



Frequency of mortality in stroke patients admitted in Ayub Teaching Hospital Abbottabad

Sana Waheed¹, Tayyaba Mumtaz², Muhammad Ali Javed², Muhammad Ali Khan²

¹Medical-D Unit, Ayub Teaching Hospital, Abbottabad, Pakistan.

²Ayub Teaching Hospital, Abbottabad, Pakistan.

ARTICLE INFO

Keywords: Inpatient mortality, Stroke, Hypertension, Diabetes, Hemorrhagic stroke, Ischemic stroke

Correspondence to: Sana Waheed, Medical-D Unit, Ayub Teaching Hospital, Abbottabad, Pakistan.
Email: sanajadoon27@gmail.com

Declaration

Authors' Contribution: *Described at the end of the paper.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 08-03-2025 Revised: 21-04-2025
Accepted: 07-05-2025 Published: 28-05-2025

ABSTRACT

Background: Inpatient stroke mortality is a serious healthcare challenge worldwide with various causes for increased risk. The study seeks to explore the influence of different demographic, clinical, and comorbidity conditions on stroke hospital mortality, emphasizing the manner in which factors have an effect on the patient.

Objective: To determine the frequency of inpatient mortality in stroke patients admitted in Ayub Teaching Hospital Abbottabad. **Study Design:** Descriptive, cross-sectional study. **Duration and Place of Study:** Conducted between August 2024 and February 2025 at the Department of General Medicine, Ayub Teaching Hospital, Abbottabad. **Methodology:** A total of 111 patients, aged 30–70 years, with a diagnosis of stroke were enrolled. Data collected included demographics, stroke type, comorbidities, and residential status. Inpatient mortality was defined as death occurring due to stroke after 24 hours of admission but before discharge. Statistical analysis was performed using IBM SPSS version 26, and a p-value of ≤ 0.05 was considered statistically significant. **Results:** The study found a 13.5% inpatient mortality rate. Mortality was higher in male patients and those from rural areas. Statistically significant associations were found between mortality and gender ($p = 0.003$), residential status ($p < 0.001$), socioeconomic status ($p < 0.001$), diabetes ($p < 0.001$), hypertension ($p = 0.010$), smoking ($p < 0.001$), and type of stroke ($p < 0.001$). **Conclusion:** Inpatient stroke mortality is significantly influenced by modifiable factors such as comorbid conditions (hypertension, diabetes, smoking), as well as demographic factors including gender, residential area, and socioeconomic status.

INTRODUCTION

Mortality from stroke remains a significant issue worldwide given the high global prevalence of stroke being among the leading causes of disability and mortality.¹ The deaths from stroke are influenced by certain factors that include the severity of stroke, the stroke type, the timing of medical care, among other factors including the presence of comorbidity.² Stroke due to the occlusion of the cerebral blood supply has a less immediate cause of death than is the case with the occurrence of hemorrhagic stroke where the accompanying intracerebral bleeding leads to the worse consequence.³ However, the two types of stroke have high mortality in the acute phase, most prominently in the first few days to weeks following the occurrence.⁴

The pathophysiology of the stroke is the primary cause for the high mortality that is encountered.⁵ Hemorrhagic stroke is marked by the rupture of the blood vessel resulting in an acute rise in the intracranial pressure, brain herniation, and, in turn, to death, in the absence of immediate care.⁶ Ischemic strokes are the cause of tissue necrosis and cellular demise due to the disruption of the

oxygen supply, and based on the area involved, this may also cause severe neurological deficits that further increase the risk of death.⁷

Other risk determinants of stroke mortality include age, gender, comorbid conditions, and socioeconomic conditions.⁸ The elderly has a worse prognosis for several reasons due to the loss of physiological reserves in addition to comorbid conditions like hypertension, diabetes mellitus, and cardiovascular disease that aggravates the stroke condition.⁹ A previous stroke or TIA also increases the risk of mortality.¹⁰ Gender also plays a role wherein different studies have shown that women, especially older women, have a higher stroke case-fatality ratio compared to men.¹⁰ Finally, the fact that most individuals in low-resource settings have no access to appropriate medical care in a timely fashion also contributes to the higher case-fatality rates in these settings.¹¹

