ORIGINAL ARTICLE

Use of Functional Status Score as a Tool to Evaluate Morbidity and Improvement in Clinical Status on Discharge from Pediatric ICU of a Tertiary Care Hospital in Karachi, Pakistan

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Pak Pediatr J 2025; **49(3&4):** 294-301

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Received for publication: July 19, 2025;
Revision received: Sept. 10, 2025
Revision accepted: Sept. 21, 2025

How to cite this: Aleena, Saleem A, Samra, Malik MF, Mohsin AM, Jamalvi W
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Pak Pediatr J. 2025; 49(3&4): 286-93

ABSTRACT

Objective: To evaluate the functional status scale (FSS) of pediatric patients at admission and discharge from the intensive care unit (ICU) to determine recovery trends and identify residual morbidity.

Study Design: Cross-sectional Study

Place and Duration of Study: Pediatric Intensive Care Unit Civil Hospital, Dow University of Health Science, Karachi, 6 months after the approval from the Institutional Review Board

Material and Methods: Children aged 1–12 years admitted for over 24 hours. Children with congenital heart disease, neurological disorders, or ICU mortality were excluded. Functional Status Scale scores across six domains were recorded at admission and discharge. Data were analyzed using SPSS 26.0 with paired t-tests, McNemar, and chi-square tests ($p<0.05$).

Results: Among 84 children (56% female), median age 3 years, 81% were admitted via the emergency department. Median FSS scores improved significantly from 12 at admission to 6 at discharge ($p<0.001$). Initially, 82.1% had moderate to very severe dysfunction; by discharge, 86.9% had normal function. Mechanical ventilation was linked to higher dysfunction ($p=0.026$), and CNS disorders to poorer recovery. Readmission occurred in 16.7% of cases, with longer hospital stays associated with higher readmission rates ($p=0.018$).

Conclusion: Pediatric ICU survivors showed marked functional recovery, underscoring the value of routine FSS assessments. Integrating FSS into standard ICU practice can improve long-term care and rehabilitation planning.

Key Words: *Functional status scale, Morbidity, Pediatric ICU*

INTRODUCTION

Advances in critical care medicine have significantly decreased mortality.[1,2] However, many of these survivors experience persistent cognitive, physical, and mental limitations that can last for months or even years after discharge from intensive care units (ICUs).[1] This has led critical care researchers to shift their focus towards examining the short, intermediate, and long-term outcomes of ICU survivors.[3]

Extracorporeal Life Support (ECLS) is a critical technology increasingly utilized in pediatric ICUs (PICUs) to assist patients with severe cardiopulmonary failure.[4] About 10-20% of the receiving patients suffer from ongoing organ failures, requiring long-term care.[1] Traditionally, these patients were treated throughout their acute care episode in general medical-surgical hospitals. However, long-term acute care hospitals (LTACHs) have recently emerged as an innovative care model that offers specialized care for critically ill patients whose treatment extends beyond the capabilities of short-stay acute care hospitals.[5]

The Functional Status Scale (FSS) was developed and validated as an age-independent measure of functional status.[1,6] The FSS is used to ascertain baseline status (pre-hospitalization) and at 28 days of hospital discharge.[7-9] For health-related quality of life (HRQL) assessments, children with significant developmental delays are measured using the Functional Status II-R (FSII-R), while typically developing children are measured using the Pediatric Quality of Life Inventory (PedsQL).[9]

The Functional Status Scale (FSS) was developed and validated as an age-independent measure of functional status.[7,10] The FSS is used to ascertain baseline status (pre-hospitalization) and at 28 days of hospital discharge.[7] The FSS has also been evaluated as a metric for measuring functional status after pediatric traumatic brain injury.[7]

Although the FSS has been widely studied in many countries, there is limited research on its use within Pakistani institutions. It is important to explore how useful the FSS is for assessing new health problems and progress among patients admitted to the ICU. This study will help us identify issues early and provide timely support and treatment to improve patients' long-term recovery and quality of life. Using the FSS will also strengthen our research and guide the development of better care policies for critically ill children.

