

Factors Predicting Functional Outcome in Patients with Acute Ischemic Stroke

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Abstract:

Background: Stroke remains one of the leading causes of morbidity and mortality worldwide. Identifying predictors of functional outcome in acute ischemic stroke (AIS) patients is crucial for guiding management and prognosis. **Methods:** This prospective observational study was conducted in the Department of Neurology at BSMMU, Dhaka, over a 12-month period following ethical approval. A total of 114 AIS patients were enrolled. Detailed history, clinical examination, and relevant investigations were performed with attention to predefined study variables. Functional outcome was assessed at 90 days using the modified Rankin Scale (mRS) by the principal investigator. Data were collected through a semi-structured questionnaire and analyzed using SPSS version 24.0. **Results:** The mean age of participants was 60.7 ± 13.5 years, with a male predominance (62% male, 38% female). Of the 114 patients, 71 (62.3%) achieved a good outcome (mRS 0–2), while 43 (37.7%) had a poor outcome (mRS 3–6). Multivariate logistic regression of variables with $p < 0.2$ in univariate analysis revealed that dyslipidemia, NIHSS score at admission, and mRS score at discharge independently predicted functional outcome ($p < 0.05$). ROC analysis demonstrated that NIHSS at admission (AUC 0.793, 95% CI 0.704–0.882) and mRS at discharge (AUC 0.867, 95% CI 0.799–0.935) were strong predictors of poor outcome. **Conclusion:** Dyslipidemia, higher NIHSS score at admission, and mRS score at discharge significantly predicted poor functional outcome in AIS patients. Larger multicenter studies are recommended to validate these findings.

Key words: Dyslipidemia, Functional Outcome, Ischemic Stroke, Stroke Outcome

Introduction

Worldwide, stroke is the second leading cause of death and the third leading cause of disability among non-communicable diseases.¹ Globally, 70% of strokes and 87% of both stroke-related deaths and disability adjusted life year (DALY) occur in low- and middle-income countries.² Over the last four decades, when the incidence of stroke has been decreasing in the developed countries, it has more than doubled in low and middle-income countries.³ Global prevalence of stroke is 101.5 million people, of which ischemic stroke accounts for 77.2 million.⁴ The only epidemiological study regarding stroke in Bangladesh found the prevalence of stroke in Bangladesh is 11.39 per 1000 population.⁵ In another study in Bangladesh, 70.75% had

ischemic stroke and rest 29.25% had hemorrhagic stroke.⁶ Another study shows the higher prevalence (38.18%) of large-artery atherosclerosis (LAA) in Bangladesh suggests the presence of uncontrolled hypertension, diabetes mellitus, smoking habit, and dyslipidemia are leading risk factors.⁷ In ischemic stroke, 8% to 12% result in death within 30 days, and of those who survive, approximately 30% require assistance with activities of daily living, 20% require assistance with ambulation, and 16% require institutional care.⁸

Following a stroke, the central nervous system undergoes reorganization during functional recovery. These neurophysiological changes are incompletely understood and often begin within one to two weeks following a stroke

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and may plateau within two to three months. A large number of factors may influence these changes and the functional outcome of stroke patients.⁹ Numerous factors have been identified as potential predictors of outcome in acute care setting such as demographic factor (age, gender); risk factor/comorbidity (hypertension, diabetes mellitus, cardiac diseases, family history of ischemic stroke); some scale and type (stroke severity as measured by the National Institutes of Health Stroke Scale (NIHSS), Glasgow Coma Scale (GCS), modified Rankin scale (mRS), Trial of ORG 10172 in Acute Stroke Treatment (TOAST) stroke subtype; laboratory (blood sugar at admission, total cholesterol, LDL, TG, HDL) and imaging (location and size of infarct) findings. Some studies showed that genetic and socio-economic factors also influence the outcome of ischemic stroke.¹⁰ The modified Rankin Scale (mRS) is a validated measure of functional outcome after stroke, commonly used in large-scale multicenter stroke trials and prospective studies of post-stroke disability.¹¹ The purpose of this hospital-based study was to determine the factors that predicted the functional outcome of acute ischemic stroke (AIS) patients.