In spite of advancements in stroke treatment, with the implementation of thrombolytic therapy and surgery, the overall case-fatality is high. Early diagnosis followed by prompt treatment is the key to reducing the risk of case-

fatality, but the contribution of rehabilitation towards improved long-term function is also critical. Still, the majority of the patients remain with disability that has the potential for developing other complications like infection and cardiovascular complications, resulting in case-fatality.¹²

A study conducted by Ranasinghe VS and colleagues revealed that the inpatient mortality rate among stroke patients was 11.7%.¹³

Having knowledge about the frequency of stroke survivor medical deaths is key to enhancing patient outcomes and shaping healthcare policies. By understanding the rates of mortality, the causes of poor outcomes can be found, and specific interventions may be devised. The research is critical to have data-driven information about the influence of stroke on survival rates in patients so that clinical treatment strategies can be formed, and healthcare policies can be devised for decreasing the rates of deaths in the high-risk group.

METHODOLOGY

This descriptive study was carried out between August 2024 and February 2025 at the Department of General Medicine, Ayub Teaching Hospital, Abbottabad. A sample of 111 patients was selected, with the sample size being calculated using the WHO sample size software, applying a 95% confidence interval, a 6% margin of error, and an expected inpatient mortality rate of 11.7% in stroke patients.¹³

The inclusion criteria were patients aged between 30 and 70 years of either gender, who had been diagnosed with stroke based on sudden onset of measurable neurological deficits such as sensory disturbances, speech difficulties, visual impairments, altered coordination, dizziness, severe headache (VAS >4), and cognitive deficits (presence of any three or more), with evidence of either hemorrhagic or ischemic stroke confirmed on a brain CT scan. Hemorrhagic stroke was identified when CT scan revealed acute blood markedly hyperdense compared to brain parenchyma, while ischemic stroke was identified by the presence of loss of grey-white matter differentiation, hypoattenuation of deep nuclei, or cortical hypodensity with associated parenchymal swelling and gyral effacement. Patients were excluded if they had a history of renal disease, liver disease, malignancy, or recurrent strokes, as these conditions could confound the analysis of stroke-related mortality.

Upon obtaining ethical approval, baseline demographic data such as age, gender, body mass index (BMI), residential status, smoking history, socioeconomic status, diabetes, hypertension, duration of stroke, and stroke type were recorded. Informed consent was obtained from the patients or their guardians, ensuring confidentiality and confirming that no risks were involved in their participation. Throughout the hospitalization period, patients were monitored, and information on inpatient mortality—defined as death occurring due to stroke after 24 hours of hospital admission and before discharge—was collected and recorded using a specifically designed proforma.

For data analysis, IBM SPSS version 26 was utilized. Quantitative variables, including age, BMI, duration of

stroke, were summarized as mean ± standard deviation. Categorical variables such as gender, residential status, smoking, socioeconomic status, diabetes, hypertension, type of stroke, and inpatient mortality were presented as frequencies and percentages. Inpatient mortality was further analyzed across various demographic and clinical characteristics and post-stratification chi-square tests were performed, with a p-value of ≤ 0.05 considered statistically significant.

RESULTS

The average age of patients was 59.4 ± 6.47 years, and the average body mass index (BMI) was 27.94 ± 2.05 kg/m². The average duration of stroke upon admission was 7.06 ± 3.15 hours. In terms of gender distribution, 64% of patients were male, while 36% were female. The residential status of the patients showed that 55% were from rural areas and 45% were from urban areas. Regarding socioeconomic status, 55% of the patients were classified as poor, 26.1% as middle class, and 18.9% as rich. The prevalence of comorbidities included 43.2% with diabetes, 54.1% with hypertension, and 40.5% were smokers. Most patients (83.8%) had ischemic stroke, while 16.2% had hemorrhagic stroke (as shown in Table 1).

