International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Influence of Length of Stay on Functional Independence Measures in Stroke Inpatients

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Abstract

Introduction: Stroke is one of the leading causes of death worldwide. Initiating rehabilitation in the early phase is paramount to preventing further disability and impairment. Greater impairments result in longer length of stay; however, this can be extremely costly for both providers and patients. Functional Independence Measure is a tool used to assess the degree of disability for patients admitted to an Inpatient Rehabilitation Facility. The functional independence measures usually provide guidance in planning rehabilitation care. Ensuring efficiency in rehabilitation requires collaborative multidisciplinary effort to ensure rehabilitation is effective and functional outcomes are met. Rehabilitation post stroke is a restorative process aimed at ensuring the patient achieves maximum functional outcomes.

Objectives: This study aimed to determine if the Length of Stay (LoS) for patients would affect the Functional Independence Measure of stroke patients in the Inpatient Rehabilitation Facility.

Material and methods: A retrospective chart review of patients admitted as inpatient for post-stroke management from 2018 to 2021. The analysis encompassed demographic and stroke-related variables, including type, severity, and location of the stroke. Continuous variables (length of stay, demographics) were run using Anova. Multiple linear regressions were run using functional independence measures on admission, discharge, gain and efficiency as dependent variables against four lengths of stay groups (<30 days, 31–60 days, 61–90 days and >90 days). Regressions tests involved the use of three different models. Model 1 was not adjusted, whereas model 2 was adjusted to account for age and gender. Model 3 was adjusted to account for age, gender, stroke type, stroke severity, and stroke site/location.

Results: Regression model with length of stay and functional independence measures on discharge was found to be statistically significant in the reference group (LoS < 30 days) with a 23.7-point increase in model 2 (adjusted for age and gender). The LoS > 91-day group proved to be the least efficient across all three groups when compared to the reference group (<30 days)

Conclusion: The study concludes that longer length of stay has a negative affiliation with functional outcomes and shorter length of stay does not necessarily have a negative impact on functional outcomes.

Keywords: Stroke, Functional Independence Measures, Length of Stay, Inpatient Rehabilitation Facility.

Introduction

Stroke has been identified as one of the leading causes for death and disability in the 2017 study of global burden and disease [1]. Some of the leading causative factors for stroke identified by John Hopkins Medicine can be attributed to hypertension, obesity, heart disease, diabetes and inactivity [2]. Iman *et al* identified sedentary lifestyle as an aggravating factor for stroke [3]. In Qatar, as evidenced in a study by Jallow *et al* data shows that the number of strokes has been increasing [4]. Other studies like the one by

Imam *et al* [3]. conducted over a 5-year time span among Qatari's show that the mean incidence rate was 92.04 per 100,000.

The guidelines governing stroke management necessitate a strong multidisciplinary effort among rehabilitation professionals[5]. Qatar Rehabilitation Institute (QRI) is currently the leading facility managing patients requiring rehabilitation post stroke, traumatic brain injury and traumatic brain injury [6].

Mackintosh mentions that Functional Independence Measure (FIM) is a tool used to assess the degree of disability for patients admitted to an Inpatient Rehabilitation Facility (IRF). FIM is a 6-point rating system between 18 to 126. Higher scores imply functional independence, while lower values imply functional dependency (mobility, locomotion, communication, social cognition, sphincter control, self-care) [7]. Based on research by Valach and Selz, tracking FIM was helpful in gauging rehabilitation effectiveness, which is why it has been the accepted measure of functional outcomes at QRI [8]. Zeltzer claims that flaws in the Barthel Index were overcome as a result of the developed FIM™ instrument [9]. Further validated by Lee *et al*. who discovered that the modified Barthel Index was less accurate than FIM in measuring functional status in cases of severe stroke [10].

