Original Article

Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital

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Article Info

Abstract

Background: To assess the use of the National Institute of Health Stroke Scale (NIHSS) in predicting functional outcomes after hospital discharge using the functional independence measure (FIM) in patient's post-stroke. **Methods**: This retrospective cohort study included 99 patients who were admitted to NGHA hospitals between January 2020 and January 2022 and had been discharged and scheduled for rehabilitation sessions in the hospital. All data were extracted from medical health records during the study period. Data on patient characteristics, NIHSS score, FIM admission and discharge scores, stroke type, rehabilitation sessions, smoking status, hypertension, and length of stay were collected. **Results:** Most patients had moderate stroke, and 88.9% of all the patients had ischemic stroke. There was a statistically significant improvement in the FIM score from admission to discharge [2.84 ($\pm$1.63) to 4.47 ($\pm$1.55), p= 0.01]. After adjusting for all other potential predictor variables, the NIHSS score for moderate stroke significantly predicted the FIM score upon discharge. Conclusion: This study showed the significance of using the NIHSS score for newly admitted patients with moderate stroke in predicting recovery. **Conclusion:** The study illustrated a significant improvement in the FIM scores from admission to discharge, demonstrating the importance of early and intensive rehabilitation post-stroke.

Keywords: Stroke; FIM, Functional Outcome, NIHSS, Rehabilitation.

Introduction

Stroke is considered the third leading cause of death and major disabilities. Two-thirds of all stroke cases occur in developing countries (Feigin, 2005; Bonita et al., 2004). While the prevalence of stroke in Saudi Arabia has been reported, different studies mention different prevalence rates. Most studies have reported a low incidence of 29 per 100,000 (Alqahtani et al., 2020) and 43.8 per 100,000 (Rajeh et al., 1993) people in Saudi Arabia. However, limited data are available regarding the rehabilitation and quality of life of stroke survivors. Although patients with stroke require assistance to improve their quality of life after hospital discharge (Alshahrani, 2020; Alotaibi et al., 2021), there remains a gap in identifying the factors that predict their recovery after discharge.

Many test scales are used in daily clinical practice for stroke survivors. In the acute stage, the National Institute of Health Stroke Scale (NIHSS) is most commonly used because of its practical applicability at the bedside (Jauch et al., 2013). Although the baseline NIHSS score is a strong predictor of stroke recovery (Adams et al., 1999; Wouters et al., 2018), few studies in Saudi Arabia have shown its applicability for long-term outcome prediction. Particularly, disability related to the activities of daily living (ADLs) is considered the most serious clinical concern after hospital discharge (Brown et al., 2015; Meyer et al., 2015).

The functional independence measure (FIM) (Linacre et al., 1994) is also a commonly used assessment tool for stroke survivors. The FIM calculates 13 motor and five cognitive items in reference to ADLs and directly reflects the burden of care. In contrast to the NIHSS, which is often assessed during the acute stage, the FIM is often used in rehabilitation settings. Moreover, the FIM

is a strong predictor of stroke survivor outcomes 3 months after hospital discharge (Brown et al., 2020; Andrews & Bohannon, 2023). Hospital length of stay (Einspieler et al., 2019) and stroke types and severity (Bindawas et al., 2018; Yang et al., 2023) are other factors shown to be good predictors of stroke recovery outcomes.

Stroke rehabilitation can significantly affect the lives of patients with stroke. Early rehabilitation of these patients can have a positive effect on the musculoskeletal, cardiovascular, respiratory, and immune systems (Yagi et al., 2017) and can lower immobility-related complications (Langhorne et al., 2000). In addition, early stroke rehabilitation improves ADLs in the short and long terms (Yang et al., 2023; Yoo et al., 2022; Davidoff et al., 1991). More recent studies showed that the burden of stroke in Saudi Arabia is increasing, with lower quality of life and ADL dependency in stroke survivors (Alotaibi et al., 2021; Basri et al., 2021). However, few studies in Saudi Arabia have examined the impact of stroke rehabilitation on patients' ADLs or quality of life (Alshahrani, 2020; Abdul-sattar & Godab, 2013; Abdulwahab et al., 2015: Shaik et. al., 2021).

This study aimed to identify predictable factors that influence stroke recovery and function in post-stroke patients using the NIHSS score, FIM motor score, and other variables that may affect recovery post-stroke. To the best of our knowledge, this is the first study in Saudi Arabia to use the NIHSS and FIM motor scores with other variables to predict recovery and function after hospital discharge in stroke survivors.

Methodology

This retrospective cohort study was conducted at King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia, covering 2 years, from January 2020 to January 2022. The Neurology Rehabilitation Unit

IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

264

(NRU) at KAMC has a capacity of 20 beds with an average of 144 admissions per year. Patients with stroke who were admitted to the NRU were included in this study. Those who received rehabilitation outside the unit and those who died or had multiple strokes were excluded from the study. A total of 106 patients with stroke were admitted, and seven were excluded from the analysis (two died, three received rehabilitations outside the NRU, and two had multiple strokes).

