

Evaluation of Hospital Admission, Discharge and Follow-Up by Obtaining POPC & PCPC Delta Score and Comparing It to the POPC & PCPC Score Declines: A Prospective Observational Study

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Abstract:

Purpose: The purpose of the present study was to examine hospital admission, discharge, and follow-up by obtaining a delta score and correlating it to the Pediatric Overall Performance Category Scale (POPC) and the Pediatric Cerebral Performance Category Scale (PCPC). Further, this study compares the POPC/PCPC delta scores and score declines among two groups of patients, viz., PICU-admitted patients and ward-admitted patients.

Methods: A prospective observational study was carried out at the pediatric intensive care unit (PICU) of the Shyam Shah Medical College, Sanjay Gandhi Memorial Hospital, and Gandhi Memorial Hospital over a 12-month period. A Purposive sampling technique was used to choose 200 kids (100 PICU admissions and 100 Ward admissions) between the ages of 28 days and 17 years who had been in the PICU for at least 24 hours. The scales used to assess the child's performance were: (i) The Glasgow Outcome Scale; (ii) The Functional Status Scale; (iii) the Pediatric Cerebral Performance Category Scale; and (iv) The Pediatric Overall Performance Category Scale.

Result: The PCPC and POPC Delta scores of the study population mostly had no change between admission, discharge, and follow-up. The PCPC decline between admission and discharge was significantly associated with the type of admission. PICU patients generally had higher declines in cerebral Performance as compared to the Ward cohort. Ward patients had a greater proportion of no change as compared to PICU patients.

Conclusion: The study found that patients admitted to the PICU had poorer cerebral and overall performance as compared to patients admitted to the Ward. The difference in performance was much greater at follow-up as compared to discharge. The study demonstrated that neurological and cardiovascular pathologies also had a significantly poorer outcome as compared to pathologies of other systems.

Keywords: Intensive care unit, Pediatric Intensive Care Unit, Pediatric Overall Performance Category Scale, Pediatric Cerebral Performance Category Scale.

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Introduction

The purpose of a Pediatric Intensive Care Unit (PICU) is to provide round-the-clock care for very ill children. More children are making a full recovery from their intensive care unit (ICU) stays because of advancements in pediatric critical care medicine [1]. The child admitted to the Pediatric Care Unit enters a highly stressful and potentially dangerous situation. Separation from parents during the stressful buildup to operations, coupled with the constant hum of equipment, has been compared to psychological trauma [2, 3]. Both critical illness and hospitalization-related conditions have been identified as risk factors for cognitive and mental deficits [4, 5]. Multiple hospitalizations and stays in pediatric intensive care units (PICUs) are common among survivors who have been discharged due to

varying degrees of morbidity [6]. Several potential explanations have been proposed to account for cognitive deterioration in the intensive care unit [7]. In terms of mental stimulation, age matters [8]. ICU hospitalization and cognition have important clinical consequences for patient management and the survivor's quality of life.

Previous research has examined the validity and reliability of the Pediatric Overall Performance Category Scale (POPC) and the Pediatric Cerebral Performance Category Scale (PCPC). Several measures of concomitant morbidity, such as PICU length of stay, total hospital expenditures, discharge care requirements, and the Pediatric Risk of Mortality Scale, have been shown to be substantially associated with Scale scores of 10. There is also

evidence of high levels of dependability in interpersonal situations. Later, a larger multi-institutional investigation [9] confirmed the substantial associations between the POPC and PCPC and the duration of stay and Pediatric Risk of Mortality Scores.

The purpose of the present study was to examine hospital admission, discharge, and follow-up by obtaining a delta score and correlating it to the POPC and PCPC scales. Further, this study compares the POPC/PCPC delta scores and score declines among two groups of patients, viz., PICU-admitted patients and ward-admitted patients.