Rehabilitation care is available to stroke patients hospitalized in IRF that provide more than three hours of therapy five times a week and are under the care of a Physician in a multidisciplinary manner [5]. What makes the QRI stand out is that it is the only facility focusing on rehabilitation in a comprehensive manner. Rehabilitation treatment is led by Physical Medicine and Rehabilitation specialists along with Physical therapists, Occupational therapists, Speech therapists, Prosthetists, Orthotists, Case managers, Psychologists and other members of the Allied healthcare professionals.

The average Length of Stay (LoS) as defined by the Organization Economic Corporation Development (OECD) refers to the average number of days patients are admitted to the hospital [11]. Numerous studies highlight the relationship between LoS and functional outcomes. For instance, in the study conducted by Camicia *et al*, it was discovered that the severity of a stroke corresponds to the length of hospitalization, meaning the worse the patient's condition is, the longer hospitalization is required [12]. Nevertheless, the primary purpose of this study is to analyze how functional outcomes are impacted by LoS and other factors of stroke such as its type, severity, and site of localization. In the study by Venkatachalam *et al*, authors aimed at identifying various determinants of LoS for stroke rehabilitation, however this research scope is LoS on FIM scores [13].

Patients at QRI were found to display an average LoS of 35 days over the past two years, however the AAPM&R adjudicates typical LoS for stroke patients in an IRF is 15.5 days [14]. As identified by Qureshi *et al*. a study conducted at an IRF in Saudi Arabia had an average LoS of 48 days [15]. Meanwhile, Bindawas *et al* reports that the average LoS in countries such as United States, Canada, and Australia is 16.5 days, 23-49 days, and 28 days [16]. Managing patients with moderate or severe functional deficits results in greater demand for the healthcare system. Prompt interdisciplinary team-initiated rehabilitation contributes to better rehabilitation outcomes nevertheless acknowledge that rehabilitation is financially demanding and adequate triage is imperative [17].

The National Institutes of Health Stroke Scale (NIHSS) is used to assess the severity of stroke, which often guides management and assisting in evaluating the patient's recovery [18]. Nevertheless, Lyden points out for patients with a history of neurological dysfunction that the efficacy of using the NIHSS is questionable [19]. It has been reported by the American Stroke Association that ischemic strokes are more

predominant (87%) than hemorrhagic strokes (13%) [20]. This is consistent with findings of Pillay *et al*. where most of their patients presented with ischemic strokes [21].

Forecasting LoS in inpatient rehabilitation facilities has proven to be extremely beneficial for fiduciary management and in order to manage patient expectations according to Garcia *et al*. [22]. Patients who suffer a stroke can be inundated with financial strain and may potentially result in increased hospital stays [23]. Therefore, effective monitoring key drivers in LoS is increasingly crucial for the QRI to ensure the efficient utilization of resources.

Methods

Study Aim

The aim of this study was to determine if the Length of Stay (LoS) for patients would affect the Functional Independence Measure (FIM) of stroke patients in the Inpatient Rehabilitation Facility (IRF).

Hypotheses

H1: By increasing the LoS for stroke patients in the inpatient rehabilitation unit, we will have better impact on the functional outcomes.

H2: Increase in the LoS for stroke patients in the inpatient rehabilitation unit does not impact the functional outcomes since there was no difference in FIM scores between patients who had shorter stays versus those who stayed longer.

H3: Increase in the LoS based on the severity of the stroke does impact the functional outcomes for stroke patients admitted to the inpatient rehabilitation unit.

Research Objectives

To ascertain whether a patient's Length of stay will have an impact on Functional Independence Measure (FIM) of stroke patients in the Inpatient Rehabilitation Facility (IRF).

To achieve the above aim the following primary objectives are formulated:

- To analyse the FIM gain in relation to the length of stay

Secondary Objectives

- To analyse the length of stay of stroke patients in the Inpatient Rehabilitation Unit
- To collect and compare data on the FIM scores on admission and discharge based on study of sociodemographic and stroke related variables
- Utilize existing FIM scores on admission and discharge to calculate FIM efficiency.