Table 1
Patient Demographics

Demographics	Mean ± SD	
Age (years)	59.396 ± 6.47	
BMI (Kg/m ²)	27.935 ± 2.05	
Duration of Stroke (hours)	7.063 ± 3.15	
Gender	Male n (%)	71 (64.0%)
	Female n (%)	40 (36.0%)
Residential Status	Rural n (%)	61 (55.0%)
	Urban n (%)	50 (45.0%)
Socioeconomic Status	Poor n (%)	61 (55.0%)
	Middle n (%)	29 (26.1%)
	Rich n (%)	21 (18.9%)
Diabetes	Yes n (%)	48 (43.2%)
	No n (%)	63 (56.8%)
Hypertension	Yes n (%)	60 (54.1%)
	No n (%)	51 (45.9%)
Smoking	Yes n (%)	45 (40.5%)
	No n (%)	66 (59.5%)
Type of Stroke	Hemorrhagic n (%)	18 (16.2%)
	Ischemia n (%)	93 (83.8%)

Inpatient mortality was observed in 13.5% of the patients (as shown in Table 2).

Table 2
Frequency of Inpatient Mortality

Inpatient Mortality	Frequency	% age
Yes	15	13.50%
No	96	86.50%
Total	111	100%

Stratified analysis revealed that mortality was significantly associated with gender, with a higher mortality rate in male patients (21.1%) compared to female patients (0.0%), with a p-value of 0.003. A

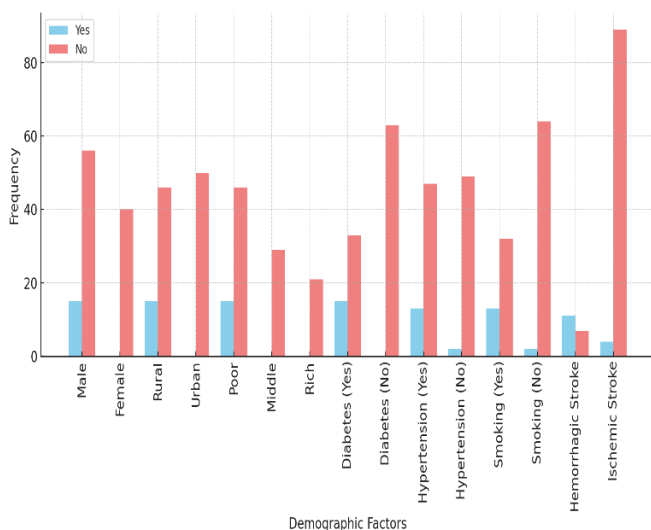
significant association was also found with residential status, where 24.6% of rural patients died compared to none in the urban group, with a p-value of <0.001. Socioeconomic status showed a similar pattern, with 24.6% of poor patients experiencing mortality, but none of the middle or rich patients did, and this difference was statistically significant ($p < 0.001$). Diabetes was another significant factor, with 31.3% of diabetic patients dying compared to 0% of non-diabetic patients, with a p-value of <0.001. Hypertension was associated with inpatient mortality as well, with 21.7% of hypertensive patients dying compared to only 3.9% of non-hypertensive patients, yielding a p-value of 0.010. Smoking was strongly associated with inpatient mortality, with 28.9% of smokers dying compared to only 3.0% of non-smokers, with a p-value of <0.001. Finally, the type of stroke had a significant relationship with mortality, as 61.1% of patients with hemorrhagic stroke died, compared to only 4.3% of ischemic stroke patients, with a p-value of <0.001 (as shown in Table 3).

Table 3
Association of Inpatient Mortality with Demographic Factors

Demographic Factors		Inpatient Mortality		p-value
		Yes n(%)	No n(%)	
Gender	Male	15 (21.1%)	56 (78.9%)	0.003*
	Female	0 (0.0%)	40 (100.0%)	
Residential Status	Rural	15 (24.6%)	46 (75.4%)	<0.001*
	Urban	0 (0.0%)	50 (100.0%)	
Socio-economic Status	Poor	15 (24.6%)	46 (75.4%)	<0.001*
	Middle	0 (0.0%)	29 (100.0%)	
	Rich	0 (0.0%)	21 (100.0%)	
Diabetes	Yes	15 (31.3%)	33 (68.8%)	<0.001*
	No	0 (0.0%)	63 (100.0%)	
Hypertension	Yes	13 (21.7%)	47 (78.3%)	0.010*
	No	2 (3.9%)	49 (96.1%)	
Smoking	Yes	13 (28.9%)	32 (71.1%)	<0.001*
	No	2 (3.0%)	64 (97.0%)	
Type of Stroke	Hemorrhagic	11 (61.1%)	7 (38.9%)	<0.001*
	Ischemia	4 (4.3%)	89 (95.7%)	

