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Frequency of Mortality and Its Associated Factors in Patients with Cerebrovascular Accidents Presenting during 2023 at the Emergency Department of Imam Khomeini Hospital in Urmia

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Abstract

Background: *Cerebrovascular accident (CVA) is a sudden neurological event caused by reduced cerebral blood flow. Following cardiovascular disorders and malignancies, CVAs represent the third most prevalent cause of mortality in developed nations and are identified as the primary driver of long-term disability for those who survive. This research investigates the fatality rate and independent predictors of mortality among CVA patients treated at the Imam Khomeini Hospital Emergency Department (Urmia, 2023).*

Methods: *This descriptive–analytical cross-sectional investigation encompassed all CVA patients admitted to Imam Khomeini Hospital during 2023, based on a census sampling approach. Information was collected using a structured checklist that captured demographic, clinical, and paraclinical characteristics. Data analysis was performed in SPSS (version 18) employing both descriptive and inferential statistical methods.*

Results: *Ischemic stroke represented the vast majority of events, comprising 81.6% of all cases. The overall mean age of patients was 68.4±14.6 years, and 52.7% were men. Patients with ischemic stroke had a significantly higher mean age (69.6±14.1 years) compared with those with hemorrhagic stroke (63.2±15.7 years). No meaningful difference was observed in gender distribution between the two stroke types. Length of stay in the intensive care unit and total hospitalization duration were both greater among patients with hemorrhagic stroke. The 24-hour and 30-day mortality rates following stroke onset were 1.9% and 11.7%, respectively, with significantly higher values in the hemorrhagic group. Overall in-hospital mortality was 21.7%, and mortality was more frequent in hemorrhagic stroke (45.7%) than in ischemic stroke (16.3%). Higher age, hypertension, diabetes mellitus, and pre-existing cardiovascular disease showed significant associations with in-hospital mortality.*

Conclusion: *Ischemic stroke was more prevalent, but hemorrhagic stroke was linked to higher mortality and a greater need for intensive care. Older age and comorbidities such as hypertension, diabetes mellitus, and cardiovascular diseases were important factors associated with in-hospital mortality.*

Keywords: Mortality, Cerebrovascular accidents, Prognosis, Associated factors, Prevalence.
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Introduction

Stroke, also referred to as cerebrovascular accident (CVA), constitutes a major worldwide health burden and remains among the principal causes of death and persistent disability globally[1, 2]. CVA is generally categorized into two main subtypes—ischemic and hemorrhagic. Ischemic events comprise roughly 85–90% of all strokes, whereas hemorrhagic stroke, despite being less frequent, is linked to markedly higher mortality[3, 4].

The impact of stroke is especially pronounced in low- and middle-income countries, where individuals tend to develop stroke at younger ages and have worse clinical outcomes than those in high-income regions[5, 6]. Iran is considered a country with a substantial stroke burden, with an estimated annual incidence of about 320 cases per 100,000 people, rendering stroke the foremost cause of disability among adults at the national level[7, 8].

Several investigations from various regions of Iran have documented differing in-hospital mortality rates, as well as diverse factors associated with death among patients with CVA. Reported mortality rates range from 12.1% in Shiraz to 17.1% in Birjand, with associated factors including hypertension, ischemic heart disease, diabetes mellitus, recurrent stroke, and sex[9–11]. These regional differences underscore the importance of hospital-based, context-specific data to better characterize mortality patterns and associated factors.

Given the significant impact of CVA within Iran, there has been a lack of hospital-based research specifically analyzing mortality and its clinical predictors in Urmia. As the Imam Khomeini Educational and Medical Center operates as a primary 24-hour emergency referral site for West Azerbaijan Province, this investigation sought to evaluate the frequency of in-hospital fatalities and the contributing factors among CVA patients treated at this facility throughout 2023.

Materials and Methods

This descriptive–analytical cross-sectional study was carried out in 2023 at Imam Khomeini Hospital in Urmia. All hospitalized patients with acute stroke were enrolled using a census sampling approach.

At the outset, explicit inclusion and exclusion criteria were established. Eligibility required: (1) age ≥18 years and (2) a

definite diagnosis of acute CVA (ischemic or hemorrhagic stroke) confirmed through clinical evaluation and neuroimaging findings. Patients diagnosed with transient ischemic attack (TIA) were not included. Cases with a history of prior stroke were included only when they were admitted during the study period for a new acute stroke event.