Study Population and Study Setting/ Location

The research study site identified was QRI in Doha, Qatar, which serves as the sole rehabilitation facility in the country for all patients. The facility primarily focuses on treating patients with diagnoses such as Stroke, Traumatic Brain Injury, and Spinal Cord Injury. The Cerner electronic medical records were the source of data collection hence no medical procedures were conducted on patients. The study was a retrospective review, and the study population included all male and female patients admitted post stroke between January 2018 till December 2021. The data collection period was inclusive of follow-up period, and no data was collected thereafter. This study involved analysis of socio-demographic variables such as age, sex and stroke related variables such stroke type, stroke severity, stroke location/site. The severity

of the stroke was measured using the NIHSS. While severity scores were recorded upon admission to the stroke program, there was a group of patients for whom no score was documented.

Statistical Analysis

Continuous variables such as LoS, FIM gain, and age were analyzed using Anova. The data has been divided into four categories according to the duration of stay: stays less than 30 days, stays between 31 and 60 days, stays between 61 and 90 days, and stays longer than 91 days. In order to test the hypothesis, the analysis conducted a comparison of four particular dependent variables related to functional outcomes (FIM on admission, FIM on discharge, FIM Gain, and FIM Efficiency) with the LoS groups using multiple linear regression testing. The tests involved the use of three different models. Model 1 was not adjusted, whereas model 2 was adjusted to account for age and gender. Model 3 was adjusted to account for age, gender, stroke type, stroke severity, and stroke site/location. The analysis of multiple regression included running the FIM scores on admission, FIM scores on discharge, FIM gain, and FIM efficiency as dependent variables in three models. The independent variables in the models consisted of LoS groups, age, gender, stroke type, stroke severity, and stroke location. The purpose was to establish whether there was a correlation between LoS and functional outcome. LSD tests were used to evaluate continuous data. All data was computed and analyzed using The Statistical Package for Social Sciences (SPSS) 28th version (IBM SPSS Statistics 28).

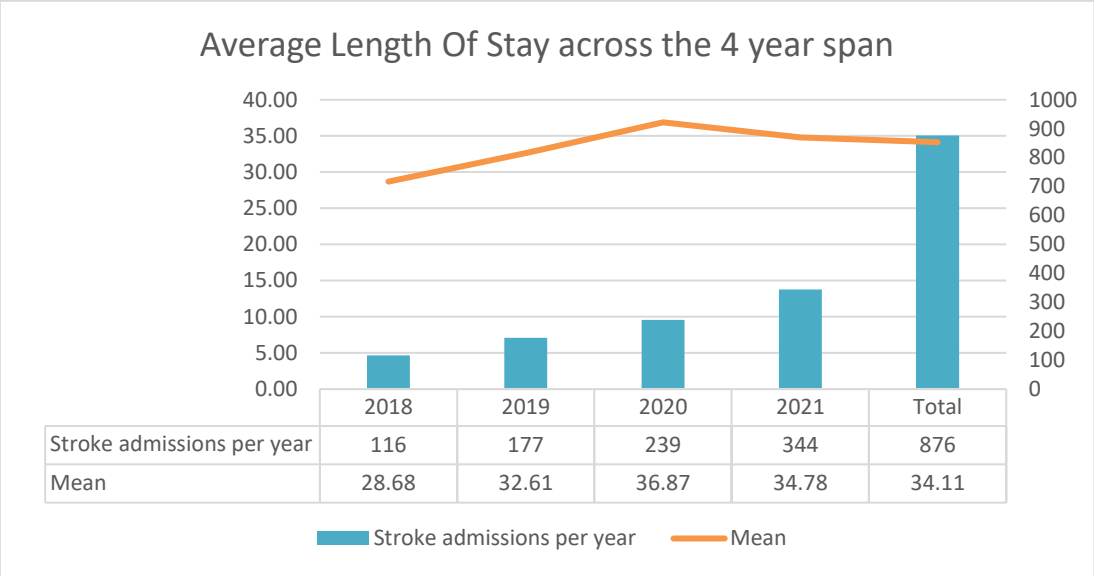
Approval of the study was granted by the HMC Medical Research Council. All articles have been handled with ethical integrity. The study was carried out in accordance with the principles of the "Declaration of Helsinki," Good Clinical Practice (GCP), and in compliance with the laws and regulations of the Ministry of Public Health in Qatar.