The objective of the study was to evaluate the Functional Status Scale (FSS) of pediatric patients at the time of admission and discharge from the ICU department.

MATERIAL AND METHODS

This cross-sectional study was conducted in the intensive care unit of Civil Hospital Karachi. using a non-probability consecutive sampling technique. The study spanned six months following approval from the institutional review board (IRB-3674/DUHS/Approval/2024-2025). The calculated sample size was 84. The study included children aged 1 to 12 years, of either gender, who were admitted to the pediatric intensive care unit for more than 24 hours and were developmentally normal. Exclusion criteria included children whose guardians refused participation, those with congenital heart disease, cystic fibrosis, pulmonary tuberculosis, congenital lung malformations, CNS disorders (e.g., cerebral palsy, developmental delay), or those who died in the ICU.

FSS is a tool to assess mental status, sensory functioning, communication, motor functioning, feeding, and respiratory functioning. Each domain ranges between 1 (normal) and 5 (very severe dysfunction), and total scores range from 6 to 30. FSS score was categorized as normal function (6–7), mild dysfunction (8–9), moderate dysfunction (10–15), severe dysfunction (16–20), and very severe dysfunction (21–30).[1]

Statistical Analysis: Data was entered and analyzed using SPSS 26.0. Quantitative variables median (IQR) was reported for non-normal variables. Frequency and percentage were reported for categorical variables. The severity of the functional status score with other categorical variables was compared using the Chi-square test. Paired t-test and McNemar test was applied to assess the difference between pre and post-functional status. Post-stratification p-value of less than 0.05 was considered significant.

RESULTS

The study included 84 participants, with 47 (56%) females. The median age, height, and weight of pediatric patients was 3 years (IQR: 2-5 years), 88 cm (IQR: 80-104.25 cm), and 11 kg (IQR: 9-17.75 kg). Regarding comorbidities, 81% of the participants had no underlying conditions. 10 (11.9%) patients had asthma. Most patients (81%) were admitted through the ER department. Mechanical ventilation and vasoactive drugs were required by 20 (23.8%) patients. Respiratory surgery was the most common admitting diagnosis, 28 (33.3%). In terms of outcomes, the majority, i.e., 82.1% of patients were discharged alive. The median hospital stay was 5 days (IQR: 4-8 days). The median FSS at admission and discharge were 12 (IQR: 10-18) and 6 (IQR: 6-6) **table-1.**

TABLE 1: Descriptive analysis

Gender		
Female	47	56.0
Male	37	44.0
	Median (IQR)	**Min-Max**
Age in years	3(2-5)	1-9
Height (cm)	88(80-104.25)	67-122
Weight (kg)	11(9-17.75)	6-24
Comorbidities		
None	68	81.0
Asthma	10	11.9
Cirrhosis	2	2.4
End-stage renal disease (ESRD)	2	2.4
Hypertension (HTN)	1	1.2
Malignancy	1	1.2
Origin		
Emergency	68	81.0
Wards	12	14.3
Mechanical Ventilation	4	4.8
Yes	20	23.8
No	64	76.2
Vasoactive drugs		
Yes	20	23.8
No	64	76.2
Admitting Diagnosis		
Respiratory surgery	28	33.3
CVS	14	16.7
CNS	14	16.7
GI-liver	12	14.3
Infection	9	10.7
Hematological issues	9	10.7
Final Outcome		
Alive	69	82.1
Referred	1	1.2
Readmission	14	16.7
	Median (IQR)	**Min-Max**
Hospital Stay	5(4-8)	2-23
FSS at admission	12(10-18)	7-26
FSS at discharge	6(6-6)	6-17

Fig 1 illustrates that the majority, i.e., 45.2% had moderate dysfunction. Only 1.2% were classified as normal at admission. By discharge, the majority, i.e., 73 (86.9%), had normal functional status.