Materials and Methods

This prospective observational study was conducted in the Department of Neurology at BSMMU from October 2021 to September 2022. After receiving ethical approval from the Institutional Review Board (IRB), all admitted patients with acute ischemic stroke were considered for this study. Before collecting data, the study details were explained to each patient, and written informed consent was obtained from the patients or their legal guardians. Ultimately, 114 patients were selected based on the specified inclusion and exclusion criteria. A detailed history, physical examination, and all relevant investigations were performed, focusing on the study variables. All necessary investigations, including CT scan, MRI, or both, were completed. Acute ischemic stroke was sub-classified into defined sub-types through

appropriate investigations. The NIHSS score at admission and the mRS score at discharge were calculated. Functional outcomes were assessed again on day 90 using the mRS. Data were collected by the researcher through face-to-face interviews and telephone conversations, using a structured data collection sheet. Numerical variables were expressed as Mean $\pm$ SD or median $\pm$ interquartile range (IQR). Categorical variables were represented by numbers, percentages, and graphs. The association between variables and functional outcomes was tested using t-test, Mann–Whitney U test, or χ^2 test where appropriate. Variables with potential significance in univariate analysis ($P < 0.2$) were included in multivariate logistic regression to identify independent factors influencing functional outcome ($P < 0.05$). ROC analysis of significant predictors for poor outcomes was conducted to determine sensitivity and specificity. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) version 24.0.

Result

The mean age of respondents was 60.7 ± 13.5 years, with the largest proportion (33.3%) aged between 60–69 years. The mean age of those with good outcomes was 59.3 ± 13.5 years, compared to 63.1 ± 13.3 years among those with poor outcomes. Overall, 54.4% were male and 45.6% female. A majority achieved a good functional outcome (62.3%), while 37.7% had a poor outcome. Notably, poor outcomes were more common among females (53.5%), whereas good outcomes were more common among males (54.9%).

A significant association was observed between dyslipidemia and functional outcome. Dyslipidemia was present in 72.1% of respondents with poor outcomes and 52.1% of those with good outcomes. Similarly, the NIHSS score at admission was significantly associated with outcome: the median (IQR) NIHSS was 6 (3) in the good outcome group and 10 (7) in the poor outcome group. The mRS score at discharge also showed a significant association with 90-day functional

Table-1
Association of risk factor with functional outcome of respondents (n=114)

Risk factor	Good outcome n=71(%)	Poor outcome n=43(%)	Total n=114(%)	p value
Hypertension	51(71.8)	36(83.7)	87(76.3)	0.148*
Diabetes	35(49.3)	22(51.2)	57(50)	0.847*
Dyslipidemia	37(52.1)	31(72.1)	68(59.6)	0.035*
Cardiac disease	22(31)	10(23.3)	32(28.1)	0.373*
H/O previous stroke	22(31)	19(44.2)	41(36)	0.155*
Age (Mean $\pm$ SD)	59.25 $\pm$ 13.53	63.14 $\pm$ 13.25		0.137**
NIHSS (Median,IQR)	6(3)	10(7)		<0.001***
mRS (Median,IQR)	4(1)	5(1)		<0.001***

* Chi-squared Test (χ^2), ** student t-test value and *** Mann Whitney U test was performed to determine the p-value

Table-2

Multivariate logistic regression analysis to detect independent predictors for poor functional outcome of respondents (n=114)

Risk factors	OR	p value	95% CI	
			Lower	Upper
Age (>60 years)	1.197	0.660	0.538	2.664
Hypertension	2.259	0.105	0.843	6.048
Dyslipidemia	2.552	0.027	1.115	5.838
Previous h/o stroke	1.763	0.156	0.805	3.863
NIHSS (>16 score)	9.211	0.046	1.038	81.728
mRS (iii-v)	8.542	0.043	1.069	68.242

outcome: median (IQR) mRS was 4 (1) in the good outcome group and 5 (1) in the poor outcome group. In contrast, TOAST subtypes were not significantly associated with outcome. Respondents with good outcomes included 7% with small vessel occlusion, whereas none with poor outcomes had this subtype.