*Fischer Exact Test

Graph 1
Association of Inpatient Mortality with Demographic Factors



DISCUSSION

The study reported an inpatient mortality rate of 13.5%, with higher mortality rates among males and residents of rural settings. The substantially greater inpatient mortality among males (21.1%) in relation to females (0%) can probably be due to a multitude of factors, including the existence of differences in biology such as risk for stroke, severity, and treatment response based on the genders. Research has indicated that stroke among men tends to occur at a younger age and there are likely to have poorer outcomes owing to adverse delays in treatment due to the primary conditions of hypertension and diabetes, both of which prevailed among this population.

Additionally, the presence of comorbid conditions such as diabetes mellitus (31.3%), hypertension (21.7%), and smoking (28.9%) was observed to aggravate the risk of mortality. These conditions, diabetes mellitus, and hypertension are established risk factors for stroke and have the effect of increasing the severity of the outcomes due to the aggravation of vascular damage, which enhances the risk of acute-phase stroke complication. Smoking, which is a modifiable risk factor, has been found to hasten the progression of atherosclerosis, thus enhancing the risk to both ischemic and hemorrhagic stroke.

Stroke subtype was also strongly associated with mortality. Hemorrhagic stroke victims had much higher mortalities at 61.1% in contrast to ischemic stroke at 4.3%. That is consistent with scientific evidence that hemorrhagic strokes where there is bleeding within the brain are more dangerous in character based on the acute severe brain damage leading to raised intracranial tension, brain herniation, and unreversible brain damage.

Our data concurred with a number of earlier studies but provided some new information about the determining factors for inpatient deaths for stroke victims. Our study had a mean age of 59.4 ± 6.47 years, consistent with other studies, for instance, Khosravi et al.¹⁴ whose study of stroke victims reported a mean age of 63.18 years. This reaffirms that stroke is perpetually affecting the middle to late stages, confirming that age is a significant stroke incidence and mortality factor. Our study also had a matching mean body mass index (BMI) of 27.94 ± 2.05 kg/m², consistent with the recent emphasis on the role of obesity in stroke referenced in other studies, for instance, Khosravi et al.¹⁴ and Maheshwari et al.¹⁵ where high BMI is associated with a high incidence of stroke and stroke deaths.

In terms of gender, our study found that 64% of the patients were male, which corresponds with the findings of Khosravi et al.¹⁴ who also observed a higher prevalence of stroke in men. However, the study by Zuhaid et al.¹⁵ presented a more balanced gender distribution (60% male, 40% female), suggesting that gender disparities in stroke incidence might vary based on the population and region. Moreover, our findings that men exhibited higher inpatient mortality (21.1%) compared to women (0.0%) is particularly noteworthy. This result is similar to the findings of Khosravi et al.¹⁴ who reported a slightly higher male mortality rate, but contrasts with the results of Maheshwari et al.¹⁵ where gender did not significantly

influence the frequency of hyperthermia in stroke patients.

Our study also revealed that a significant percentage of patients were from rural areas (55%), and the mortality rate was significantly higher in rural patients (24.6%) compared to urban patients (0%). This finding is consistent with Hwong et al.¹⁶ where disparities in healthcare access between rural and urban populations may contribute to worse outcomes in rural stroke patients. These results further emphasize the need for targeted healthcare interventions in rural areas, where timely access to stroke care and specialized treatment remains a challenge.

Regarding socioeconomic status, our study found that 24.6% of poor patients experienced mortality, whereas none of the middle or rich patients did. This result mirrors the findings of Kamiab et al.¹⁷ who highlighted the role of socioeconomic factors in stroke outcomes. In particular, patients from lower socioeconomic backgrounds are more likely to experience delays in seeking care, poorer management of stroke risk factors, and limited access to rehabilitation, all of which can contribute to higher mortality. This finding underscores the importance of addressing health inequalities to reduce stroke-related mortality.

