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HEALTH AND REHABILITATION

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OUTCOMES OF STROKE PATIENTS IN A TERTIARY CARE HOSPITAL

Original Research

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Acknowledgement: The authors gratefully acknowledge the support of the clinical and rehabilitation teams involved in patient care during this study.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Stroke remains a major global cause of mortality and long-term disability, imposing substantial burdens on individuals, families, and healthcare systems. Tertiary care hospitals play a pivotal role in improving outcomes through specialized acute stroke services, advanced neuroimaging, and structured rehabilitation programs. Understanding short-term and intermediate recovery trajectories is essential for optimizing treatment pathways, guiding rehabilitation strategies, and identifying predictors of unfavourable outcomes within high-acuity clinical environments.

Objective: This study aimed to evaluate clinical outcomes, functional recovery, mortality patterns, and predictors of poor prognosis among stroke patients in a tertiary care hospital, with specific emphasis on the impact of early rehabilitation on recovery.

Methods: A prospective observational study was conducted over 12 months at the Pakistan Emirates Military Hospital, enrolling 130 adult patients admitted within 24 hours of symptom onset with confirmed ischemic or hemorrhagic stroke. Data included demographic characteristics, comorbidities, admission NIHSS scores, neuroimaging findings, therapeutic interventions, and Modified Rankin Scale (mRS) scores at discharge and at three months. Survival rates, readmissions, and rehabilitation status were also documented. Statistical analysis using SPSS (version 23) involved descriptive statistics, t-tests, chi-square tests, and logistic regression to identify prognostic factors associated with poor outcomes.

Results: Of the total patients, 75% presented with ischemic stroke and 25% with hemorrhagic stroke. In-hospital mortality was 10%. At discharge, 20% demonstrated good recovery (mRS 0–2), while 45% had moderate disability and 25% had severe disability. At three-month follow-up, good recovery increased to 35% and severe disability declined to 15%. Early physiotherapy yielded functional improvement in 65% of participants compared with 25% among those without rehabilitation. Higher NIHSS scores, atrial fibrillation, delayed hospital arrival beyond six hours, and hemorrhagic stroke subtype were significant predictors of poor outcomes.

Conclusion: Early rehabilitation significantly enhances functional recovery following stroke, while timely hospital arrival and initial stroke severity remain critical determinants of prognosis. Identifying high-risk patients enables tailored interventions that can substantially improve recovery trajectories in tertiary care settings.

Keywords: Disability Evaluation, Early Ambulation, Hemorrhagic Stroke, Ischemic Stroke, Mortality, Rehabilitation, Stroke.

INTRODUCTION

Stroke remains one of the leading global causes of morbidity and mortality, imposing profound medical, social, and economic burdens on individuals, families, and healthcare systems (1,2). It results from an interruption in cerebral blood flow that precipitates neuronal injury and subsequent neurological impairment. Clinically, stroke presents in two major forms—ischemic and hemorrhagic—each with distinct etiological and pathophysiological pathways (3). Approximately 85% of all stroke events are ischemic, arising from vascular occlusion, whereas hemorrhagic strokes occur due to ruptured blood vessels and often carry a higher risk of severe disability or death. Despite advancements in acute stroke care, including modern neuroimaging, thrombolysis, thrombectomy, and refined critical care practices, stroke continues to cause long-term disability for a large proportion of survivors due to the irreversible neurological deficits that persist beyond the acute phase (4). Early intervention in the acute phase is critical for optimizing functional outcomes and reducing mortality. Evidence shows that specialized stroke care—particularly when delivered in tertiary hospitals equipped with advanced therapeutic options—significantly improves patient recovery trajectories (5,6). However, many individuals continue to experience poor outcomes due to delayed hospital arrival, high initial stroke severity, and prevalent comorbidities such as hypertension and atrial fibrillation, which compound the clinical burden (7). In recent years, early rehabilitation has emerged as a promising adjunct to acute medical treatment, with growing evidence suggesting it may positively influence neuroplasticity, functional independence, and long-term quality of life. Nonetheless, the full extent of its impact—particularly in combination with advanced acute interventions—remains an area of active scientific inquiry (8).