Materials and methods

It was an observational study with a longitudinal design. The study was conducted in the ICU of the pediatric department of the Shyam Shah Medical College in Rewa. Shyam Shah Medical College is among the oldest medical colleges in Madhya Pradesh, India. The college is associated with Sanjay Gandhi Memorial Hospital and Gandhi Memorial Hospital. Study participants were Patients who were admitted to the pediatric ICU for more than 24 hours, aged >28 days to 17 years, and the study was carried out over a period of 12 months from April 2021 to March 2022. The following patients were excluded from the study: i) patients who Spent <24 hours of admission in the ICU ii) Parents did not give consent; iii) Pediatric Cases of trauma and surgery.

Sample Size estimation and sampling technique:

Sample size (n) was calculated using the below formula:

$$n = (Z_{1-\alpha/2})^2 P (1-P) / d^2$$

Where,

P= Expected prevalence of global performance morbidity, taken as 0.86^[10]

r= level of precision, taken as 5%

Z_{1-α/2}= Constant

1-α= Desired confidence level, taken as 95%

According to the above formula, the minimum sample size requirement calculated was 200.

Purposive sampling was done to recruit the patients.

Method of measurement of the outcome of interest:

The difference between the POPC scale during their admission and discharge was measured. The same was done for the PCPC scale. The difference was denoted as delta. These delta scores were compared. It should be emphasized that a delta score of zero indicates that a child's performance did not alter during their time in the ICU. A positive value signifies an increase in morbidity, and a negative value indicates that there has been an improvement in relation to the pre-admission state.

Study technique and data collection procedure:

Morbidity was assessed by means of the PCPC and POPC scales applied at admission, by means of clinical history taken from parents, and, at patient discharge, by means of clinical observation. The measurement employed to evaluate the impact of the ICU stay was the morbidity classification, i.e., at discharge and at admission, the delta score (delta PCPC and delta-POPC).

Table 1: Paediatric Cerebral Performance Category Scale (PCPC) [11]

Normal-Score 1	<ul style="list-style-type: none"> • Age-appropriate level of functioning • Preschool child; developmentally appropriate • School-aged child; attends regular school classroom
Mild Disability-Score 2	<ul style="list-style-type: none"> • Conscious, alert, and able to interact at age- appropriate level • Preschool child: may have minor developmental delays • School-aged child: attending regular classroom, but grade is not appropriate for age, or child is failing appropriate grade because of cognitive difficulties • Possibility of mild neurologic deficit or mild neurologic disease that is controlled and does not interfere with daily functioning (i.e. seizure disorder)
Moderate Disability-Score 3	<ul style="list-style-type: none"> • Conscious; below age-appropriate functioning • Neurologic disease that is not controlled and severely limits activities • Preschool child: delayed for most of their activities of daily living • School-aged child: Sufficient cerebral function for age-appropriate independent activities of daily life; attending special education classroom because of cognitive difficulties and /or learning deficits.
Severe Disability-Score 4	<ul style="list-style-type: none"> • Conscious • Preschool child: delayed for most of their activities of daily living and excessively dependent on others for the provision of activities of daily living

	<ul style="list-style-type: none"> School –aged child: may be so impaired as to be unable to attend school; dependent on others for daily support because of impaired brain function
Coma/ vegetative- Score 5	<ul style="list-style-type: none"> Any degree of coma Unaware, even if awake in appearance, without interaction with environment Cerebral unresponsiveness and no evidence of cortical function (i.e. not aroused by verbal stimuli) Possibility of some reflective response, spontaneous eye-opening and sleep-wake cycles

Table 2: Pediatric Overall Performance Category Scale (POPC)

Score	Category	Description
1	Good overall performance	PCPC 1; healthy, alert, and capable of normal activities of daily life
2	Mild overall disability	PCPC 2; possibility of minor physical problem that is still compatible with normal life
3	Moderate overall disability	PCPC 3; possibility of moderate disability from non-cerebral systems dysfunction alone or with cerebral dysfunction; performs independent activities of daily life but disabled for competitive performance at school
4	Severe overall disability	PCPC 4; possibility of severe disability from non-cerebral systems dysfunction alone or with cerebral dysfunction; conscious but dependent on others for activities of daily living support
5	Coma or vegetative state	PCPC 5