Results

Socio-demographic variables

From the findings reflected in Figure 1 below, we found that there was a substantial increase in number of patients admitted to the QRI for inpatient rehabilitation with a collective cohort (n= 876). An analysis of descriptive statistics as reflected in Table_1 reveals that out of the total population, there was 52.7% (n=462) in the reference group LoS<30 days, while the smallest proportion was among LoS>91 days, accounting for 2.5% (n=22). This particular group also exhibited the longest average LoS of 126 days. Males have a higher prevalence of stroke, with 730 cases (83.3%), compared to females, with 146 cases (16.7%). In the reference group, patients were notably younger at an average age of 53.62 years (SD=11.0) compared to the LoS 61–90 days and > 91-day groups, where the average ages were 58.44 (SD=12.3) and 62.82 (SD=13) years, respectively.

Figure 1: Average length of stay for stroke patients admitted to inpatient rehabilitation unit across the 4-year span



Stroke related variables

Ischemic strokes were more prevalent in all groups, for 782 cases (89.3%), while hemorrhagic strokes made up 84 cases (9.6%), and an additional 10 cases (1.1%) were classified as Ischemic with hemorrhagic transformations. The percentage of patients with moderate strokes was lower in the LoS 31-60-day group (86.9%) compared to the <30-day group (79.9%), with 265 and 369 patients, respectively. Data related to stroke location found that 435 strokes (49.7%) were attributed to the left hemisphere, while 376 strokes (42.9%) were attributed to the right hemisphere. Out of the total, 37 (4.2%) were due to bilateral strokes, and 28 (3.2%) were attributed to other sites.

Across all groups, the difference between left and right hemisphere strokes was only 6.8%. In comparison to other groups, the average admission and discharge FIM scores for patients in the LoS<30-day group were higher at 81.0 (SD=19.6). The Post Hoc test showed a statistically significant difference between the group with LoS<30 days (p<.001) and all the other LoS groups. The group with a length of stay (LoS) between 61 and 90 days showed the highest average FIM gain of 37.7 (SD=16.9), while the group with a LoS<30 days displayed the lowest average of 29.5 (SD=17.3). The LoS >91-day group exhibited lower FIM efficiency at .27 (SD = .20).

Table 1: Anova tests for the outcome variables

Demographic data					
Characteristics	LoS <30 days N= 462	LoS, 31–60 days N=305	LoS, 61–90 days N=87	LoS >91 days N=22	P-value*
LoS, mean ±SD[a]	16.12 ±7.3	43..95 ±8.3	71.89 ±7.3	126.05 ±67.3	<0.000
Age in years, mean ±SD[a]	53.62 ±11.0	54.14 ±12.0	58.44 ±12.3	62.82 ±13	0.098
Gender, n (%)					0.007