The exclusion criteria were: (1) unclear stroke type (ischemic or hemorrhagic) or suspicion of an alternative diagnosis, (2) history of head trauma or other neurological conditions such as epilepsy, brain tumors, or central nervous system infections, and (3) complete unavailability of patient data.

Comorbid conditions were identified based on information recorded in the patients' medical charts. Hypertension was considered present if there was a documented prior diagnosis, current use of antihypertensive agents, or an admission blood pressure reading of ≥140/90 mmHg. Diabetes mellitus was defined by a previous diagnosis, treatment with glucose-lowering medications, or a fasting plasma glucose level of ≥126 mg/dL. Cardiovascular disease was determined according to documented evidence of ischemic heart disease, heart failure, or other clinically recorded cardiac disorders.

Data acquisition was performed using a standardized checklist capturing demographic and clinical variables, including age, sex, comorbidities, presenting complaints at admission, consciousness status and vital signs on arrival, stroke subtype, patient status at 24 hours, and the final in-hospital outcome.

All records that satisfied the eligibility criteria were entered into the analysis. When specific data elements were not available in the charts, they were coded as missing, and statistical analyses were conducted using an available-case approach.

Following completion of the data collection process, the dataset was entered into SPSS software (version 18). Results were summarized using descriptive measures (counts, proportions, mean, and standard deviation) and evaluated with inferential tests, including the Chi-square test and analysis of variance (ANOVA).

Results

The study population consisted of 571 patients. Among them, 466 cases (81.6%) were diagnosed with ischemic stroke, whereas 105 patients (18.4%) had hemorrhagic stroke. The overall mean age was 68.4±14.6 years, with an age range of 25 to 106 years. Individuals in the ischemic stroke group were significantly older, with a mean age of 69.6±14.1 years, compared with 63.2±15.7 years in the hemorrhagic stroke group. In terms of sex distribution, 52.7% of the patients were men and 47.3% were women, and no statistically significant difference was observed between the two groups in this regard (Table 1).

Table 1. Demographic characteristics of patients with stroke

Variable	Subgroup	Stroke type		Total patients	P-value
		Ischemic	Hemorrhagic		
Gender	Male	244 (52.4)	57 (54.3)	301 (52.7)	0.746
	Female	222 (47.6)	48 (45.7)	270 (47.3)	
Age (years)		69.6±14.1	63.2±15.7	68.4±14.6	0.001

Admission to the intensive care unit (ICU) was significantly more common among patients with hemorrhagic stroke (57.1%) than among those with ischemic stroke (28.1%). In addition, the duration of hospitalization was markedly longer in the hemorrhagic group (25.2±12.3 days) compared with the ischemic group (15.3±7.9 days) (Table 2).

Table 2. Clinical profile of patients with stroke

Variable	Subgroup	Stroke type		Total patients	P-value
		Ischemic	Hemorrhagic		
Ward of admission	General	335 (71.9)	45 (42.9)	380 (66.5)	0.001
	Intensive Care Unit (ICU)	131 (28.1)	60 (57.1)	191 (33.5)	
Length of hospital stay (days)		15.3±7.9	25.2±12.3	17.4±11.6	0.001

The overall mortality within 24 hours and 30 days of stroke onset was 1.9% and 11.7%, respectively. Both of these mortality measures were markedly higher among patients with hemorrhagic stroke (6.7% and 23.8%, respectively) than among those with ischemic stroke (0.9% and 9%, respectively). Total in-hospital mortality was 21.7%, and this rate was likewise considerably greater in the hemorrhagic group (45.7%) compared with the ischemic group (16.3%) (Table 3).

Table 3. Outcomes of patients with stroke

Variable	Subgroup	Stroke type		Total patients	P-value
		Ischemic	Hemorrhagic		
Outcome	Survival >30 days	420 (90.1)	73 (69.5)	493 (86.3)	0.001
	Death within 30 days	42 (9)	25 (23.8)	67 (11.7)	
	Death within the first 24 hours	4 (0.9)	7 (6.7)	11 (1.9)	
In-hospital outcome	Discharge	390 (83.7)	57 (54.3)	447 (78.3)	0.001
	Death	76 (16.3)	48 (45.7)	124 (21.7)	

No statistically significant difference in gender distribution was observed between patients who were discharged and those who passed away during hospitalization. In contrast, patients who died had a significantly higher mean age (72.1±15.9 years) compared to those who survived and were discharged (67.4±14.07 years) (Table 4).

