

**Clinical Outcomes of Standardized Inpatient Protocols for Severe and Moderate Acute Malnutrition in Children Aged 0–5 Years - A Retrospective Study from a Tertiary Care Hospital**

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Abstract

Background: Severe and moderate acute malnutrition remain important contributors to morbidity and mortality in under-five children, particularly in resource-limited settings. Standardized inpatient protocols may improve clinical outcomes, but evidence from tertiary-care nutrition rehabilitation centres is limited.

Objectives: To evaluate the clinical efficacy of standardized inpatient management protocols for severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) in children aged 0–59 months.

Methods: This retrospective observational study was conducted at the Nutrition Rehabilitation Centre of a

tertiary care hospital in Bengaluru from 1 July 2025 to 31 January 2026. Medical records of 200 children aged 0–59 months admitted with SAM or MAM and managed using a standardized inpatient protocol were reviewed.

Data were extracted from case sheets and follow-up records. Clinical outcomes, anthropometric changes, length of stay, recovery, relapse, and mortality were analyzed.

Results: Among 200 children, 54.0% were female and 46.0% were aged below 1 year. Weight-for-length/height was the most common admission criterion (93.0%). The mean weight increased significantly from 6.98 ± 3.10 kg at admission to 7.28 ± 3.13 kg at discharge and $7.47 \pm$

3.17 kg at follow-up ($p < 0.0001$). At discharge, 42.3% of children had normalized nutritional status, while 95.5% achieved recovery by final follow-up. Relapse occurred in 2.5% and mortality was 2.0%. Most children (74.6%) had a hospital stay of 7 days or less.

Conclusion: Standardized inpatient management of SAM and MAM in under-five children was associated with significant weight gain, high recovery, low relapse, and low mortality. These findings support continued protocol-based care in tertiary nutrition rehabilitation centres, along with strengthened post-discharge follow-up to reduce relapse.

Keywords: Severe Acute Malnutrition, Moderate Acute Malnutrition. Children Under Five, Nutrition Rehabilitation Centre, Inpatient Protocol, Recovery, Retrospective Study.

Introduction

Severe acute malnutrition (SAM) in children 0–59 months is defined, according to World Health Organization (WHO) criteria, by a weight – for – height or weight – for – length z - score less than -3 standard deviations of the WHO Child Growth Standards median, a mid-upper arm circumference (MUAC) less than 115 mm in children aged 6–59 months, and/or the presence of bilateral pitting oedema of nutritional origin. Moderate acute malnutrition (MAM) is defined by a weight – for – height or weight – for – length z - score between -3 and -2 standard deviations or a MUAC between 115 and 125 mm, in the absence of oedema.^{1–3}

Acute malnutrition (wasting), encompassing both SAM and MAM, remains a major global health problem; in 2024 an estimated 6.6% of children under 5 years were affected by wasting worldwide, with about 12.2 million children suffering from severe wasting.^{4,5}

In India, where recent national estimates indicate one of the highest prevalences of wasting and severe wasting among under - five children globally, acute malnutrition remains a leading contributor to preventable morbidity and mortality, particularly in resource - constrained settings.⁶

Despite the availability of evidence - based guidelines, severe acute malnutrition remains a major cause of under - five children mortality, with malnutrition estimated to contribute to a substantial proportion of preventable child deaths; however, case - fatality rates for complicated SAM in many low- and middle - income settings still exceed recommended targets, reflecting persistent challenges in early identification, timely referral, and quality of inpatient care.^{7–11}

In tertiary - care hospitals, the implementation of standardized inpatient protocols is often constrained by high patient loads, inconsistent adherence to guideline - based steps, variability in staff training and experience, and limitations in resources such as therapeutic feeds and monitoring, leading to heterogeneity in case management and outcomes even within the same health system. Therefore, there is a need to examine the clinical outcomes of standardized inpatient protocols for severe and moderate acute malnutrition in under-five children in tertiary - care settings.

Aims

To evaluate the clinical efficacy of standardized inpatient management protocols for Severe Acute Malnutrition and Moderate acute malnutrition in children below 5yrs of age.

Materials and Methods

- Study design and setting
- Study design: Retrospective observational study.

- Study period: 1 July 2025 to 31 January 2026 (7 months).

Setting

Nutrition Rehabilitation Centre (NRC), Department of Pediatrics, Bowring & Lady Curzon Hospital (B&LCH), Sri Atal Bihari Vajpayee Medical College and Research Institute (SABVMCRI), Bengaluru.

Source of data

- Medical records of children aged 0–5 years diagnosed with severe or moderate acute malnutrition and requiring inpatient care at the NRC, Department of Pediatrics, SABVMCRI.