This study received Institution Review Board approval from the King Abdullah International Medical Research Center (KAIMRC) (Reference No. 1217/22). The requirement for informed consent was waived by the KAIMRC considering the retrospective nature of the study.

The demographic data of the patients were extracted from their electronic medical records. The investigated patient variables included sex, age, type of stroke, length of stay in the rehabilitation center in days, number of rehabilitation sessions, initial NIHSS score, FIM score, scores at admission and discharge, smoking status, and hypertension history.

The NIHSS is a scale used to measure patients' level of stroke impairment by scoring the following 15 items: consciousness (three subclasses), gaze, visual field loss, facial palsy, right and left upper extremity motor strength, right and left lower extremity motor strength, limb ataxia, sensory loss, language, dysarthria, and extinction/attention. The total score (ranging from 0 to 42) is often used as an index of stroke severity. The NIHSS data were obtained in the first 24 hours post-stroke (Goldstein et al., 1989).

The FIM comprises 13 motor and five cognitive items. In this study, we focused on the FIM motor assessment items of self-care, transfer, and locomotion. Each item was scored on a 7-point scale: 1, total assistance; 2, maximal assistance; 3, moderate assistance; 4, minimal contact assistance; 5, supervision or set-up; 6, modified independence; and 7, complete independence. The FIM motor scores were obtained at admission and discharge (Granger, 1998).

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS V.25.0; SPSS Inc, Chicago, IL). For descriptive analyses, continuous variables are presented as mean ± standard deviation (SD) and interquartile range (IQR), and categorical variables are presented as proportions. Paired t-tests were used to compare the changes between the mean FIM motor scores at admission and discharge. The NIHSS score and all other collected variables, including age, sex, stroke type, length of stay, smoking status, and hypertension, were analyzed using simple linear regression with FIM motor scores at discharge as the dependent variable. All variables analyzed in the simple linear regression with a p-value of <0.05 were included in a multiple regression analysis. A p-value of <0.05 indicated statistical significance.

Result

The clinical and demographic characteristics of the patients are presented in Table 1. This study included 99 patients. The mean age of the patients was 57.2 ($\pm$10.87) years; 60.6% of the participants were males and 39.4% were females. Most patients had a moderate stroke (63.6%), followed by a minor stroke (24.2%) and a moderate to severe stroke (9.1%), according to the NIHSS. Approximately 88.9% of the patients had ischemic stroke. Moreover, 70.7% of the patients had hypertension, and only 13.1% of the patients were smokers. The median of rehabilitation sessions was 66 sessions, with an interquartile range of 45 to 93 sessions. While the median rehabilitation

IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

265

length of stay was 23 days, with an interquartile range of 10 to 37 days.

Table 1: Baseline characteristics and outcome of all stroke patients.

Variables	Number (%)
Sex	
Male	60 (60.6%)
Female	39 (39.4%)
NIHSS	
No stroke symptoms	2 (2.0%)
Minor stroke	24 (24.2%)
Moderate stroke	63 (63.6%)
Moderate to severe stroke	8 (8.1%)
Severe stroke	2 (2.0%)
Stroke type	
Hemorrhagic	11 (11.1%)
Ischemic	88 (88.9%)
Rehabilitation Session (Median, IQR)	66 (45,93)
Smoking	
Yes	13 (13.1%)
No	86 (86.9%)
Hypertension	
Yes	70 (70.7%)
No	29 (29.3%)
LOS in rehabilitation (Median, IQR)	23 (10,37)

*LOS: length of stay

FIM Motor Scores

The mean FIM motor scores from admission to discharge are presented in Table 2. The overall mean FIM motor score increased from 2.84 ($\pm$ 1.63) at admission to 4.47 ($\pm$ 1.55) at discharge. This change was statistically significant (p= 0.01).

Table 2: FIM scores throughout admission to discharge during treatment

	FIM Admission	FIM Discharge
Mean $\pm$ SD	2.84 $\pm$1.63	4.47$\pm$1.55
Mean Diff. $\pm$ SD	-1.62 $\pm$1.39	
P Value	0.01	

Table 3: Unadjusted and adjusted linear regression models predicting change in FIM score for stroke patients