Men	400 (86.6)	248 (81.3)	68 (78.2)	14 (63.6)	
Women	62 (13.4)	57 (18.7)	19 (21.8)	8 (36.4)	
Stroke type, n (%)					0.888
Hemorrhagic	41 (8.9)	32 (10.5)	8 (9.2)	3 (13.6)	
Ischemic	416 (90)	270 (88.5)	77 (88.5)	19 (86.4)	
Ischemic with hemorrhagic transformation	5 (1.1)	3 (1)	2 (2.3)	0	
Stroke severity, n (%)					0.00
Mild	81 (17.5)	18 (5.9)	7 (8.0)	0	
Moderate	369 (79.9)	265 (86.9)	61 (70.1)	15 (68.2)	
Moderate/Severe	2 (0.4)	15 (4.9)	15 (17.2)	6 (27.3)	
Not documented	10 (2.2)	7 (2.3)	4 (4.6)	1 (4.5)	
Stroke site/location, n (%)					0.237
Bilateral	19 (4)	13 (4)	3 (3)	2 (9)	
Left hemisphere	232 (50.2)	153 (50.2)	40 (46)	10 (45.5)	
Other	11 (2.4)	10 (3.3)	4 (4.6)	3 (13.6)	
Right hemisphere	200 (43.3)	129 (42.3)	40 (46)	-31.8	
FIM on Admission mean ±SD[a]	81.0 ±19.6	62.9 ±20.0	53.0 ±17.6	49.2 ±18.7	0.795
FIM on Discharge mean ±SD[a]	110.5 ±16.7	99.7 ±20.3	90.8 ±20.3	78.8 ±27.9	0.00
FIM Gain, mean ±SD[a]	29.5 ±17.3	36.8 ±15.0	37.7 ±17.0	29.6 ±20.3	0.019
FIM Efficiency mean ±SDa[1]	2.19 ±1.9	0.86 ±0.4	0.53 ±0.2	0.28 ±0.2	0.00

Multi-linear regression data analysis

FIM Score on admission

Model 1 (unadjusted) presented in Table_2 indicates an inverse correlation of reference group compared to other groups with most significant difference observed in the LoS>91-day group in which FIM on admission was lower by 112.8 points (P=0.001), while the LoS 31-60 day group was 99.1 points (P=0.001) lower . In model 2, after adjusting for age and gender, there was only a slight enhancement of 1 point (P=0.001) in the FIM for the LoS 61–90-day group and 1.6 points (P=0.001) for the LoS>91-day group when compared to the reference group. Model 3 (adjusted for stroke type, severity and location) indicated a notable enhancement of 4.3 points (P=0.001) in FIM for the group with LoS>91 days.

Table 2: Regression analysis with FIM on admission as the dependent variable

Dependent Variable: FIM score on admission	**Model 1**		**Model 2**		**Model 3**	
	Un standardized	Sig.	Un standardized	Sig.	Un standardized	Sig.

1 a. Data are presented as mean ±SD

Abbreviations: n= number, LoS= Length of stay, FIM= Functional Independence Measures

	Coefficients		Coefficients		Coefficients	
	B		B		B	
(Constant) Length of stay <30 days	81.017	0	99.144	<.001	106.552	<.001
Length of stay groupings=31 - 60	-18.122	<.001	-18.178	<.001	-16.56	<.001
Length of stay groupings=61 - 90	-27.971	<.001	-26.959	<.001	-25.633	<.001
Length of stay groupings=> 91	-31.835	<.001	-30.163	<.001	-27.525	<.001
Age			-0.277	<.001	-0.287	<.001
Gender (Males vs females)			-3.804	0.032	-3.728	0.031
Stroke Type (Ischemic strokes vs Hemorrhagic strokes)					4.51	0.037
Stroke severity (Moderate/severe vs other types of strokes)					-13.207	<.001
Stroke location (Left hemisphere vs others)					-0.129	0.968
R Squared		0.24		0.022		0.04

FIM Score on discharge

As reflected in Table_3 improvement in the regression of FIM on discharge was found to be statistically significant in the reference group with a 23.7-point increase in model 2. The group with LoS>90 days exhibited the most significant improvement, with 4.9 points (P=0.001) in model 2 and 2 points (P=0.001) in model 3. There was minimal change in the LoS 31–60-day group of only 0.4 points (P=0.001) in model 2 and 1.1 points (P=0.001) in model 3. The changes in variance are reflected in the consecutive decrease from R^2=0.151 to R^2=0.08 and R^2=0.03. Model 1 showed that the LoS 61-90-day group had the best discharge FIM with 8 points (P=0.001)more than LoS>91-day group and 1 point (P=0.001) more than the 31–60-day group.