While previous research has extensively documented survival rates and functional limitations after stroke, fewer studies have systematically explored the predictors of unfavourable outcomes alongside the role of early rehabilitation in mitigating these risks (9,10). This gap is particularly evident in tertiary care settings where access to specialized interventions provides a unique opportunity to examine how early rehabilitative measures integrate with high-level acute management to shape recovery patterns. Understanding these interactions is crucial, as tertiary facilities treat some of the most clinically complex stroke cases and therefore stand to benefit significantly from evidence-guided rehabilitation strategies. Grounded in this context, the present study investigates clinical outcomes among stroke patients admitted to tertiary care hospitals, with a focus on identifying predictors of poor recovery and evaluating the contribution of early rehabilitation to functional improvement. By examining these dimensions together, the study aims to generate practical insights that can guide clinicians, inform hospital protocols, and ultimately enhance the standard of stroke management. The objective of this research is therefore to determine how early rehabilitation, in conjunction with acute stroke care, influences functional outcomes and survival while identifying key factors associated with unfavourable recovery trajectories.

METHODS

This prospective observational study was conducted over a 12-month period at the Pakistan Emirates Military Hospital, a tertiary-care reference facility equipped with advanced stroke services, including neuroimaging, thrombolytic therapy, mechanical thrombectomy, and intensive care monitoring. The study aimed to assess clinical outcomes, functional recovery, and survival patterns among patients admitted with acute stroke. Ethical approval was obtained from the Institutional Review Board prior to study initiation, and written informed consent was secured from all participants or their legally authorized representatives before data collection commenced. Eligible participants included adult patients aged 18 years and above who were admitted within the first 24 hours of symptom onset and received a confirmed diagnosis of stroke based on clinical evaluation supported by neuroimaging. Patients were excluded if they presented with transient ischemic attacks, pre-existing severe disability defined as a Modified Rankin Scale (mRS) score greater than 4 prior to stroke onset, or stroke secondary to trauma, malignancy, or infectious etiologies. Individuals with incomplete medical records or those who could not be followed up were excluded from the final analysis to ensure data integrity and reliability.

Data were collected using a standardized form that captured demographic characteristics and clinical variables, including blood pressure measurements, serum glucose levels, and National Institutes of Health Stroke Scale (NIHSS) scores at admission. Detailed documentation of therapeutic interventions—such as thrombolysis, mechanical thrombectomy, and conventional medical management—was maintained. Hospital-related indicators, including length of stay, intensive care admissions, and in-hospital

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complications such as pneumonia, deep vein thrombosis, and recurrent stroke, were systematically recorded. Functional outcomes were evaluated at discharge and again at three months post-stroke using the Modified Rankin Scale (mRS), while survival status and readmission events were tracked throughout the study period. All data were analyzed using SPSS version 23. Descriptive statistics were used to summarize baseline characteristics, with continuous variables presented as mean ± standard deviation (SD) and categorical variables expressed as frequencies and percentages. Comparative analyses between ischemic and hemorrhagic stroke groups were conducted using independent t-tests for continuous variables and chi-square tests for categorical variables. Logistic regression analysis was applied to identify independent predictors of poor functional outcomes and mortality. Kaplan–Meier survival curves were generated to estimate survival probabilities over the three-month follow-up interval. A p-value of <0.05 was considered statistically significant.

RESULTS

The study included adult stroke patients with a mean age of 65 ± 12 years, of whom 58% were male and 42% were female. Hypertension emerged as the most common comorbidity, affecting 72% of participants, followed by diabetes mellitus at 42% and atrial fibrillation at 18%. Among the total cohort, ischemic stroke accounted for 75% of all cases, whereas hemorrhagic stroke represented 25%. Functional outcome assessment at discharge showed that 20% of patients achieved good recovery with a Modified Rankin Scale (mRS) score of 0–2, while 45% demonstrated moderate disability (mRS 3–4) and 25% exhibited severe disability (mRS 5). Mortality during the initial hospital stay was 10%. At the three-month follow-up, functional improvement was evident, with good recovery increasing to 35%, moderate disability decreasing to 40%, and severe disability dropping to 15%. Mortality remained unchanged at 10%. Analysis of prognostic factors revealed that a higher NIHSS score at admission was significantly associated with poor functional outcomes ($p<0.01$). The presence of atrial fibrillation also contributed to worse recovery patterns ($p=0.03$). Patients who presented to the hospital more than six hours after symptom onset experienced poorer outcomes compared to those who arrived earlier ($p<0.05$). Hemorrhagic stroke subtype was identified as a predictor of significantly worse functional recovery compared to ischemic stroke ($p<0.01$). Early rehabilitation demonstrated a substantial positive impact on patient progress. Among those who received early physiotherapy, 65% showed functional improvement, whereas only 25% of those who received no rehabilitation demonstrated similar progress.