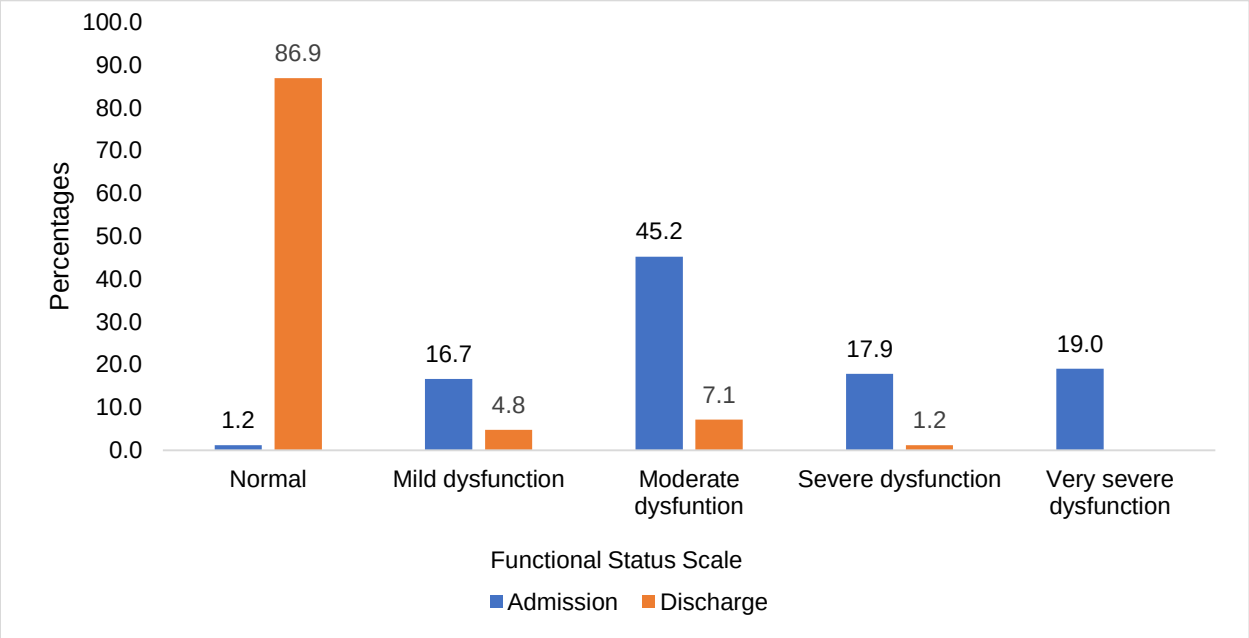

Fig 1: Functional status scale at admission and discharge

Assisted mechanical ventilation was significantly associated with functional status (p<.001). The majority of the patients (83.6%) who had normal function were not mechanically ventilated, while 83.3% patients who had moderate dysfunction were mechanically ventilated. Admitting diagnoses also significantly varied across functional groups (p=0.026), with most patients with respiratory

surgery, 28 (33.3%), having normal functional status. The rest of the associations with functional outcomes were non-significant, as shown in **table 2.**

A significant association was found between hospital stay duration and readmission status (p = 0.018), with readmitted patients having a longer median hospital stay (6.5 days, IQR: 5.8–10.3) compared to non-readmitted patients (5 days, IQR: 4–7) **table 3.**

TABLE 2: Association of demographic, clinical history, and outcome with FSS at discharge