Table 4. Association of patient demographics with mortality outcomes in stroke cases

Variable	Subgroup	Stroke type		P-value
		Discharge	Death	
Gender	Male	238 (53.2)	63 (50.8)	0.685
	Female	209 (46.8)	61 (49.2)	
Age (years)		67.4±15.9	72.1±15.9	0.02

The frequencies of hypertension, diabetes mellitus, hyperlipidemia, and cardiovascular diseases were 57.4%, 33.6%, 38%, and 27.7%, respectively. Analysis using Fisher's exact test revealed that hypertension, diabetes mellitus, and cardiovascular disorders were significantly more prevalent among patients who succumbed to the condition compared to those who were discharged. Conversely, no statistically significant association was found between hyperlipidemia and in-hospital mortality (Table 5).

Table 5. Correlation of comorbid conditions with in-hospital mortality outcomes in stroke patients

Subgroup	In-hospital outcome		Total patients	P-value
	Discharge	Death		
Hypertension	245 (54.8)	83 (66.9)	328 (57.4)	0.016
Diabetes mellitus	136 (30.4)	56 (45.2)	192 (33.6)	0.002
Hyperlipidemia	175 (39.1)	42 (33.9)	217 (38)	0.284
Cardiovascular disease	109 (24.4)	49 (39.5)	158 (27.7)	0.001

Discussion

Globally, stroke stands as a primary driver of mortality and chronic disability, encompassing both ischemic and hemorrhagic forms. Our investigation at Imam Khomeini Hospital, Urmia, in 2023 characterized the epidemiological profile and identified determinants of in-hospital mortality among admitted stroke patients. Aligning with international trends, ischemic stroke occurred more frequently. Nevertheless, patients experiencing hemorrhagic stroke faced poorer outcomes, evidenced by increased mortality rates, a greater demand for intensive care, and prolonged hospitalizations. These observations underscore the critical need to recognize the differential clinical trajectories and prognostic significance of stroke subtypes.

In our cohort, 81.6% of cases were ischemic, and 18.4% were hemorrhagic. Consistent with World Health Organization reports, approximately 70–85% of strokes globally are ischemic, with hemorrhagic strokes making up the balance of 15–30%. Similar findings have been reported in Iran. Tabrizi et al. (2020) reported that nearly 80% of strokes were ischemic[12], and Daneshfard et al. (2015) documented an approximate 85% to 15% ratio of ischemic to hemorrhagic stroke in Shiraz[9]. The predominance of ischemic stroke in our population may be explained by the cumulative effects of atherosclerosis, atrial fibrillation, and other chronic vascular risk factors that increase with age.

In our study, the mean patient age was 68.4 years, closely mirroring the results reported by Daneshfard et al. (68.3 years)[9]. Interestingly, individuals diagnosed with ischemic stroke were significantly older than their counterparts with hemorrhagic stroke. This finding aligns with the research of Wang et al. (2024)[13], who observed that hemorrhagic strokes typically manifest at earlier ages. The underlying mechanisms may differ between subtypes. Hemorrhagic stroke, particularly in relatively younger individuals, is often precipitated by acute and poorly controlled hypertension, leading to rupture of small penetrating arteries and rapid hematoma formation. In contrast, ischemic stroke is more commonly associated with chronic

endothelial injury, progressive atherosclerosis, and cardioembolic sources such as atrial fibrillation—conditions that accumulate over time and are more prevalent in older populations[13]. These pathophysiological differences likely account for the age disparity observed between the two groups.

The 30-day mortality rate observed in our study was markedly higher for patients with hemorrhagic stroke (23.8%) in contrast to those with ischemic stroke (9%). This outcome corroborates existing international data on the subject**.** Van Asch et al. (2019) reported that in-hospital mortality for hemorrhagic stroke ranged from approximately 20% to 40%, whereas mortality for ischemic stroke was generally below 10%[14]. The markedly higher mortality in hemorrhagic stroke can be explained by the mechanical mass effect of the hematoma, which increases intracranial pressure (ICP), causes midline shift, and may lead to brain herniation. Furthermore, hemorrhagic stroke is associated with rapid secondary neuronal injury and neuroinflammatory cascades, contributing to early neurological deterioration. These mechanisms also explain the significantly higher ICU admission rate (57.1% vs. 28.1%) and longer hospital stays observed in hemorrhagic stroke patients in our cohort.