Table 3: Regression analysis with FIM on discharge as the dependent variable

Dependent Variable: FIM score on discharge	**Model 1**		**Model 2**		**Model 3**	
	Un standardized Coefficients	Sig.	Un standardized Coefficients	Sig.	Un standardized Coefficients	Sig.
	B		B		B	

(Constant) Length of stay <30 days	110.485	0	134.254	<.001	134.688	<.001
Length of stay groupings=31 - 60	-10.809	<.001	-10.434	<.001	-9.319	<.001
Length of stay groupings=61 - 90	-19.738	<.001	-17.219	<.001	-16.361	<.001
Length of stay groupings=> 91	-31.667	<.001	-26.695	<.001	-24.67	<.001
Age			-0.481	<.001	-0.483	<.001
Gender (Males vs females)			2.364	0.149	2.477	0.125
Stroke Type (Ischemic strokes vs Hemorrhagic strokes)					1.827	0.366
Stroke severity (Moderate/severe vs other types of strokes)					-9.197	<.001
Stroke location (Left hemisphere vs others)					5.714	0.054
R Squared		0.151		0.08		0.025

FIM Gain and Efficiency

Model 2 for FIM gain revealed better improvements than model 3. The LoS>91-day group displayed a 3.3-point (P=0.001) increase while LoS 61-90-day group had 1.5-point (P=0.001) increase whereas there was less FIM gain in model 3 as evidenced in Table_4. The LoS > 91-day group proved to be the least efficient across all three groups with 4 points (P=0.001) less in comparison to the reference group. The LoS 31 – 60-day group was the most efficient of groups with increasing efficiency as models were adjusted Table 5. Model 1 β= -1.33, p< .001; Model 2 β= -1.30, p< .001 and Model 3 β= -1.28, p< .001. Variance changes across all 3 models were R^2=0.207 to R^2=0.022 and R^2=0.005 consecutively.

Table 4: Regression analysis with FIM gain as the dependent variable

Dependent Variable: FIM Gain	**Model 1**		**Model 2**		**Model 3**	
	Un standardized Coefficients	Sig.	Un standardized Coefficients	Sig.	Un standardized Coefficients	Sig.
	B		B		B	

(Constant) Length of stay <30 days	29.468	<.001	35.136	<.001	28.18	<.001
Length of stay groupings=31 - 60	7.319	<.001	7.751	<.001	7.246	<.001
Length of stay groupings=61 - 90	8.234	<.001	9.74	<.001	9.272	<.001
Length of stay groupings >91	0.169	0.963	3.467	0.334	2.853	0.426
Age			-0.205	<.001	-0.196	<.001
Gender (Males vs females)			6.153	<.001	6.19	<.001
Stroke Type (Ischemic strokes vs Hemorrhagic strokes)					-2.707	0.146
Stroke severity (Moderate/severe vs other types of strokes)					4.01	0.019
Stroke location (Left hemisphere vs others)					5.846	0.032
R Squared change		0.049		0.042		0.013

The increase in age significantly contributed to a decrease in FIM Gain – (-0.2 points, P=0.001), Efficiency - (--0.013 points, P=0.001), Discharge - (-0.483 points, P=0.001) Table_2. The FIM gain was most significantly (P=0.001) influenced by male gender (6.190 points, P=0.001). Ischemic strokes had a negative impact on FIM gain (-2.707, P=0.146). Ischemic strokes impacted FIM on discharge positively (1.827 points, P=0.366) Table_2. Additionally, there was a positive link between FIM efficiency and Ischemic strokes, with (.114 points, P= .481) Table_5. The score for FIM gain in moderate/severe strokes was (4.010 points, P= 0.019) compared to mild or moderate strokes. In the admission and discharge FIM regression analysis, the moderate/severe stroke group displayed a negative impact on scores and was observed with (-13.3 points, P=0.001) on admission and (-9.97 points, P=0.001) on discharge.