	Normal	Mild dysfunction	Moderate dysfunction	Severe dysfunction	Total	p value
Gender						
Female	41(56.2)	2(50)	4(66.7)	-	47(56)	
Male	32(43.8)	2(50)	2(33.3)	1(100)	37(44)	0.769□
Total	73(100)	4(100)	6(100)	1(100)	84(100)	
Age group						
≤1	11(15.1)	-	2(33.3)	1(100)	14(16.7)	
2-4	41(56.2)	3(75)	3(50)	-	47(56)	0.416□
≥5	21(28.8)	1(25)	1(16.7)	-	23(27.4)	
Total	73(100)	4(100)	6(100)	1(100)	84(100)	
Comorbidities						
Present	14(19.2)	1(25)	1(16.7)	-	16(19)	
Absent	59(80.8)	3(75)	5(83.3)	1(100)	68(81)	1.000□
Total	73(100)	4(100)	6(100)	1(100)	84(100)	
Origin of patients						
Emergency	57(78.1)	4(100)	6(100)	1(100)	68(81)	
Wards	12(16.4)	-	-	-	12(14.3)	0.898□
Other hospitals	4(5.5)	-	-	-	4(4.8)	
Total	73(100)	4(100)	6(100)	1(100)	84(100)	
Assisted Mechanical Ventilation						
Yes	12(16.4)	2(50)	5(83.3)	1(100)	20(23.8)	
No	61(83.6)	2(50)	1(16.7)	-	64(76.2)	0.000**□
Total	73(100)	4(100)	6(100)	1(100)	84(100)	
Admitting diagnosis						
CVS	10(13.7)	2(50)	2(33.3)	-	14(16.7)	
CNS	8(11)	1(25)	4(66.7)	1(100)	14(16.7)	
GI-liver	12(16.4)	-	-	-	12(14.3)	
Infection	8(11)	-	1(16.7)	-	9(10.7)	0.026*□
Metabolic	-	-	-	-	-	
Respiratory surgery	26(35.6)	2(50)	-	-	28(33.3)	
Hematological disorder	9(12.3)	-	-	-	9(10.7)	
Final outcome						
Alive	60(82.2)	4(100)	4(66.7)	1(100)	69(82.1)	
Referred	-	-	1(16.7)	-	1(1.2)	0.184□
Readmission	13(17.8)	-	1(16.7)	-	14(16.7)	
Total	73(100)	4(100)	6(100)	1(100)	84(100)	

* p <0.05, **p<0.001, □ Fischer Exact test

TABLE 3: Association of demographic, clinical history, and FSS with outcome

	Alive	Readmission	Total	P value
Gender				
Female	36(52.2)	10(71.4)	46(55.4)	
Male	33(47.8)	4(28.6)	37(44.6)	0.186□
Total	69(100)	14(100)	83(100)	
Age group				
≤1	11(15.9)	3(21.4)	14(16.9)	
2-4	40(58)	7(50)	47(56.6)	0.833ł
≥5	18(26.1)	4(28.6)	22(26.5)	
Total	69(100)	14(100)	83(100)	
Comorbidities				
Yes	13(18.8)	2(14.3)	15(18.1)	
No	56(81.2)	12(85.7)	68(81.9)	0.686□
Tota	69(100)	14(100)	83(100)	
Assisted mechanical ventilation				
Yes	14(20.3)	6(42.9)	20(24.1)	
No	55(79.7)	8(57.1)	63(75.9)	0.091ł
Total	69(100)	14(100)	83(100)	
Use of vasoactive drug				
Yes	13(18.8)	6(42.9)	19(22.9)	
No	56(81.2)	8(57.1)	64(77.1)	0.078ł
Total	69(100)	14(100)	83(100)	
Functional status score at admission				
Normal	1(1.4)	-	1(1.2)	
Mild dysfunction	14(20.3)	-	14(16.9)	
Moderate dysfunction	36(52.2)	2(14.3)	38(45.8)	0.000**ł
Severe dysfunction	9(13)	6(42.9)	15(18.1)	
Very severe dysfunction	9(13)	6(42.9)	15(18.1)	
Total	69(100)	14(100)	83(100)	
Functional status score at Discharge				
Normal	60(87)	13(92.9)	73(88.0)	
Mild dysfunction	4(5.8)	-	4(4.8)	
Moderate dysfunction	4(5.8)	1(7.1)	5(6.0)	0.778ł
Severe dysfunction	1(1.4)	-	1(1.2)	
Total	69(100)	14(100)	83(100)	
Hospital Stay				
Media (IQR)	5(4-7)	6.5(5.8-10.3)	5(4-8)	0.018*ł
Min-Max	2-23	4-15	2-23	

