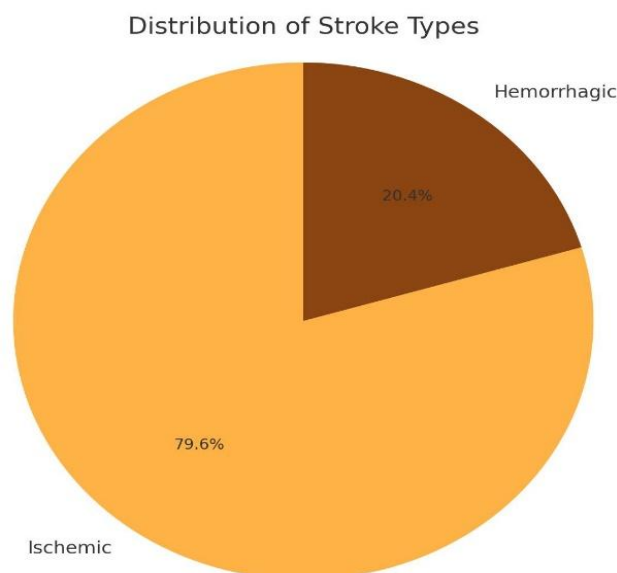*Figure 1 Prevalence of Stroke Risk Factors*

Figure 2 Distribution of Stroke Types

DISCUSSION

The present study investigated the distribution of key risk factors among stroke patients admitted to Mardan Medical Complex, with findings broadly aligning with both regional and global data while also reflecting some unique trends. Ischemic stroke emerged as the predominant subtype, affecting nearly four out of every five patients, which corroborates global data indicating ischemic strokes account for 80–85% of all cerebrovascular accidents (14). The observed higher incidence of ischemic stroke further validates previous epidemiological patterns noted in both South Asian and international settings (15). Hypertension was the most frequently encountered risk factor in this study (66.7%), reinforcing the overwhelming consensus that elevated blood pressure is the leading contributor to both ischemic and hemorrhagic stroke (16,17). Similarly, smoking was prevalent in nearly 40% of patients, highlighting its continued impact as a modifiable risk factor. The significant association between smoking and ischemic stroke has been quantified in previous meta-

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analyses, which report up to a 1.66-fold increased risk among active smokers (17). The prevalence of diabetes mellitus (32.1%) in the present cohort was notable, particularly given its pro-thrombotic effects and role in endothelial dysfunction, which significantly increase ischemic stroke risk (18). Hypercholesterolemia and family history of coronary artery disease, although less prevalent, were still important contributors. These findings are supported by cohort data which show lipid disorders and hereditary cardiac conditions as potent risk enhancers, particularly in cases of ischemic stroke (19).

In contrast to other regions, where hemorrhagic strokes have shown increasing prevalence due to poorly controlled hypertension or anticoagulant misuse (20), this study reaffirmed ischemic stroke as the dominant subtype in the local population. However, the observed 20.4% of hemorrhagic stroke cases remains clinically significant, particularly considering its more severe prognostic implications and higher fatality rates. The study also observed that nearly one-third of patients had experienced a previous stroke, suggesting a high recurrence rate and potentially suboptimal secondary prevention strategies in this population. This underscores the need for aggressive risk factor control and structured follow-up protocols post-discharge. Recent evidence has demonstrated that clustering of risk factors—particularly in diabetic populations—dramatically increases the likelihood of recurrent stroke events (21,22). While the study presents valuable insights into the local burden of stroke and its risk factors, it is not without limitations. Being single-centered and hospital-based, the findings may not be fully generalizable to the wider population, especially rural communities with limited healthcare access. Additionally, the non-probability consecutive sampling technique, although practical, may introduce selection bias. The study did not assess stroke severity or clinical outcomes, nor did it stratify ischemic strokes by etiology using TOAST classification, which limits deeper pathophysiological interpretations. Moreover, while imaging was used to confirm stroke types, lack of data on carotid imaging or cardiac monitoring restricted insights into embolic sources.

Despite these limitations, the study has several strengths. It provides a structured, operationally defined assessment of key risk factors using clinical and biochemical diagnostics. The six-month data collection window ensured seasonal variation was captured, and the use of standard imaging increased diagnostic accuracy. Additionally, the findings are consistent with multiple large-scale international studies, strengthening external validity. Future research should adopt a multicenter approach to encompass more diverse populations and incorporate prospective designs to examine outcomes and recurrence. Stratifying stroke subtypes with advanced neuroimaging and etiological classification would further enhance the clinical utility of such studies. Intervention-based studies assessing the impact of targeted public health strategies on modifiable risk factors like hypertension and smoking would also be valuable. In conclusion, the study underscores hypertension, smoking, and diabetes as the most prevalent and actionable risk factors among stroke patients in this setting. Prioritizing early detection and aggressive management of these modifiable risks can significantly reduce stroke incidence and its associated morbidity. Comprehensive and continuous surveillance is essential for optimizing prevention and tailoring interventions to regional health dynamics.

CONCLUSION

This study identified hypertension, smoking, and diabetes mellitus as the most prevalent modifiable risk factors among stroke patients at Mardan Medical Complex, with ischemic stroke being the dominant subtype. These findings emphasize the urgent need for targeted preventive strategies and public health interventions to control these risk factors. Early identification and management can substantially reduce stroke burden, improve patient outcomes, and alleviate healthcare system pressures.

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AUTHOR CONTRIBUTION

Author	Contribution
Zeeshan Ali	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muzamil Mehmood*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Nasir Khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Noman Ahmad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shakeel Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Syed Ali Abdullah Jan	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Naveed Khan	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Abuzar Ali	Writing - Review & Editing, Assistance with Data Curation

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