The overall in-hospital mortality rate for stroke patients in our investigation was 21.7%. This rate is notably higher than the 12.1% mortality reported in the study conducted by Daneshfard et al.[9]. This discrepancy may be related to differences in patient referral patterns, stroke severity at admission, availability of specialized stroke units, or variations in acute management protocols between centers. Among patients who did not survive the hospital stay, a significantly higher prevalence of hypertension, diabetes mellitus, and cardiovascular disease was observed in our study cohort. These findings are consistent with those of Donnell et al.[15], who demonstrated that hypertension and diabetes are independently associated with increased post-stroke mortality. From a pathophysiological perspective, these comorbidities contribute to endothelial dysfunction, impaired cerebrovascular autoregulation, and reduced physiological reserve, thereby limiting the brain's capacity to tolerate acute ischemic or hemorrhagic insults.

Interestingly, hyperlipidemia was not significantly associated with mortality in our cohort. This finding may be explained by the widespread use of statins in stroke patients, which exert pleiotropic effects beyond lipid lowering. Potential mechanisms include anti-inflammatory properties, promotion of plaque stabilization, and enhancement of endothelial function. Collectively, these actions may serve to mitigate the influence of initial lipid profiles on short-term mortality risks. Similar inconsistencies regarding hyperlipidemia and post-stroke mortality have been reported in other studies[15]. Regarding gender distribution, no significant association was observed between sex and stroke occurrence or mortality in our study. Although Amarenco et al. (2009) reported a higher prevalence of ischemic stroke among men[16], such discrepancies may reflect regional differences in lifestyle, prevalence of risk factors, healthcare access, and health-seeking behaviors rather than inherent biological differences alone.

Overall, our findings underscore the critical importance of controlling modifiable factors associated with mortality—particularly hypertension and diabetes—to reduce stroke-related mortality. Strengthening primary and secondary prevention programs, including systematic blood pressure monitoring, glycemic control, and management of cardiac arrhythmias, should be prioritized within the Iranian healthcare system. Evidence from Luo et al. (2024) further indicates that implementation of standardized stroke management protocols and establishment of dedicated stroke units can significantly improve clinical outcomes[17].

The interpretation of this study's findings should consider several inherent limitations. Primarily, its execution within a single tertiary care center might introduce selection biases, thereby limiting the extent to which the results can be generalized to diverse stroke patient populations. Furthermore, the cross-sectional design employed restricts the ability to ascertain definitive causal links between the identified associations and in-hospital mortality. Third, because individual-level data were not available, multivariate logistic regression could not be performed; therefore, the associations reported are based solely on univariate analyses and may be affected by residual confounding. Additionally, key clinical variables—such as standardized stroke severity measures (e.g., NIHSS, GCS) and detailed treatment information, including thrombolysis, neurosurgical procedures, and the intensity of ICU management—were not consistently documented in patient records. Given the prognostic significance of these factors, their absence may limit the depth and precision of the mortality risk assessment. Future multi-center prospective studies with comprehensive clinical datasets and multivariable modeling are essential to more accurately identify independent predictors of mortality in patients presenting with CVAs.

Conclusion: Our research indicates that ischemic stroke occurs more frequently than hemorrhagic stroke. Nevertheless, hemorrhagic stroke is linked to poorer outcomes, including elevated mortality rates, increased demands on intensive care, and prolonged hospitalizations. Key determinants of in-hospital mortality identified in our cohort were advanced age, hypertension, diabetes mellitus, and cardiovascular diseases. These results highlight the necessity for focused preventive measures, robust management of mortality-associated risk factors, and optimized clinical care pathways for stroke patients, ultimately aiming to lessen the stroke burden within Iran, we recommend establishing specialized stroke units, developing rapid emergency intervention protocols, educating the public on stroke warning signs, conducting cohort studies on stroke survivors, performing genetic and epidemiological investigations of stroke in younger populations, and undertaking comparative studies on the effectiveness of different therapeutic interventions.

Ethical Considerations

The research presented in this article originates from the thesis work of Samin Balalzadeh. Its ethical approval was granted by the Ethics Committee of Urmia University of Medical Sciences, bearing the ethics code IR.UMSU.HIMAM.REC.1403.063.

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Conflict of Interest

The authors affirm that no competing interests exist in relation to this work.

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