Table 1: Patient Characteristics

Characteristic	Value
Mean Age (years)	65 ± 12
Gender	
Male	58%
Female	42%
Hypertension	72%
Diabetes Mellitus	42%
Atrial Fibrillation	18%

Table 2: Stroke Subtypes

Stroke Type	Percentage
Ischemic Stroke	75%
Hemorrhagic Stroke	25%

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Table 3: Functional Outcomes (mRS)

Outcome Category	At Discharge (%)	At 3-Month Follow-up (%)
Good Recovery (mRS 0-2)	20%	35%
Moderate Disability (mRS 3-4)	45%	40%
Severe Disability (mRS 5)	25%	15%
Mortality	10%	10%

Table 4: Predictors of Poor Outcomes

Predictor Factor	p-value
Higher admission NIHSS score	<0.01
Presence of atrial fibrillation	0.03
Delayed hospital arrival (>6 hours)	<0.05
Hemorrhagic stroke subtype	<0.01

Table 5: Impact of Early Rehabilitation

Rehabilitation Status	Functional Improvement (%)
Received Early Physiotherapy	65%
No Rehabilitation	25%

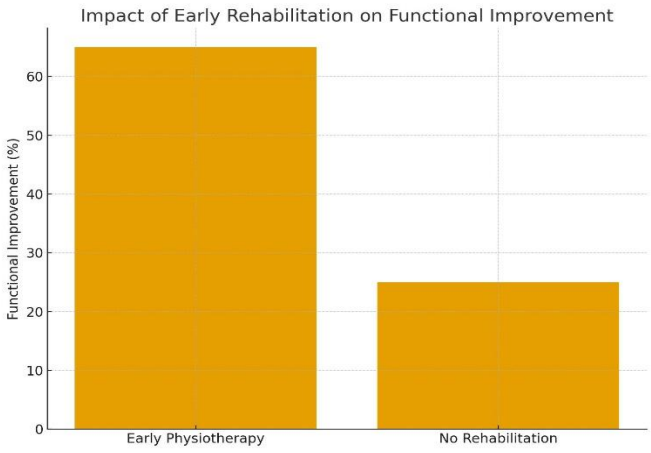

Figure 2 Impact of Early Rehabilitation on Functional Improvement

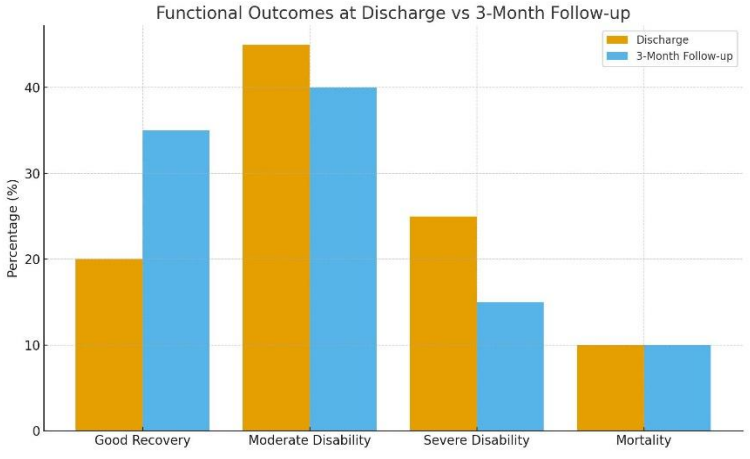

Figure 2 Functional Outcomes at Discharge vs 3- Month Follow-up

DISCUSSION

The findings of this study align closely with global evidence on stroke outcomes and further support the established understanding of stroke as a major contributor to disability and mortality across diverse healthcare systems. The in-hospital mortality rate of 10% observed

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in this cohort corresponded with the mortality trends reported internationally, where similar studies have documented rates between 8% and 15%, reinforcing the persistent burden of acute stroke despite advancements in neurocritical care (11,12). This consistency suggests that the outcomes of stroke care remain influenced by the intrinsic severity of neurological injury and the variability in patient comorbidities rather than regional differences alone. Functional outcomes in this study highlighted substantial limitations at discharge, with only 20% of patients achieving good recovery (mRS 0–2). This pattern mirrors previous findings that early post-stroke disability remains high due to the intensity of neurological damage and the limited timeframe for early neuroplastic changes (13). The improvement to 35% good recovery at the three-month mark corroborates earlier research indicating that the most meaningful gains in stroke rehabilitation typically occur within the first 90 days following onset (14). This trajectory reflects the critical window of neurobiological recovery and underscores the value of structured follow-up rehabilitation services. Early rehabilitation emerged as a significant determinant of functional improvement in the present cohort. Patients who engaged in early physiotherapy demonstrated a 65% improvement rate compared with only 25% among those who did not receive rehabilitation, supporting the established evidence that early mobilization enhances functional recovery and reduces long-term disability (15,16). Such outcomes emphasize the necessity for tertiary hospitals to integrate standardized early rehabilitation protocols into acute stroke pathways to maximize functional outcomes.