Predictor	Unadjusted β	SE	p	Adjusted β	SE	p
Age	-0.001	0.01	0.92	-0.002	0.01	0.88
NIHSS						
No stroke symptoms	0.29	1.1	0.79	0.31	1.08	0.76
Moderate stroke	-0.97	0.36	0.01	-0.96	0.34	0.006
Moderate to severe stroke	-1.2	0.56	0.03	-0.95	0.57	0.09
Sex	-0.40	0.31	0.21	-0.45	0.29	0.14
Rehabilitation session	-0.006	0.004	0.13	-0.005	0.003	0.12
Stroke type	-0.12	0.49	0.80	-0.10	0.47	0.82
LOS	-0.01	0.01	0.03	-0.01	0.00	0.07
Smoking	0.693	0.49	0.13	0.70	0.48	0.12
Hypertension	0.135	0.36	0.69	0.14	0.35	0.67

*LOS: length of stay

Univariate and Multivariate Prediction Models

Table 3 presents both the adjusted and unadjusted linear regression models that predicted changes in the FIM motor scores at discharge. In the unadjusted model, the NIHSS score for moderate and moderate-to-severe strokes showed statistical significance ([β=-0.97, p=0.01] and [β=-1.20, p=0.03], respectively). This means that as the NIHSS score for moderate and moderate-to-severe stroke increased by one unit, the FIM score tended to decrease. Further, the length of stay was found to be statistically significant (β=-0.01, p=0.03), indicating that an increase in the number of days spent in the hospital tended to be associated with a decrease in the FIM outcome. However, after adjusting for all other potential predictor variables, only the NIHSS score for moderate stroke (β= -0.96, p= 0.006) significantly predicted FIM motor scores at discharge. None of the other variables showed a statistically significant predictive value for the FIM motor scores at discharge.

Discussion

The results showed that FIM motor scores improved significantly in stroke patient from admission to discharge. Moreover, our results showed that the initial NIHSS score was a strong predictor of improvement in the FIM motor scores at discharge specifically to patients with moderate stroke.

Our findings are similar to those of other studies that showed the strong prognostic value of the initial NIHSS score for patient outcomes (Adams et al., 1999; Bang et al., 2005; Wouters et al., 2018). Moreover, the initial NIHSS score is a good predictor of long-term FIM motor scores (Saito et al., 2018; García-Rudolph et al., 2023). Our findings also showed that the impact of rehabilitation sessions in predicting FIM motor scores with fewer rehabilitation sessions usually results in better outcomes because the patient is predicted to improve much faster. In addition, a significant difference between the FIM motor scores at admission and discharge indicates the importance of rehabilitation services, specifically acute rehabilitation, in stroke patients. This result is consistent with studies that showed that early intensive rehabilitation improved the outcomes of stroke survivors (Oyanagi et al., 2021). The improvement in the FIM motor score indicates better function of the ADLs after discharge.

In the current study of 99 stroke patients, the mean age was 57.2 years, which was lower than that in other developed countries (Kissela et al., 2012; Lee et al., 2011). In an earlier study examining stroke patients between 1982 and 1992 from KAMC, the mean age was 63 years (al Rajeh et al., 1993). Furthermore, recent studies in Saudi Arabia reported a mean age of stroke onset of 56 years (Khathaami et al., 2019). This may be attributed more to the Saudi Arabian population tilting towards a younger age than to the impact of lifestyle elements, specifically hypertension, influencing the risk for stroke.

Some studies in Saudi Arabia have examined the quality of life (QoL) of stroke survivors after hospital discharge, with all studies reporting a low QoL (Alshahrani, 2020; Alotaibi et al., 2021; Ghandour, 2016; Almrzouqi et al., 2022). However, no study in Saudi Arabia has examined the predictive factors influencing stroke recovery using the FIM, ADLs, or QoL assessments. Our results show the importance of using initial NIHSS scores and rehabilitation to improve FIM motor scores and potentially ADLs and QoL in stroke survivors after hospital discharge.

IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

267

This study had some limitations. Our sample size was relatively small and may not represent the entire population of Saudi Arabia. In addition, the majority of the patients in our study had moderate stroke, which may limit the applicability of the findings. This study was conducted in one center in one city, which may limit the generalizability of our findings. Another limitation was the lack of long-term follow-up, as our study reported FIM motor scores in the short term (only less than 30 days post-stroke on average). Future studies should include multisite centers with longer follow-up periods to increase the sample size and improve the generalizability of the findings.

Conclusion

The initial NIHSS score, and number of rehabilitation sessions might be strong predictors of the recovery of stroke with moderate stroke at discharge, as indicated by the FIM motor scores. Significant improvements in FIM motor scores at admission and discharge suggest a significant benefit of early intensive rehabilitation. Although our study was conducted in a single center with a relatively small sample size, our findings suggest a strong predictor of better recovery for stroke survivors. These finding may serve as crucial information for stroke rehabilitation programs to understand factors that influence the recovery of patients with moderate stroke.

Disclosure of interest

The authors report no conflict of interest.

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268

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IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

269

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IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

270

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IJOPRP | Predict Factors that Influence Stroke Recovery and Function Using FIM Score at Discharge in a Tertiary Hospital.

271