In terms of comorbidities, our study showed that 43.2% of patients had diabetes, 54.1% had hypertension, and 40.5% were smokers. These results align closely with studies such as Khosravi et al.¹⁴ and Zuhaid et al.¹⁵ where hypertension and diabetes were identified as significant risk factors for stroke and mortality. Our study found that 31.3% of diabetic patients died compared to 0% of non-diabetic patients, which is similar to the findings of Khosravi et al.¹⁴ who observed a higher mortality rate in diabetic stroke patients. Similarly, smoking was strongly associated with mortality in our study, with 28.9% of smokers dying compared to only 3.0% of non-smokers, which is consistent with the findings of Maheshwari et al.¹⁵ where smoking was identified as a major modifiable risk factor contributing to poor outcomes.

Finally, the type of stroke played a significant role in mortality in our study, with 61.1% of hemorrhagic stroke patients dying compared to only 4.3% of ischemic stroke patients. This result is consistent with multiple studies, including Khosravi et al.¹⁴ and Khattak et al.¹⁸ where hemorrhagic stroke was associated with higher mortality rates. Hemorrhagic strokes tend to result in more severe brain injury due to the immediate effect of bleeding and increased intracranial pressure, leading to poorer outcomes and higher mortality.

While our findings are consistent with several existing studies, they also reinforce the significance of early intervention, particularly in rural areas and among lower socioeconomic groups, where stroke outcomes are often poorer. The significant mortality observed in hemorrhagic stroke patients further underscores the need for timely and specialized care for these patients to improve survival

rates.

However, there are some limitations to this study that should be considered. First, the study was conducted at a single center, so the results would not hold for other hospitals or other geographic locations. The study population is also most likely to have some local variations that may not hold for the general population of stroke patients due to differences in healthcare utilization and population demographics. Second, the study was observational, so the study cannot determine causal relations between the factors that are so determined and the consequence of mortality, although useful information is produced. Finally, the fact that the study is based on hospital records may include missing or incomplete data that may compromise the accuracy of the findings. Lastly, the short duration of the study may not capture long-term post-stroke recovery or long-term mortality, which are also important to ascertain the prognosis of stroke. All these limitations point to the fact that more large multicenter studies are warranted to verify our findings and explore the long-term implications of stroke mortality.

CONCLUSION

Our findings have shown that inpatient stroke mortality is to a large extent affected by a number of modifiable conditions, for instance, comorbidity conditions such as hypertension, diabetes, and smoking, along with demographic conditions such as gender, residential area, and socioeconomic origin. The finding points to the importance of timely recognition and intervention, most critically in populations that are both rural as well as of low socioeconomic origin. The stroke class, where the hemorrhagic stroke has higher related mortality, also points to the importance of specialist care in improving patient outcomes. These conditions can be treated through targeted healthcare measures to reduce stroke-associated mortality, improving patient survival rates in general.

Acknowledgments

We sincerely acknowledge the hard work and diligence of the medical team in the Department for their precise record-keeping and the organized management of patient information. Their commitment has been essential and is greatly valued.

*Author's Contribution

Each author has significantly contributed to the development of this manuscript, as outlined below:

Dr. Sana Waheed was responsible for the study design, drafting the article, and collecting hospital data.

Dr Tayyaba Mumtaz contributed to data analysis, literature review, and interpretation of study findings.

Dr Muhammad Ali Javed handled data validation, statistical analysis, and assisted in drafting the methodology section.

Dr Muhammad Ali Khan was responsible for supervising the research, critical revision of the article, and final approval of the version to be published.