Ischemic stroke was associated with superior recovery compared to hemorrhagic stroke in this study, which is consistent with prior literature reporting better functional trajectories and lower disability severity among ischemic stroke survivors (17). Hemorrhagic stroke naturally carries a higher risk of neurological deterioration due to mass effect, elevated intracranial pressure, and secondary complications, which explains the comparatively poorer outcomes observed. Multiple predictors of poor outcomes were identified, including higher NIHSS scores at admission, the presence of atrial fibrillation, delayed hospital arrival beyond six hours, and hemorrhagic stroke subtype. These predictors align with previous work demonstrating that initial stroke severity and cardiac comorbidities markedly influence prognosis (18,19). Delayed presentation further restricted eligibility for time-sensitive interventions such as thrombolysis, supporting existing evidence that the therapeutic window is strongly linked with recovery potential (20). Such findings reiterate the need for public health initiatives to enhance awareness of stroke symptoms and promote timely healthcare seeking behaviors. The strengths of this study include its prospective design, standardized assessment tools, and comprehensive three-month follow-up, which allowed for a clear depiction of short-term functional recovery patterns. The use of validated instruments such as NIHSS and mRS strengthened the reliability of the findings. Additionally, the real-world setting of a tertiary care hospital enhances the generalizability of the results to similar healthcare environments.

However, certain limitations should be acknowledged. The study was conducted in a single tertiary-care center, which may limit broader applicability to rural or resource-limited settings. The exclusion of patients who could not be followed up may have introduced selection bias, potentially underestimating poor outcomes. The study also did not stratify outcomes based on treatment modalities such as thrombolysis versus mechanical thrombectomy, which could have provided deeper insights into treatment-related differences. Furthermore, the absence of detailed analyses such as odds ratios and survival curve metrics limited the ability to quantify risk magnitude associated with identified predictors. Incorporating imaging findings and rehabilitation intensity levels would have strengthened the explanatory depth relating to functional outcomes. Future research should consider multicenter designs, longer follow-up durations, and a more comprehensive evaluation of treatment pathways, rehabilitation intensity, and socioeconomic determinants. Evaluating patient adherence to post-discharge rehabilitation and integrating patient-reported outcome measures would further enhance the understanding of recovery dynamics. Overall, the study reinforces the global evidence base, demonstrating that early rehabilitation, timely hospital arrival, and lower initial stroke severity remain essential determinants of favorable recovery. The results advocate for structured early rehabilitation programs, improved acute care pathways, and enhanced community awareness strategies to optimize stroke outcomes.

CONCLUSION

This study reinforced well-documented patterns in stroke outcomes by highlighting the differing recovery trajectories of ischemic and hemorrhagic strokes, the persistent burden of post-stroke disability, and the critical role of early rehabilitation in improving functional recovery. The findings emphasize the importance of timely stroke recognition and rapid initiation of acute treatment, alongside the need for structured, standardized rehabilitation pathways to optimize patient outcomes. By identifying key areas for improvement and underscoring the value of early therapeutic interventions, the study contributes meaningful evidence to strengthen stroke care practices within tertiary healthcare settings. Future work should focus on long-term follow-up, individualized rehabilitation strategies, and emerging treatment approaches to further enhance recovery potential for stroke survivors.

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AUTHOR CONTRIBUTION

Author	Contribution
Rida Asghar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdul Aziz	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
Ehtisham ul Haq	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Rabia Afroze	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Qurrat-ul-Ain Kalim	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Uzma Fareed	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

REFERENCES

1. GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. Neurology. 2021 Oct;20(10):795.

2. Wang, Y.J., Li, Z.X., Gu, H.Q., Zhai, Y., Jiang, Y., Zhao, X.Q., Wang, Y.L., Yang, X., Wang, C.J., Meng, X. and Li, H., 2020. China stroke statistics 2019: a report from the National center for healthcare quality management in neurological diseases, China national clinical research center for neurological diseases, the Chinese stroke association, National center for chronic and non-communicable disease control and prevention, Chinese center for disease control and prevention and Institute for global neuroscience and stroke collaborations. Stroke and vascular neurology, 5(3).

3. Iso H. Cardiovascular disease, a major global burden: Epidemiology of stroke and ischemic heart disease in Japan. Global Health & Medicine. 2021 Dec 31;3(6):358-64.

4. Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, Abbasifard M, Abbasi-Kangevari M, Abd-Allah F, Abedi V, Abualhasan A. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet Neurology. 2021 Oct 1;20(10):795-820.

