

Functional evaluation of children on discharge from pediatric intensive care unit using functional status scale

Seema Sakina^{1*}, Humaira Rafiq², Attaullah Khan³, Maliha Aziz⁴, Fatima Gul⁵

^{1,5} Fellow, Pediatric Intensive Care Unit, Shifa International Hospital, Islamabad, Pakistan

² Associate Consultant, Pediatric Intensive Care Unit, Shifa International Hospital, Islamabad, Pakistan

³ Consultant, Pediatric Intensive Care Unit, Shifa International Hospital, Islamabad, Pakistan

⁴ Biostatistician, Shifa Clinical Research Center, Shifa International Hospital, Islamabad, Pakistan

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Correspondence

Seema Sakina

seemafaris@gmail.com

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A B S T R A C T

Introduction: Despite a reduction in pediatric critical care mortality rates over the past three decades, morbidity among survivors has increased noticeably. The Functional Status Scale (FSS) serves as a crucial tool for evaluating morbidity in these patients. This study aims to assess FSS scores in children upon discharge from the pediatric intensive care unit (PICU) and three months later.

Methodology: A prospective observational study was conducted at Shifa International Hospital from January to June 2023. FSS scores were collected pre-illness, upon admission, discharge, and at a three-month follow-up. Demographics and clinical data were obtained via a predetermined questionnaire.

Results: Of 191 patients, 132 were included, with a median age of 54 months (range: 12-114) and 76 (57%) males. The median PRISM score was 3 (range: 0-7). Acute respiratory illnesses 24(18%) and neuromuscular illnesses 22 (16%) were the most common diagnostic categories. New morbidity incidence between pre-illness and discharge was 24(18%), and between pre-illness and follow-up was 5(3.7%). Children with neuromuscular diseases had significantly higher new morbidity risks at both discharge and follow-up. Length of PICU stay and duration of mechanical ventilation showed significant associations.

Conclusion: The study revealed 18% new morbidity incidence at PICU discharge and 3.7% at 03-month follow-up. Neuromuscular disease patients were notably vulnerable. These findings emphasize the need for ongoing functional assessments and targeted interventions, especially for pediatric ICU survivors with neuromuscular conditions.

Keywords: Functional status scale FSS; Pediatric Intensive care unit (PICU); Morbidity

Introduction

Pediatric mortality has been significantly reduced from 11 to 4.8 % after the advancement of pediatric critical care units over the last three decades.¹ Evidence shows that the use of invasive ventilation, complex procedures, and medications has led to this reduction in mortality.² In contrast it has been observed a substantial rise in the incidence of morbidity among children who have been treated in pediatric intensive care units.³ In the context of critically ill pediatric patients, morbidity may be viewed

because of the progression of specific diseases and the interventions provided within the PICU.⁴ Morbidity is influenced by various indicators, such as the development of multi-system organ dysfunction, the need for vasoactive medications, the number of days on the ventilator, the length of hospital stays, and the occurrence of hospital-acquired infections.⁴

In 2009, Pollack et al. developed the Functional Status Scale (FSS) to quantify the performance of daily activities

in critically ill pediatric patients. The FSS is a precise, quantifiable, and impartial measure of functional impairment in children, which can be completed quickly and easily. A difference of 3 points or more between baseline and hospital discharge indicates the presence of morbidity acquired during hospitalization.⁵ The validity and reliability of the FSS have been well established in previous studies.⁶ Recent studies have compared it to other scales and applied it to various sub-populations of critically sick pediatric patients using this tool to determine morbidity at the PICU.⁷⁻¹¹ The impact of the Functional status scale and its effect on morbidity in PICU from Pakistan has been published in only two studies.¹²⁻¹⁴ Therefore, there is a need for more robust studies to investigate its functionality in the current setting.

The purpose of this study is to investigate the baseline, hospital discharge, and follow-up functional status of children admitted to the PICU and to determine any associations between diagnosis, length of PICU stay, mechanical ventilation, and its days and prism score on the FSS.

Methodology

This is a prospective study, conducted at the Pediatric Intensive care unit of Shifa International Hospital Islamabad Pakistan, which is a closed unit with 9 beds. The study was started after approval from the hospital IRB department. IRB number is 0325-22. All types of pediatric patients, including transplant and surgical patients, are admitted to this unit from the age of 4 months to 16 years. A questionnaire was used to collect the demographic data from the hospital database, and the physician on duty assessed the functional status scale at admission and discharge. Via a telephone call, the functional status scale was virtually assessed after a three-month follow-up. The scores were plotted on the Collaborative Pediatric Critical Care Research Network. Informed consent was obtained from the parents at the time of admission.