Sample size

- The required sample size for estimating the proportion of clinical recovery was calculated using the single - proportion formula:
- $n = Z^2 \times P(1-P) / d^2$
- For a 95% confidence level, Z was set at 1.96; P, the expected recovery rate based on SPHERE standards for SAM management, was taken as 0.75; and absolute precision d was fixed at 0.07 to match the anticipated caseload during the study period. This yielded a minimum sample size of approximately 150 children, which was taken as the target sample for the study.

Data collection and assessment tools

- Methods of data collection:
- Case - sheet review of all eligible admissions during the study period.
- Extraction of pre-defined variables into a structured data - collection proforma.
- Assessment tools:
- Consultation records.
- Inpatient case records.
- NRC follow - up records (up to at least 1 month after discharge).

Inclusion criteria

- Children aged 0–59 months.
- Diagnosed with severe acute malnutrition (SAM) or moderate acute malnutrition (MAM) based on WHO criteria (weight – for - height/ length z - score, MUAC thresholds, and/or presence of bilateral pitting oedema), and admitted for inpatient care at the NRC.
- Managed according to the standardized NRC inpatient protocol during the study period.
- Case records with documented anthropometric measurements at admission and discharge (and at least one follow - up visit).
- Parents/guardians who provided informed consent for routine clinical management (for retrospective chart review, you usually clarify that no additional consent was required for record based analysis, as per ethics approval).

Exclusion criteria

- Children outside the specified age range.
- Children transferred out before completion of initial stabilization in the NRC, if their outcomes cannot be reliably attributed to your inpatient protocol.
- Records with missing key variables (e.g., admission or discharge weight/height, WHZ, or unclear diagnosis), making classification of SAM/MAM or outcome assessment impossible.

Outcome measures

Patient - level clinical outcomes (efficacy)

- Successful outcome: discharge after achieving target weight gain and clinical stability.
- Target weight gain: >15% increase in admission weight maintained for at least 3 consecutive days (as per NRC protocol).

Facility - level NRC performance indicators

- Average weight gain (g/kg/day).

- Average length of stay (days).
- Recovery rate (% of children meeting discharge criteria).
- Defaulter rate (% of children leaving against medical advice or lost to follow - up).
- Relapse rate (% of children readmitted with SAM/MAM within the follow - up period).
- Referral rate (% of children referred to higher centres).
- Death rate during NRC stay and during post - discharge follow -up.
- Scheduled follow -up visits at 1 week, 2 weeks, and 4 weeks post - discharge, with additional visits as clinically indicated.

Results

Study population

During the 7-month study period, 200 children aged 0–59 months with acute malnutrition were admitted to the Nutrition Rehabilitation Centre (NRC) and met the inclusion criteria. Most were infants: 92/200 (46.0%) were less than 1 year of age, and only 9/200 (4.5%) were between 4 and 5 years. Females slightly outnumbered males (108/200, 54.0%), and first-born children formed the largest group (75/200, 37.5%). The majority of mothers were between 21 and 30 years of age and had at least secondary school education, and more than half of the children in our study belonged to Muslim households.

Table 1: Baseline sociodemographic characteristics of children admitted to the NRC (n = 200)

Variable	Category	Number (n)	Percentage (%)
Age (years)	≤1	92	46.0
	1–2	55	27.5
	2–3	23	11.5
	3–4	21	10.5
	4–5	9	4.5
Sex	Male	92	46.0
	Female	108	54.0
Birth order	1	75	37.5
	2	72	36.0
	3	41	20.5
	≥4	12	6.0
Mother's age (years)	≤20	18	9.0
	21–25	75	37.5
	26–30	74	37.0
	31–35	26	13.0
	36–40	7	3.5
Mother's education	No education	14	7.0
	Primary	10	5.0

	Secondary	176	88.0
Religion	Hindu	79	39.5
	Muslim	114	57.0
	Christian	7	3.5

Admission criteria and baseline nutritional status

Weight – for – length/ height (WFL) was the predominant admission criterion, being used in 186/200 (93.0%) children, with a small proportion admitted using combined WFL with weight – for – age or MUAC. At

admission, based on WFL z - scores, 122/199 (61.3%) children were classified as having moderate acute malnutrition (MAM; WFL between –3 and –2 SD), and 78/199 (38.7%) had severe acute malnutrition (SAM; WFL <–3 SD).

Table 2: Nutritional status and admission criteria of study participants

Variable	Category	Number (n)	Percentage (%)
Admission criteria	WFA	5	2.5
	WFL	186	93.0
	WFL and WFA	7	3.5
	WFL and MUAC	2	1.0
	Total	200	100.0
Weight-for-height/length (WHZ) at admission	MAM (–3 to –2 SD)	122	61.3
	SAM (<–3 SD)	77	38.7
	Total	199	100.0

Inpatient course and length of stay

Most children had a short inpatient course under the standardized NRC protocol. Among those with complete data, 149/199 (74.9%) were discharged within 7–8 days,

35/199 (17.6%) stayed 9–14 days, and only 13/199 (6.5%) required more than 2 weeks of hospitalization. Very few children stayed beyond 1 month.