REFERENCES

1. Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, et al. World Stroke Organization: global stroke fact sheet 2025. *Int J Stroke*. 2025;20(2):132-144. <https://doi.org/10.1177/17474930241308142>.
2. Abdu H, Tadese F, Seyoum G. Clinical profiles, comorbidities, and treatment outcomes of stroke in the medical ward of Dessie comprehensive specialized hospital, Northeast Ethiopia; a retrospective study. *BMC Neurol*. 2022;22(1):399. <https://doi.org/10.1186/s12883-022-02916-7>.
3. Crispino P. Hemorrhagic coagulation disorders and ischemic stroke: how to reconcile both? *Neurol Int*. 2023;15(4):1443-1458. <https://doi.org/10.3390/neurolint15040093>.
4. Pinto CS, Ferreira F, Margarido I, Neves AL, Nunes JPL, et al. Alkaline phosphatase and mortality in stroke patients: a systematic review. *Ann Transl Med*. 2023;11(12):412. <https://doi.org/10.21037/atm-23-1627>.
5. Tento T, Kume A, Kumaso S. Risk factors for stroke-related functional disability and mortality at Felege Hiwot Referral Hospital, Ethiopia. *BMC Neurol*. 2023;23(1):393. <https://doi.org/10.1186/s12883-023-03444-8>.
6. Richmond J, Quarles J, Talati S, Pandey J, et al. Educational case: mechanism and locations of intracranial hypertensive hemorrhage leading to stroke. *Acad Pathol*. 2025;12(1):100165. <https://doi.org/10.1016/j.acpath.2025.100165>.
7. Ren K, Pei J, Guo Y, Jiao Y, Xing H, et al. Regulated necrosis pathways: a potential target for ischemic stroke. *Burns Trauma*. 2023;11:tkad016. <https://doi.org/10.1093/burnst/tkad016>.
8. Ospel J, Singh N, Ganesh A, Goyal M, et al. Sex and gender differences in stroke and their practical implications in acute care. *J Stroke*. 2023;25(1):16-25. <https://doi.org/10.5853/jos.2022.04077>.
9. Ruksakulpiwat S, Zhou W, Phianhasin L, Benjasirisan C, Salehizadeh S, et al. Associations between diagnosis with stroke, comorbidities, and activity of daily living among older adults in the United States. *Chronic Dis Transl Med*. 2023;9(2):164-176. <https://doi.org/10.1002/cdt3.60>.
10. Lin PY, Lin SH, Sung PS. Comparing the risk of subsequent ischemic stroke and mortality in patients with epilepsy and patients with ischemic stroke. *Epilepsy Behav Rep*. 2025;30:100766. <https://doi.org/10.1016/j.ebr.2025.100766>.
11. Qurat Ul Ain H, Junaid Tahir M, Abbasher Hussien Mohamed Ahmed K, Ahmed F, Mohamed Ibrahim Ali M, et al. Tele-stroke: a strategy to improve acute stroke care in low- and middle-income countries. *Ann Med Surg (Lond)*. 2024;86(7):3808-3811. <https://doi.org/10.1097/MS9.0000000000002187>.
12. Mosisa W, Gezehagn Y, Kune G, Chego M, Yigezu HF, et al. Survival status and predictors of mortality among adult stroke patients admitted to Jimma University Medical Center, Southwest Ethiopia: a retrospective cohort study. *Vasc Health Risk Manag*. 2023;19:527-541. <https://doi.org/10.2147/VHRM.S399815>.
13. Ranasinghe VS, Pathirage M, Gawarammana IB, et al. Predictors of in-hospital mortality in stroke patients. *PLOS Glob Public Health*. 2023;3(2):e0001278. <https://doi.org/10.1371/journal.pgph.0001278>.
14. Khosravi A, Amirifard H, Karami F. Frequency and causes of mortality in patients with stroke referred to Zahedan hospitals in 2016. *Int J Res Med Sci*. 2018;6(3):743-6. <https://doi.org/10.18203/2320-6012.ijrms20180588>.
15. Zuhaid M, Chawla JA, Farooq U, Ahmad A, Khan S, et al. Frequency of modifiable risk factors in stroke patients. *J Ayub Med Coll Abbottabad*. 2014;26(2):235-8. <http://www.ayubmed.edu.pk/IAMC/26-2/Zuhaid.pdf>.
16. Hwong WY, Ang SH, Bots ML, Sivasampu S, Selvarajah S, Law WC, et al. Trends of stroke incidence and 28-day all-cause mortality after a stroke in Malaysia: a linkage of national data sources. *Global Heart*. 2021;16(1):39. <https://doi.org/10.5334/gh.791>.
17. Kamiab Z, Vakilian A, Afzal S, Moghadam-Ahmadi A, Jalali N, et al. Investigating the in-hospital mortality rate of stroke and its related factors at Ali-Ibn-Abi Talib Hospital of Rafsanjan. *Gulhane Med J*. 2021;63:110-6. <https://doi.org/10.4274/gulhane.galenos.2020.1221>.
18. Khattak MB, Marwat ZI, Riaz M, Shah N, Shahzad A, et al. Factors contributing to mortality due to acute stroke in hospitalized patients. *KJMS*. 2015;8(2):293-6.