The FSS examines 6 domains of functioning, and each domain receives a score of 1 (normal), 2 (mild dysfunction), 3 (moderate dysfunction), 4 (severe dysfunction), or 5 (very severe dysfunction). Final scores range from 6 to 30. These scores are further categorized as normal function (6–7), mild dysfunction (8–9), moderate dysfunction (10–15), severe dysfunction (16–20), and very severe

dysfunction (21–30). The FSS score was calculated pre-illness, admission, discharge, and 3 months follow-up. We categorized the patients on discharge from PICU into two functional groups: Group I (FSS score ≤ 9) normal and mild dysfunction and Group II (FSS score ≥ 10) moderate, severe, and very severe dysfunction group [GA6].⁶ Morbidity is defined as a change of ≥ 3 points in the aggregate score of FSS.⁵ All patients who were admitted to the PICU from age 4 months to 16 years were included in the study. The patients who remained for less than 24 hours in the PICU, were discharged without medical advice or shifted to other facilities, and patients who were readmitted were excluded from the study.

Demographic variables like age and gender, admitting diagnosis based on diagnostic categories like respiratory illness, neuromuscular, liver failure, post cardiac surgery, neurosurgical, post general surgery, sepsis, oncological renal, metabolic and trauma were included, severity based on PRISM-III score, length of PICU stay, PICU interventions like use of Mechanical ventilation, and FSS score preadmission, admission, discharge and 3 months follow up were collected on a structured proforma. The sample size is calculated with the WHO sample size calculator 2.0. The confidence level of 95%, the anticipated population proportion is 12.3%¹², and the precision required is 6%. The sample size required for this study comes out to be $n=116$.

All data was entered and analyzed in SPSS version 23.0. Categorical variables are presented as frequency and percentages, and continuous variables are expressed as means $\pm$ standard deviation. The univariate analysis was performed to investigate the association between independent variables and the outcome variable of morbidity. The student's t-test was used to compare continuous variables. The Chi-square or Fisher's tests were used to compare categorical variables. The $p \leq 0.05$ was considered statistically significant.

Results

The study was conducted between January 2023 and June 2023. During this period 191 children were admitted to PICU out of which 132 (68.75%) sick children met the inclusion criteria. The demographic and clinical characteristics of this population are shown in Table 1. There were 76 (57 %) male children, the median age was

54 (12-114) months. The most common diagnostic criteria were respiratory illness 24 (18%) followed by neurological illness 22 (16%). Most patients were admitted through the emergency department 112 (85%). Regarding the clinical parameters, the median for mechanical ventilation was 54 (25-75). The median length of stay in the PICU was 3 days (2-7). The median PRISM score was 3 (0-7).

Table 1: Clinical & Demographic Characteristics

N (%) or median [interquartile 25-75] Variables (n=132)	
Gender	
Male	76(58)
Female	56(42)
Age (months)	54 [12-114]
Diagnostic Categories	
Respiratory Illness	24 (18)
Neuromuscular	22 (17)
Liver Failure	8 (6)
Post Cardiac Surgery	6 (5)
Neurosurgical	11 (8)
Post General Surgery	9 (7)
Sepsis	10 (8)
Oncological	11 (8)
Renal	12 (9)
Metabolic	5 (4)
Trauma	8 (6)
Other	6 (5)
Mode of Admission	
Emergency	112 (85)
OPD	20 (15)
Mechanical Ventilation	
Yes	54 (41)
No	78 (59)
Length of PICU Stay (Days)	3[2-7]
Prism Score	3[0-7]
MV Time (Days)	0[0-2]

Table 2 presents the association between preadmission and discharged groups. Out of 132 children, 24 (18%) children had new morbidity at the time of discharge; out of them 1/3rd were neuromuscular diseases 8/24 (33%), significant p-value was observed for mechanical ventilation, mechanical ventilation days, length of PICU stay and PRISM score. Table 3 shows the association of FSS at pre-admission and follow-up. Only 5(3.7%) showed new morbidity out of 132 children. A significant p-value was observed for length of stay and mechanical ventilation days. Most of the cases with a decline in functional status scale on follow-up were with

neuromuscular illness and all of them were admitted via emergency services.