Statistical Analysis Method:

The collected data of 200 study participants was checked for consistency and completeness and entered into a Microsoft Excel data sheet. The data were organized and presented using the principles of descriptive and inferential statistics. Categorical variables were expressed as percentages of total participants. Continuous variables were expressed as Mean ± Standard Deviation when the distribution was symmetrical and medians and interquartile ranges when the distribution was asymmetrical. The Kruskal-Wallis test was used to compare length of ICU stay and PIM according to delta scores. Bar diagrams and pie diagrams were used to present the data. The statistical software IBM SPSS version 20 was used for the analysis. An alpha level of 5% was taken into consideration; thus, a p value less than 0.05 was considered statistically significant.

Ethical issues: Ethical approval was obtained from the Institutional Ethics Committee.

Results

A total of 200 pediatric ICU study subjects were included in this study. The majority of them were female. Most of the study population was classified as Grade 1 on the PCPC Score and Grade 2 on the POPC Score. The mean (SD) PRISM-IV score was 4.07 (4.91), the PCPC score was 1.50 (0.98), and the POPC score was 2.30 (1.12) at the time of admission. The mean duration of stay for patients admitted to the PICU was 9.55 (5.82) days, while those admitted to the ward had a mean duration of

6.64 (3.92) days. Most of the study population was discharged in Grade 1 of PCPC and POPC. The mean (SD) PCPC score was 1.82 (1.53) and the POPC score was 2.25 (1.52) at discharge. Results detailed in the study (Baghel et al., 2023) [12]

PCPC Delta Score [Table 3]

Between Admission and Discharge: The PCPC Delta score of the study population mostly had no change between admission and discharge. Ward patients had a greater proportion of no change as compared to PICU patients. 9% of the cohort showed worsening, whereas 6% showed improvement. Improvement was distributed in equal proportions among both Ward and PICU admissions, while worsening was shown by a greater proportion of PICU patients. These differences were statistically significant.

Between Follow-Up and Discharge: The PCPC Delta score of the study population mostly had no change between follow-up and discharge, with Ward patients being in greater proportions. 24.9% of the cohort showed worsening, whereas 9.7% showed improvement. PICU patients mostly showed improvement as well as worsening. The difference in proportions was statistically significant.

Between Follow-Up and Admission: The PCPC Delta score of the study population mostly had no change between follow-up and admission, with Ward patients being in greater proportions. 26.5% of the cohort showed worsening, whereas 13.5% showed improvement.

PICU patients mostly showed improvement as well as worsening. The difference in proportions was statistically significant.

POPC Delta Score [Table 3]

Between Admission and Discharge: The POPC Delta score of the study population mostly had no change between admission and discharge.

A greater proportion of patients were admitted to the ward. 8.5% of the cohort showed worsening, whereas 22% showed improvement. Worsening patients were mostly from the PICU, whereas Improvement was shared equally among the two cohorts. The difference in proportions was statistically significant.

Between Follow-Up and Discharge: The POPC Delta score of the study population mostly had no change between follow-up and discharge, with Ward patients being in greater proportions. 23.8% of the cohort showed worsening, whereas 23.2% showed improvement. PICU patients mostly showed improvement as well as worsening. The difference in proportions was not statistically significant.

Between Follow-Up and admission:The POPC Delta score of the study population mostly had no change between follow-up and admission, with Ward patients being in greater proportions. 17.8% of the cohort showed worsening, whereas 39.5% showed improvement. PICU patients mostly showed improvement as well as worsening. The difference in proportions was not statistically significant.