Left hemisphere strokes impacted admission FIM negatively (-0.129 points, P=0.001), but had the highest effect on FIM gain (5.846, P=.032) and discharge FIM (5.714 points, P=0.054) when compared to bilateral/other sites in the brain as evidenced in Table_5. The data indicated that in model 2 of the reference group, there was a 0.3-point increase in FIM efficiency while the longest LoS group had a 0.2-point increase.

Table 5: Regression analysis with FIM efficiency as the dependent variable

a Dependent Variable: FIM Efficiency	**Model 1**		**Model 2**		**Model 3**	
	Unstandardized Coefficients	Sig.	Unstandardized Coefficients	Sig.	Unstandardized Coefficients	Sig.

	B		B		B	
(Constant) Length of stay <30 days	2.194	<.001	2.528	<.001	2.204	<.001
Length of stay groupings=31 - 60	-1.334	<.001	-1.304	<.001	-1.277	<.001
Length of stay groupings=61 - 90	-1.663	<.001	-1.562	<.001	-1.544	<.001
Length of stay groupings> 91	-1.919	<.001	-1.696	<.001	-1.634	<.001
Age			-0.013	0.001	-0.013	0.002
Gender (Males vs females)			0.438	<.001	0.445	<.001
Stroke Type (Ischemic strokes vs Hemorrhagic strokes)					0.114	0.481
Stroke severity (Moderate/severe vs other types of strokes)					-0.207	0.163
Stroke location (Left hemisphere vs others)					0.395	0.096
R Squared change		0.207		0.022		0.005

Discussion

Socio-demographic and Stroke variables

The research is distinct because it is the sole study in Qatar since Venkatachalam to investigate the connection between LoS and functional outcomes [13]. However, the previous study did not find any link between LoS and FIM scores upon discharge. The average total LoS was 34 days, whereas studies carried out in Canada by Tran *et al* determined that their average LoS was 65.5 days [24]. Patients with LoS>90 days, on average, had a longer stay compared to those in the group with LoS<30 days.

The average age in the study conducted in Saudi Arabia by Qureshi *et al* was found to be 63 years, while our study showed an average age of 54.5 years [15]. Furthermore, their research indicated that older patients had a shorter LoS. More male patients were observed compared to females, and both genders were densely concentrated within the group with a LoS of less than 30 days. Interestingly, Bindawas *et al* discovered a higher proportion of male patients in the group with a LoS between 31-60 days [16].

Ischemic strokes were present in over 80% of the total cohort. Patients who were diagnosed with ischemic strokes demonstrated lower average FIM gain scores compared to those with hemorrhagic strokes. In a study conducted by Chu *et al*, it was determined that patients with hemorrhagic strokes exhibited superior functional outcomes compared to those with ischemic strokes following inpatient rehabilitation [25].

The 31-60-day LoS group had a higher percentage of patients (86.9%) presenting with moderate strokes compared to the reference group with (79.9%). When compared with other groups, the moderate/severe stroke group showed a significantly higher average FIM gain, particularly because this stroke severity group also had the lowest average FIM on admission. As the severity increased, FIM on admission,

discharge, and efficiency progressively decreased. According to Lin *et al* study, patients with severe strokes were mainly male and in the younger age group [26].

Regression analysis

The fully adjusted model analysis indicated that shorter LoS had a statistically significant positive impact on FIM gain. A study in Saudi Arabia also found that shorter LoS had a significant impact on cognitive FIM [16]. Males exhibited a significantly greater propensity for FIM gain compared to females, which is consistent with findings from studies conducted in Singapore showing that males had significantly higher FIM gain than females [17]. Age was negatively correlated with FIM gain, indicating that older individuals experienced a lesser degree of FIM gain. ÇAKIR *et al* discovered in their study that FIM scores were higher in the <65-year age group. Ischemic strokes were inversely associated with FIM gain compared to hemorrhagic strokes according to the regressions [27]. The study observed that patients with moderate/severe strokes had a positive association with FIM gain compared to those with mild or moderate/severe strokes. Conversely, a study by Lin *et al* revealed that patients in the severe stroke severity group exhibited poor functional status at discharge [26]. Patients with left hemisphere strokes showed a positive functional gain compared to those with right and other sites.