5. Grefkes C, Fink GR. Recovery from stroke: current concepts and future perspectives. Neurological research and practice. 2020 Jun 16;2(1):17.

6. Todhunter-Brown A, Sellers CE, Baer GD, Choo PL, Cowie J, Cheyne JD, Langhorne P, Brown J, Morris J, Campbell P. Physical rehabilitation approaches for the recovery of function and mobility following stroke. Cochrane Database of Systematic Reviews. 2025(2).

7. Teasell R, Salbach NM, Foley N, Mountain A, Cameron JI, Jong AD, Acerra NE, Bastasi D, Carter SL, Fung J, Halabi ML. Canadian stroke best practice recommendations: rehabilitation, recovery, and community participation following stroke. Part one: rehabilitation and recovery following stroke; update 2019. International Journal of Stroke. 2020 Oct;15(7):763-88.

8. Stinear CM, Lang CE, Zeiler S, Byblow WD. Advances and challenges in stroke rehabilitation. The Lancet Neurology. 2020 Apr 1;19(4):348-60.

9. Lee KE, Choi M, Jeoung B. Effectiveness of rehabilitation exercise in improving physical function of stroke patients: a systematic review. International journal of environmental research and public health. 2022 Oct 5;19(19):12739.

10. Salvadori E, Papi G, Insalata G, Rinnoci V, Donnini I, Martini M, Falsini C, Hakiki B, Romoli A, Barbato C, Polcaro P. Comparison between ischemic and hemorrhagic strokes in functional outcome at discharge from an intensive rehabilitation hospital. Diagnostics. 2020 Dec 28;11(1):38.

11. Westendorp WF, Dames C, Nederkoorn PJ, Meisel A. Immunodepression, infections, and functional outcome in ischemic stroke. Stroke. 2022 May;53(5):1438-48.

12. Banda KJ, Chu H, Kang XL, Liu D, Pien LC, Jen HJ, Hsiao ST, Chou KR. Prevalence of dysphagia and risk of pneumonia and mortality in acute stroke patients: a meta-analysis. BMC geriatrics. 2022 May 13;22(1):420.

13. Andrade JB, Mohr JP, Lima FO, de Carvalho JJ, Barros LC, Nepomuceno CR, Ferrer JV, Silva GS. The role of hemorrhagic transformation in acute ischemic stroke upon clinical complications and outcomes. Journal of Stroke and Cerebrovascular Diseases. 2020 Aug 1;29(8):104898.

14. Huang S, Diao S, Wan Y. Application of machine learning methods in predicting functional recovery in ischemic stroke patients. InProceedings of the 1st International Scientific and Practical Conference, Innovative Scientific Research: Theory, Methodology, Practice 2024 Sep 3 (p. 240).

15. Moore JL, Nordvik JE, Erichsen A, Rosseland I, Bø E, Hornby TG, FIRST-Oslo Team. Implementation of high-intensity stepping training during inpatient stroke rehabilitation improves functional outcomes. Stroke. 2020 Feb;51(2):563-70.

16. Hobeanu C, Lavallée PC, Charles H, Labreuche J, Albers GW, Caplan LR, Donnan GA, Ferro JM, Hennerici MG, Molina CA, Rothwell PM. Risk of subsequent disabling or fatal stroke in patients with transient ischaemic attack or minor ischaemic stroke: an international, prospective cohort study. The Lancet Neurology. 2022 Oct 1;21(10):889-98.

17. Olive-Gadea M, Cano D, Rodrigo-Gisbert M, Muchada M, Montiel E, Baladas M, Sanchez-Gavilan E, Paredes C, Garcia-Tornel A, Rubiera M, Requena M. Redefining disability: patient-reported outcome measures after minor stroke and transient ischemic attack. Stroke. 2023 Jan;54(1):144-50.

18. Liu SY, Hsu YL, Tu YC, Lin CH, Wang SC, Lee YW, Shih YT, Chou MC, Lin CM. Functional outcome prediction of ischemic stroke patients with atrial fibrillation accepting post-acute care training. Frontiers in neurology. 2022 Sep 23;13:954212.

19. Su F, Xu W. Enhancing brain plasticity to promote stroke recovery. Frontiers in neurology. 2020 Oct 30;11:554089.

20. Klassen TD, Dukelow SP, Bayley MT, Benavente O, Hill MD, Krassioukov A, Liu-Ambrose T, Pooyania S, Poulin MJ, Schneeberg A, Yao J. Higher doses improve walking recovery during stroke inpatient rehabilitation. Stroke. 2020 Sep;51(9):2639-48.