Table 3: PCPC and POPC Delta score between admission, discharge and follow-up

Variable	Charecterestics	Change	Total N (%)	PICU N	Ward N	Chi Square (p value)
PCPC	Delta score between admission and discharge	Improved	12 (6.0)	6	6	12.042 (0.002)*
		No Change	170 (85.0)	78	92	
		Worsened	18 (9.0)	16	2	
		Total	200 (100)	100	100	
	Delta score between Follow-Up and Discharge	Improved	18 (9.7)	14 (16.1)	4 (4.1)	9.394 (0.009)*
		No Change	121 (65.4)	49 (56.3)	72 (73.5)	
		Worsened	46 (24.9)	24 (27.6)	22 (22.4)	
		Total	185 (100)	87 (100)	98	
	Delta score between Follow-Up and Admission	Improved	25 (13.5)	12 (13.8)	13 (12.3)	20.064 (0.000)*
		No Change	111 (60.0)	39 (44.8)	72 (73.5)	
		Worsened	49 (26.5)	36 (41.4)	13 (13.3)	
		Total	185 (100)	87 (100)	98	
POPC	Delta score between admission and discharge	Improved	44 (22.0)	22	22	11.157 (0.004)*
		No Change	139 (69.5)	63	76	
		Worsened	17 (8.5)	15	2	
		Total	200 (100)	100	100	
	Delta score between Follow-Up and Discharge	Improved	43 (23.2)	24 (27.5)	19 (19.4)	2.549 (0.280)
		No Change	98 (53.0)	41 (47.1)	57 (58.2)	
		Worsened	44 (23.8)	22 (25.3)	22 (22.4)	
		Total	185 (100)	87 (100)	98	
	Delta score between Follow-Up and Admission	Improved	73 (39.5)	38 (43.7)	35 (35.7)	1.645 (0.439)
		No Change	79 (42.7)	33 (37.9)	46 (46.9)	
		Worsened	33 (17.8)	16 (18.4)	17 (17.3)	
		Total	185 00)	87(100)	98(100)	

PCPC and POPC Decline [Figure 1 and 2]

PCPC and POPC Decline between Follow-Up and Discharge: The majority of patients who suffered PCPC declines had 0 declines (72.5%) between Follow-Up and Discharge, followed by 1 decline (27.5%). There were no patients who experienced two declines. PICU patients exhibited both 0 and 1 Decline. The proportional difference was not statistically significant. The majority of patients who had POPC declines had 0 declines (69.0%) between Follow-Up and Discharge,

followed by 1 decline (30.3%). One patient had two declines. Ward patients showed 0 and 2 declines, respectively, whereas PICU patients showed 1 decline. The proportional difference was not statistically significant.

PCPC and POPC Decline between Follow-Up and Admission: The majority of patients who experienced declines had 0 PCPC decline (69.4%) during follow-up and admission, followed by 1 Decline (28.1%). 2.5% of patients had a 2 Decline. Ward patients had the greatest proportion of 0

Decline, whereas PICU patients showed the greatest proportion of 1 and 2 Decline. The proportional difference was statistically significant. The majority of patients who experienced declines had 0 POPC decline (70.5%) between follow-up and admission,

with 1 Decline (26.6%). One patient had two declines. Ward patients showed 0 and 2 declines, respectively, whereas PICU patients showed 1 decline. The proportional difference was not statistically significant.