Table 2: Pre-admission and Discharge

Variables	Total (n=132)	Functional Status Unchanged (n=108)	Decline in Functional Status (n=24)	p- value
Gender				
Male	76 (58)	62 (57)	14 (58)	1.000
Female	56 (42)	46 (43)	10 (42)	
Age (months)	54 [12-114]	48 [12-96]	60 [15-132]	0.534
Diagnostics Categories				
Respiratory Illness	24 (18)	19 (18)	5 (21)	0.174
Neuro-muscular	22 (17)	14 (13)	8 (33)	
Liver Failure	8 (6)	8 (7)	0 (0)	
Post Cardiac Surgery	6 (5)	6 (6)	0 (0)	
Neuro-surgical	11 (8)	7 (7)	4 (17)	
Post General Surgery	9 (7)	7 (7)	2 (8)	
Sepsis	10 (8)	8 (7)	2 (8)	
Oncological	11 (8)	11 (10)	0 (0)	
Renal	12 (9)	11 (10)	1 (4)	
Metabolic	5 (4)	5 (5)	0 (0)	
Trauma	8 (6)	7 (7)	1 (4)	
Other	6 (5)	5 (5)	1 (4)	
Mode of Admission				
Emergency	112 (85)	90 (83)	22 (92)	0.528
OPD	20 (15)	18 (17)	2 (8)	
Mechanical Ventilation				
Yes	54 (41)	38 (35)	16 (67)	0.006*
No	78 (59)	70 (65)	8 (33)	
Length of PICU Stay (Days)	3 [2-7]	2 [2-5]	7 [3-11]	0.000*
Prism Score	3 [0-7]	3 [0-7]	6 [3-11]	0.002*
MV Time (Days)	0 [0-2]	0 [0-1]	4 [0-7]	0.000*

*significant

The FSS was categorized into different categories, showing that 72% of children fell in the normal group on discharge, 12% in mild, 13% in moderate, 3% in severe, and none in very severe at the time of discharge. However,

on follow-up, it was seen that 86 % fall under the normal category, 8% in mild, 5% in moderate, 2 % in severe, and none in the very severe category (Figure 1).

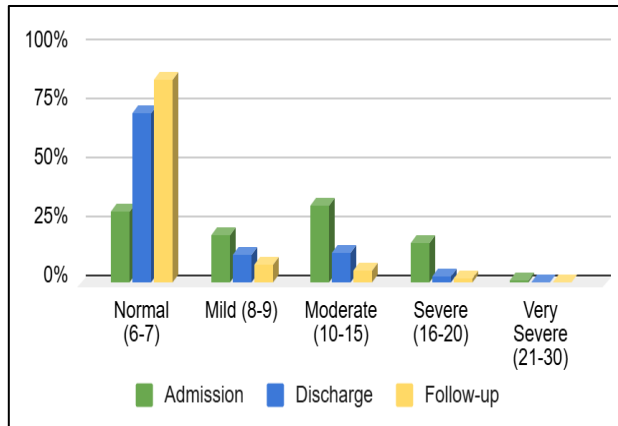


Figure 1: Functional Status Scale Categories

Table 3: Preadmission to Follow-Up

Variables	Total (n=132)	Functional Status Unchanged (n=127)	Decline in Functional Status (n=5)	p- value
Gender				
Male	76 (58)	72 (57)	4 (80)	0.395
Female	56 (42)	55 (43)	1 (20)	
Age (months)	54 [12-114]	60 [12-120]	36 [14-114]	0.689
Diagnostic categories				
Respiratory Illness	24 (18)	23 (18)	1 (20)	0.862
Neuromuscular	22 (17)	20 (16)	2 (40)	
Liver Failure	8 (6)	8 (6)	0 (0)	
Post Cardiac Surgery	6 (4)	6 (5)	0 (0)	
Neurosurgical	11 (8)	10 (8)	1 (20)	
Post General Surgery	9 (7)	9 (7)	0 (0)	
Sepsis	10 (8)	9 (7)	1 (20)	
Oncological	11 (8)	11 (9)	0 (0)	
Renal	12 (9)	12 (9)	0 (0)	
Metabolic	5 (4)	5 (4)	0 (0)	
Trauma	8 (6)	8 (6)	0 (0)	
Other	6 (4)	6 (5)	0 (0)	
Mode of Admission				
Emergency	112(85)	107 (84)	5 (100)	1.000
OPD	20 (15)	20 (16)	0 (0)	
Mechanical Ventilation				
Yes	54 (41)	50 (39)	4 (80)	
No	78 (59)	77 (61)	1 (20)	