Table 3: Duration of NRC stay among children with acute malnutrition

Duration of stay (days)	Number (n)	Percentage (%)
≤7	149	74.6
8–14	35	17.8
15–21	9	4.6
22–29	1	0.5
30–36	3	1.5
Total	197	100.0

Anthropometric changes from admission to discharge and follow - up

Paired analyses showed significant improvement in weight during NRC stay, which was sustained at follow -

up. Mean weight increased from 6.98 ± 3.10 kg at admission to 7.28 ± 3.13 kg at discharge ($n = 197$; $p < 0.0001$, paired t - test), and further to 7.47 ± 3.17 kg at follow - up ($n = 196$; $p < 0.0001$ for admission – to –

follow - up and discharge – to – follow - up comparisons). Height/length and MUAC changed only modestly over this short period and did not show statistically significant differences, as expected for the time frame, but weight – for - height categories

improved: at discharge, 82/194 (42.3%) children were in the normal range (≥ -2 SD), 77/194 (39.7%) remained MAM, and only 35/194 (18.0%) were still classified as SAM.

Table 4: Anthropometric measurements at admission, discharge, and follow-up (paired data)

Variable	Comparison	N	Mean $\pm$ SD	P - value
Weight (kg)	Admission	197	6.98 $\pm$ 3.10	<0.0001
	Discharge		7.28 $\pm$ 3.13	
Height/Length (cm)	Admission	197	72.32 $\pm$ 16.35	0.706
	Discharge		72.32 $\pm$ 16.35	
MUAC (cm)	Admission	127	12.21 $\pm$ 0.76	0.152
	Discharge		12.24 $\pm$ 0.74	
Weight (kg)	Admission	196	6.99 $\pm$ 3.11	<0.0001
	Follow-up		7.47 $\pm$ 3.17	
Height/Length (cm)	Admission	196	72.33 $\pm$ 16.39	0.325
	Follow-up		72.12 $\pm$ 16.37	
Weight (kg)	Discharge	196	7.28 $\pm$ 3.14	<0.0001
	Follow-up		7.47 $\pm$ 3.17	
Height/Length (cm)	Discharge	196	72.34 $\pm$ 16.39	0.241
	Follow-up		72.12 $\pm$ 16.37	

Paired t-test used; $p < 0.05$ considered statistically significant.

NRC performance indicators and final outcomes

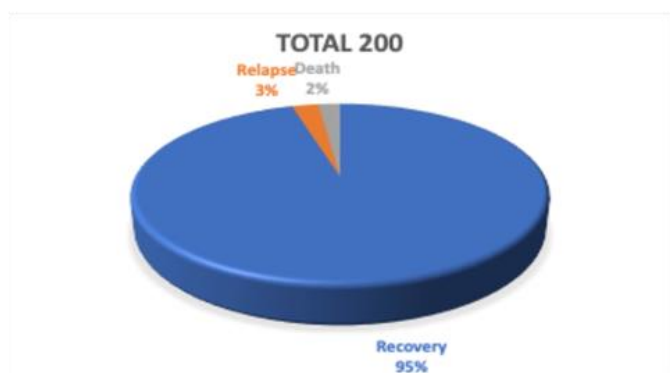
Under the standardized inpatient management protocol, clinical response was generally favourable. Target weight, as defined by the NRC protocol, was achieved in the large majority of children. At the end of the NRC episode and 3-month follow - up, 191/200 (95.5%) children met recovery criteria, 5/200 (2.5%) experienced

relapse of acute malnutrition, and 4/200 (2.0%) died during NRC admission or within the follow - up period. These results correspond to a high recovery rate, a low case - fatality rate, and a small but important proportion of relapses among children previously discharged as recovered.

Table 5: Final outcomes of children treated under the NRC protocol (n = 200)

Outcome category	Number (n)	Percentage (%)
Recovery	191	95.5
Relapse	5	2.5
Death	4	2.0
Total	200	100.0

Figure 1: Distribution of final outcomes (recovery, relapse, death) at 3-month follow-up



Conclusion

In this retrospective study from a tertiary care Nutrition Rehabilitation Centre, standardized inpatient management protocols for severe and moderate acute malnutrition in under five children were associated with clinically significant weight gain during admission and sustained improvement at follow-up. The protocol achieved a high recovery rate (95.5%) with a low case fatality rate (2.0%) and a small proportion of relapses (2.5%), indicating good clinical efficacy in this setting. These findings support continued implementation and scaling of protocol based inpatient care for acute malnutrition, while highlighting the need to strengthen post discharge follow-up and community level support to further reduce relapse and mortality.

Further prospective studies comparing protocol based inpatient care with alternative models, and evaluating long-term growth and neurodevelopmental outcomes, are warranted to optimize management of acute malnutrition in similar resource constrained tertiary settings.

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