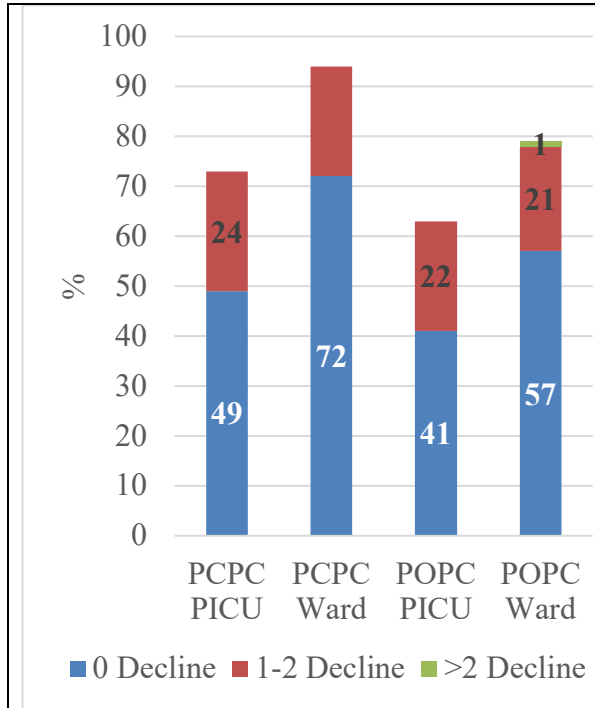


Figure 1: PCPC AND POPC Decline between Follow Up and Discharge

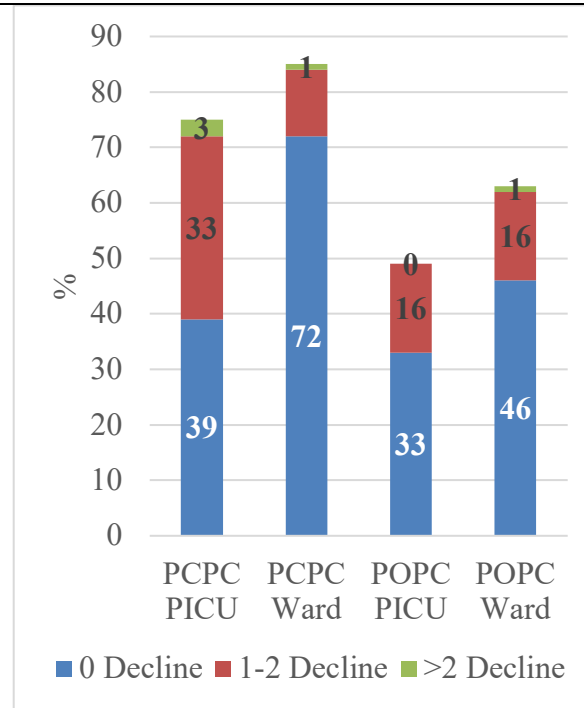


Figure 2: PCPC AND POPC Decline between Admission and Follow-Up

System Involvement

Comparison of Mean decline of PCPC and POPC Delta at Discharge: While comparing the system-wise involvement with delta scores of PCPC of the two cohorts of admitted patients, higher means were generally shown by the patients admitted to the PICU.

Statistically, Systemic pathology involvement was not statistically significant, while the type of ward admission was significant.

However, when the two factors are taken into consideration together, they are not statistically significant. While comparing the system-wise involvement with delta scores of POPC of the two cohorts of admitted patients, higher means were generally shown by the patients admitted to the PICU. Statistically, Systemic pathology as well as ward admission had statistically significant associations. However, when the two factors are taken into consideration together, there is no statistical significance.

Table 4: Comparison of Mean declines of PCPC and POPC Delta at Discharge

	System Involvement	PICU Mean (SD)	Ward Mean (SD)
PCPC	CNS	0.26 (0.86)	0.36 (1.33)
	CVS	2.60 (2.50)	1.50 (2.12)
	GIT	1.00 (2.10)	0.00 (0.00)
	Multiple System	0.94 (2.01)	0.00 (0.00)
	Renal	0.42 (1.44)	0.00 (0.00)
	Respiratory	0.79 (1.81)	0.09 (0.59)
	System	Sum of Squares	p-value
	System Involvement	16.432	0.064
	PICU/Ward	12.044	0.006*
	System Involvement and Type of Ward	7.467	0.440
POPC	CNS	0.08 (0.28)	0.23 (0.83)
	CVS	2.60 (2.51)	1.00 (1.41)

	GIT	0.75 (1.39)	0.00 (0.00)
	Multiple System	0.80 (1.39)	0.00 (0.00)
	Renal	0.27 (0.90)	0.00 (0.00)
	Respiratory	0.68 (1.53)	0.00 (0.00)
	System	Sum of Squares	p-value
	System Involvement	13.924	0.006*
	PICU/Ward	9.769	0.010*
	System Involvement and Type of Ward	6.770	0.153

Comparison of Mean decline of PCPC Delta at Follow Up-Discharge

While comparing the system-wise involvement with delta scores of PCPC of the two cohorts of admitted patients, higher means were generally shown by the patients admitted in the PICU, except for CNS and Respiratory involvement. CVS patients had negligible mean scores.