Length of PICU Stay (Days)	3 [2-7]	3 [2-6]	11[4-16]	
Prism Score	3 [0-7]	3 [0-7]	6 [4-8]	
MV Time (Days)	0 [0-2]	0 [0-2]	5 [2-8]	

Discussion

In our study, an 18 % incidence of new morbidity was observed upon PICU discharge, which subsequently reduced to 3.7% on follow-up after 3 months from PICU discharge. Pollack et al in a prospective cohort of PICU patients from 8 Medical and Cardiac PICUs comprising 5017 patients, showed that there were 4.8% new morbidity from hospital discharge while another study by Juan et al showed 3.56% new morbidity on PICU discharge which was lower than the finding of the current study.¹³ A study published in the Journal of Pediatric Critical Care by Haque et al showed a 12.2 % incidence of new morbidity on PICU discharges from a tertiary care hospital in Pakistan¹¹ which is comparable to the current findings. This could be an indication of higher rates of new morbidity in the current study setting.

A prospective longitudinal study in Brazil showed the incidence of 39.3% of the children with some level of functional impairment at hospital discharge.¹⁵ A recent prospective study performed in Pakistan showed the incidence of new morbidity from PICU discharge to 40% and 5.8% on follow-up of 3 months.^{16, 17} The follow-up rate of incidence of new morbidity is almost similar to our study. Another multi-center long-term follow-up of PICU children showed that 9 % developed a new morbidity.³ A study showing functional outcomes in pediatric survivors study showed that 4.3 % showed a decline in functional status scale on 28 days follow-up.¹⁸ The most common clinical symptoms involved in different studies were Respiratory 37% followed by 27% neurological,³ 22% respiratory,¹⁴ 64% respiratory¹¹ which is like the findings of our study.

The pediatric population has determined many risk factors associated with increased incidence of morbidity such as high prism score on admission, younger age group, specific diagnostic criteria on admission like neurological illness, prolonged PICU stay, and use of mechanical ventilation. Our results showed a significant p-value difference in mechanical ventilation, length of stay, prism score days, and MV days in pre-admission to the

discharge group. In study by Haque et al. showed no significant risk factors in their cohort.¹¹ However, studies on FSS in children have identified a few risk factors that are associated with new morbidity. Severe physiological derangement is based on a high PRISM 3 score on admission, young age, certain diagnostic categories such as acute neurological, use of mechanical ventilation and prolonged PICU stay were reported as predictors of new occurrence of morbidity.^{6,7,14-18}

In both the discharge and follow-up groups in our study, the individual domains most impacted were motor and feeding. This is like a study conducted in Brazil, which showed that the motor and feeding domains were most affected emphasizing the need for targeted interventions in these areas. A study conducted at AKUH Pakistan showed feeding and respiration as the most common changes in individual domains.¹⁴ We have categorized FSS into normal, mild, moderate, severe, and very severe dysfunction. Most of our children on discharge had mild FSS scores with mild dysfunction on follow up which is similar to other studies.^{12,14} However moderate dysfunction was a reported category in most studies.^{7,18}

The strength of our study was that it was a prospective study. We calculated the functional status score after a 3-month discharge from the PICU. Limitations: Our study was a single-center study with a small sample size, which could affect generalizability. Longitudinal studies should distinguish between underlying disease-related outcomes and ICU-related complications to better inform clinical management and improve long-term functional status in critically ill pediatric patients. Further multicenter, larger sample size studies from different PICU in Pakistan may facilitate the validation of scores, which will help in implementation into clinical practice, identify factors to prevent newly acquired morbidity optimize care of critically ill pediatric patients, and evaluate long-term functional status.

Conclusion

This is the first study using the FSS in our PICU unit. The functional status scale was observed, and results demonstrated that the incidence of new morbidity in critically ill pediatric patients at PICU discharge was 24(18)%, and after 3-month follow-up was 5(3.7%). Children with neuromuscular illness were at high risk for

new morbidity and a higher prevalence of mild dysfunction was observed on discharged 72% which improved on follow-up as 86% showed mild dysfunction. The most common physical domains on discharge and follow-up were the motor and feeding domains.

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