Multivariate logistic regression identified dyslipidemia, NIHSS score, and mRS score at discharge as independent predictors of poor functional outcome ($P < 0.05$). ROC analysis demonstrated strong predictive value: the AUC for NIHSS at admission was 0.793 (95% CI: 0.704–0.882), and for mRS at discharge was 0.867 (95% CI: 0.799–0.935), both statistically significant ($P < 0.001$). Optimal cut-off values were NIHSS ≥ 8.5 (sensitivity 65.1%, specificity 80.3%) and mRS ≥ 4.5 at discharge (sensitivity 69.8%, specificity 93%).

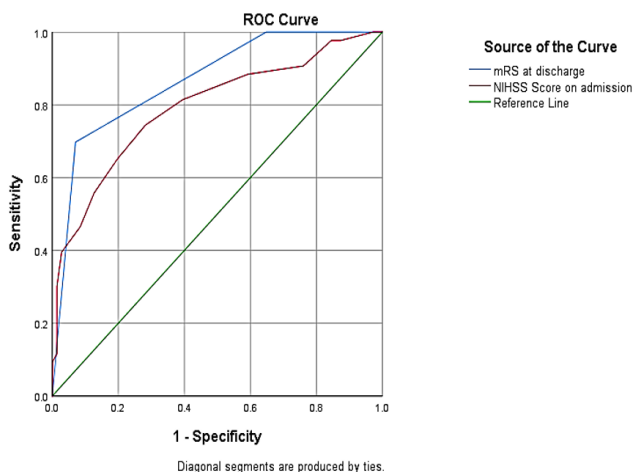


Figure 1: Receiver operator curve analysis of NIHSS and mRS score at discharge for predicting poor outcome of respondents with AIS (n=114)

Discussion

This study revealed that the majority of respondents (62.3%) had a good outcome, while 37.7% experienced a poor outcome. Similar findings have been reported in several studies,¹² although some have shown different results¹¹. Such discrepancies are likely attributable to variations in methodology, timing of mRS assessment, and the cut-off used to define favorable outcomes (<3).

Among risk factors, dyslipidemia was significantly associated with outcome in this study ($P = 0.035$). Other risk factors showed inconsistent associations across studies, which may reflect differences in study design, sampling techniques, public awareness, and control of modifiable risk factors across countries. No statistical association was found between TOAST subtypes and functional outcome. The most common etiologies observed were undetermined stroke, followed by large artery atherosclerosis and cardioembolism. A similar pattern was reported in a 2021 study from our country, where the high proportion of undetermined etiology was attributed to multiple causes in individual patients and limited access to advanced diagnostic investigations.⁷

A significant association was found between NIHSS score and functional outcome. The median (IQR) NIHSS score was 6 (3) in the good outcome group and 10 (7) in the poor outcome group, consistent with findings from a 2017 study.¹³ Likewise, mRS score at discharge was significantly associated with outcome: patients with poor outcomes most often had severe disability (mRS = 5). These results align with findings reported in 2021.¹⁴

Multivariate logistic regression analysis identified dyslipidemia ($P = 0.027$), NIHSS score >16 ($P = 0.046$), and mRS score at discharge (III–IV) ($P = 0.043$) as independent predictors of poor functional outcome. These findings are consistent with prior studies.¹⁵ ROC analysis further demonstrated that NIHSS at admission and mRS at discharge had good sensitivity and specificity for predicting poor outcomes, again in agreement with previous research.¹⁶

Conclusion

Dyslipidemia, NIHSS score at admission and mRS score at discharge have independent prediction ability of poor outcome of acute ischemic stroke patients with good sensitivity and specificity.

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Conflicts of Interest

The authors declare that they have no conflicts of interest related to this work.

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