The LoS was shorter for patients with higher FIM scores on admission in the regression analysis. This finding aligns with Durand *et al*, who found that patients with FIM scores <80 on admission had longer lengths of stay in rehabilitation and larger FIM gains, while those with FIM scores >80 had shorter lengths of stay and lower FIM gains [28]. Older patients tended to have lower admission FIM scores, while females had higher admission FIM scores compared to males. In a related study conducted in Turkey, it was observed that females had higher FIM scores on admission, but there were no differences in FIM gain or FIM efficiency [27].

As LoS increased for all groups, result was decreased in the discharge FIM score. However, the shortest LoS group showed a statistically significant positive impact on FIM at discharge. According to Garcia *et al* as the total FIM score increased, the LoS decreased (standardized Beta -.041) [22]. They concluded that for every single point increase in FIM, the LoS would decrease by half a day. On discharge, the average FIM scores were higher for left hemisphere and other stroke sites compared to right hemisphere strokes. Conversely, O'Brien discovered that patients with right hemisphere strokes had lower mean FIM scores on discharge than those with left hemisphere strokes or others [29]. However, Ring *et al*. found that there was no difference in average total FIM scores when patients were categorized by the side of damage (right or left hemisphere) [30].

FIM efficiency was positively affected by a LoS of less than 30 days, and this was statistically significant for all groups. Increase in age and stroke severity decreased FIM efficiency. Black-Schaffer and Winston obtained similar results in their study on age and functional outcomes after stroke, revealing that increased age had an inverse relationship with FIM efficiency as the LoS increased [31].

The study's strengths lie in its incorporation of the entire patient sample admitted to the country's exclusive specialist rehabilitation facility. This is currently the sole study in the State of Qatar that examines the duration of stay and functional results in stroke patients who were released from inpatient rehabilitation units. The facility is certified to utilize the FIM scoring tool from UDSMR, which is an acceptable measure of functionality internationally.

Summary and Conclusions

The study concludes that increased length of stay does not result in better functional outcomes for stroke patients since the longer the patients in the LoS >91-day group displayed the lowest average FIM scores on discharge and FIM efficiency. Patients in the LoS < 31 – 60-day group had higher mean FIM scores on discharge, FIM gain and FIM efficiency in comparison to the LoS >91-day group. In the regression study, analysis found that as length of stay increased, there was negative impact on FIM efficiency and FIM score on discharge. However, the study reveals that patients in the LoS <30-day group had better mean FIM scores on admission. FIM gain was observed in all length of stay groups. Increased age had a negative impact on FIM, while increased stroke severity had a negative impact on discharge FIM and efficiency.

The study confers that longer length of stay has a negative affiliation with functional outcomes and shorter length of stay does not necessarily have a negative impact on functional outcomes. In fact, shorter length of stay is associated with better efficiency rates as well as better functional outcomes. The relationship between nationality and co-morbidities on LoS and functional outcomes has not been investigated in the study. However, this could be included in future research.

Data availability

The datasets generated or analyzed during this study are not publicly available in order to maintain patient data privacy and protection.

Abbreviations

Abbreviation	Description
FIM	Functional Independence Measure
IRF	Inpatient Rehabilitation Facility
LoS	Length of Stay
QRI	Qatar Rehabilitation Institute
NIHSS	National Institutes of Health Stroke Scale

Acknowledgements

The study was conducted at Qatar Rehabilitation Institute at Hamad Medical Corporation, Doha. The author expresses gratitude and thanks to Hamad Medical Corporation Research department for full support during this research.

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