Statistically, Systemic pathology as well as ward admission had statistically significant associations. Also, when the two factors are taken into consideration together, there is a statistically significant association. While comparing the

system-wise involvement with delta scores of POPC of the two cohorts of admitted patients, higher means were shown by patients admitted in the PICU only having GIT and respiratory involvement, while the other systems showed higher means among ward patients. CVS patients in the ward had negligible mean scores. Statistically, Systemic pathology involvement was statistically significant, while the type of ward admission was not significant. However, when the two factors are taken into consideration together, there is no statistical significance.(Table 5)

Table 5: Comparison of Mean decline of PCPC Delta at Follow Up-Discharge

	System Involvement	PICU Mean (SD)	Ward Mean (SD)
PCPC	CNS	0.47 (0.66)	0.93 (0.70)
	CVS	-	-
	GIT	0.56 (0.73)	0.18 (0.39)
	Multiple System	0.55 (0.82)	0.13 (0.34)
	Renal	0.67 (0.70)	-
	Respiratory	0.10 (0.44)	0.18 (0.53)
	System	Sum of Squares	p-value
	System Involvement	9.200	0.000*
	PICU/Ward	1.327	0.043*
	System Involvement and Type of Ward	5.968	0.003*
POPC	CNS	0.67 (0.87)	0.81 (0.65)
	CVS	0.50 (0.71)	-
	GIT	0.40 (0.52)	0.21 (0.43)
	Multiple System	0.00 (0.00)	0.29 (0.77)
	Renal	0.43 (0.53)	0.16 (0.41)
	Respiratory	0.47 (0.83)	0.19 (0.49)
	System	Sum of Squares	p-value
	System Involvement	5.874	0.023*
	PICU/Ward	0.084	0.661
	System Involvement and Type of Ward	1.552	0.470

Comparison of Mean decline of PCPC Delta at Follow Up-Admission

While comparing the system-wise involvement with delta scores of PCPC of the two cohorts of admitted patients, higher means were shown by patients admitted to the PICU. Statistically, Systemic pathology involvement was statistically significant, while the type of ward admission was not significant.

However, when the two factors are taken into consideration together, there is no statistical significance. While comparing the system-wise involvement with delta scores of POPC of the two cohorts of admitted patients, higher means were shown by patients admitted in the PICU only having Renal and respiratory involvement, while the other systems showed higher means among ward patients. CVS patients in the ward had negligible mean scores, as did GIT patients in the PICU. Statistically, Systemic pathology involvement as well as the type

of ward admission was not significant. Also, the two factors taken together had no statistical significance.(Table 6)

Table 6: Comparison of Mean decline of PCPC Delta at Follow Up-Admission

	System Involvement	PICU Mean (SD)	Ward Mean (SD)
PCPC	CNS	1.16 (1.02)	0.55 (0.69)
	CVS	1.00 (0.00)	-
	GIT	0.63 (0.74)	0.14 (0.36)
	Multiple System	0.45 (0.69)	0.23 (0.69)
	Renal	0.33 (0.50)	0.20 (0.44)
	Respiratory	0.45 (0.76)	0.03 (0.18)
	System	Sum of Squares	p-value
	System Involvement	8.709	0.002*
	PICU/Ward	1.494	0.067
	System Involvement and Type of Ward	0.944	0.827
POPC	CNS	0.47 (0.79)	0.60 (0.73)
	CVS	0.50 (0.70)	-
	GIT	0.29 (0.49)	0.20 (0.42)
	Multiple System	-	0.39 (0.97)
	Renal	0.33 (0.52)	0.25 (0.50)
	Respiratory	0.70 (0.95)	0.19 (0.40)
	System	Sum of Squares	p-value
	System Involvement	1.401	0.702
	PICU/Ward	0.015	0.859
	System Involvement and Type of Ward	1.800	0.433

Discussion

Admission to intensive care is frequently considered a last resort. Especially among the pediatric population. Multiple studies have demonstrated that admission to a pediatric intensive care unit has a profound effect on a child's neurological and psychological health. The combination of an alien environment and anxiety frequently has a negative effect on the outcome.