*p<0.05, **p<0.001, ł Chi-square test, □ Fischer Exact test

DISCUSSION

Our results revealed that only 1.2% of patients initially had a normal functional status, which significantly improved to 86.9% by the time of discharge. Specifically, the proportion of patients with mild dysfunction decreased from 16.7% to 4.8%, moderate dysfunction from 45.2% to 7.1%, and severe dysfunction from 17.9% to 1.2%. These findings highlight the substantial recovery achieved

during the hospital stay. This improvement was consistent with many previous studies that have employed the FSS to assess outcomes in pediatric ICU settings.[11-13].

These results aligned with the studies that highlighted the incidence of new morbidity in children upon discharge from the PICU in developing countries, underscoring the importance of early functional assessments. This study reported that more than 94.2% patients discharged from PICU had good functional status(normal and mild dysfunction) and only 5.8% patients had severe dysfunction.[1] Similarly local studies in Pakistan showed that according to FSS >82% patients had normal to mild dysfunction, and about 13% showed moderate dysfunction by the time of discharge.[12,14] In similar studies, patients with moderate dysfunction were found to be more frequent by the time of discharge.[1,12-13]

In our study population, there was no significant association of gender (p=0.769), comorbidities (p=1.000), or mode of admission (p=0.898) with functional status. However, a significant association was found among patients' admitting diagnoses (p=0.026). This suggested that the severity of the disease condition played a potent role in functional recovery. This interpretation was supported by study done in 2021, which reported that decrease in functional status based on FSS is dependent on factors like age (≤1 year), mortality risk at PICU admission (PIM2), the use of central venous catheter and assisted mechanical ventilation (AMV), and prolonged hospital stays.[15,16]

We also found that patients who required mechanical ventilation and those with central nervous system (CNS) disorders exhibited higher levels of dysfunction at both admission and discharge. This observation is in line with research that was conducted in 2016, in which it was noted that children with traumatic brain injuries had higher FSS scores, indicating greater functional impairment.[10,17] A study of pediatric sepsis survivors in Tanzania found persistent functional impairments, especially in those with neurological damage, underscoring the critical need for post-discharge rehabilitation after severe brain injury.[18]

Another significant finding from our study was that 16.7% of patients required readmission, and a small number, specifically 1.2% remained in the severe dysfunction category at discharge. A study conducted in Brazil reported that 40% of patients were readmitted.[13] Furthermore, in 2022 study, one more study was conducted in Brazil they were also reported (45.8%) patients readmission after discharge due to worsening functional status at admission.[19] It was found that the readmission of PICU patients is correlated with invasive mechanical ventilation (IMV) time and the length of hospital stay, similar to our study, which showed that patients who were readmitted had a history of a longer hospital stay compared to those who were not readmitted.[13,20],

Several studies suggest that utilizing functional status assessment tools, such as the FSS, is essential for improving patient outcomes.[9,15,21] By systematically evaluating functional status, healthcare providers can identify patients at risk for complications or long-term impairments early in their treatment. This enables the implementation of targeted interventions that can significantly enhance recovery trajectories.

Conclusion

This study highlighted the importance of functional status assessment in pediatric ICU patients, showed significant recovery during hospitalization. While all patients experienced functional decline at admission, 100% patients showed improvement at discharge as compare to baseline FSS. Prolonged hospital stays and mechanical ventilation were linked to higher readmission risk, emphasizing the need for post-discharge monitoring.

Source of funding: None
Conflict of interest: None

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Author's Contribution

A: Proposed topic, basic study design, material and methods and manuscript writing.
AS: Data collection and did the manuscript writing.
S: Literature review & referencing and quality insurer.
MFM: SPSS data input and analysis.
AMM: Discussion and conclusion writing.
WJ: Proof reading and editing article.
All the authors have approved the final manuscript draft and accept the responsibility of research integrity.