Although mortality predictors have been devised and are widely utilized, the same cannot be said of pediatric outcome scores. Fiser et al. [13] devised the Pediatric Outcome Performance Grading and the Pediatric Cerebral Performance Grading as a variation of the Glasgow Outcome Scale to resolve the deficiency. The present study compares the differences in scores between admission, discharge, and follow-up for these two scales.

Most studies reported Delta scores at Discharge. According to Alievi et al. [10], 74.9% of the population had no change in PCPC score at discharge. However, their study only considered PICU patents. In the present investigation, 85 percent of patients were unchanged at discharge. 78% of PICU patients, compared to 92% of patients admitted to pediatric wards, did not experience any change. Fiser et al. [14] observed a similar result, demonstrating that 0 Delta had the highest proportion in their study population. Alievi et al.

[10] also reported that 58.9% of the population at discharge had no change in POPC score. The previous study determined this value to be 69.5%. Notably, the majority of studies have not reported absolute delta scores, but rather the results of statistical analyses using delta scores. The current investigation revealed no statistically significant differences. POPC and PCPC scores decreased in the admission and discharge delta scores between the PICU and ward admission groups. Similar studies comparing admissions to the PICU and general ward could not be obtained despite the author's best efforts.

It was challenging to compare the change and decline of the POPC/PCPC score between the discharge and follow-up scores. No previous research has compared these values. The PCPC and POPC decline groups 0 between follow-up and discharge were 72.5% and 69.0%, respectively, according to the preceding study. As a tertiary referral center, the study setting typically encounters a greater number of children with debilitating illnesses. This explains why the proportion of negligible decline is higher.

This is the first study of its kind in this region of the world to compare the POPC/PCPC deltas and declines between two patient categories, namely PICU- and ward-admitted patients. Despite

extensive endeavors to search the majority of journal databases, a comparable study could not be located.

We compared the mean delta score between discharges, admission, and follow-up between systemic pathology and the type of admission (ward and PICU). The PCPC decline between admission and discharge was significantly related to admission type. In general, PICU patients experienced greater declines in cerebral Performance than Ward patients. The factor system involvement was substantially associated, but the combination of system involvement and form of admission was not. In contrast, the PICU cohort had a higher mean for the POPC delta between Admission and Discharge than the Ward cohort. System and Admission Type were independently significantly associated with higher POPC Decline scores. However, when compared together, there was no significant correlation between them.

When comparing decline scores between Discharge and follow-up, however, a different picture emerged. Although patients admitted to the PICU exhibited higher mean PCPC Decline, CNS and Respiratory pathologies did not follow this trend. Individually and collectively, system involvement and type of admission were significantly associated with this decline. In contrast, there was only a significant association between POPC Declines and systemic pathology.

Lastly, when decline scores were compared between follow-up and admission, patients admitted to the PICU tended to have higher mean PCPC Decline scores. The only significant association with PCPC decline between admission and follow-up was systemic pathology. The same result was observed when comparing the POPC Declines to the same conditions. A summary table of associations is given below. (Table 7).

Table 7: A summary table of associations

Factors	PCPC Decline			POPC Decline		
	Discharge/ Admission	Follow-up/ Discharge	Follow-Up/ Admission	Discharge/ Admission	Follow-up/ Discharge	Follow-Up/ Admission
System	Non-significant	Significant	Significant	Significant	Significant	Non-significant
PICU/Ward	Significant	Significant	Non-significant	Significant	Non-significant	Non-significant
Both	Non-significant	Significant	Non-significant	Non-significant	Non-significant	Non-significant

Conclusion

According to the research, patients admitted to the PICU performed worse cognitively and generally than those admitted to the Ward. When compared to discharge, the performance gap at follow-up was much more.

The research showed that, in comparison to diseases of other systems, neurological and cardiovascular pathologies also had a much worse prognosis.

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