



# The effectiveness of facility-based management of children with Severe acute malnutrition and their determinants in Jharkhand, India: A retrospective study

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## ABSTRACT

**Background:** Children with Severe acute malnutrition (SAM) experience a high risk of disease and developmental delays contributing to large scale morbidity and mortality particularly in the developing world with existing progress inadequate to attain the Sustainable Development Goal for improved nutrition, and the cessation of all forms of undernourishment by 2030.

The study objective was to assess the functioning and effectiveness of facility-based management of children with SAM in terms of their recovery (anthropometric indicators), adherence to discharge, and follow-up guidelines.

**Methods:** This secondary data analysis obtained data from the physical patient registers of two malnutrition treatment centres (MTCs) located in the Jamtara district of Jharkhand. Information of 245 children admitted to these MTCs from April 2019-April 2020 was obtained consecutively including anthropometric outcome (weight, length, and Mean Upper Arm Circumference) measurements during the period of their admission. The primary outcome was the proportion of children who attained the recommended discharge criterion of greater than 15% weight gain at the time of discharge.

**Results:** The mean (SD) age of the children with SAM was 1.52 (0.73) years including 55.1% females and 44.9% males. There were 38% of children had a MUAC below 11.5 cm, and 62% had a Z score for weight for height below -3SD. The mean (SD) length of admission stay at the MTCs was 17.16 (5.76) days. A statistically significant improvement in the mean weight and MUAC at discharge was found although the effect size was small (0.98 kg). Only 105 (44.3%) (n = 237) children with SAM achieved recovery as per the discharge criterion requirement of  $\geq 15\%$  weight gain since the time of admission. The mean (SD) duration of stay of the children who recovered was 20.43 (5.64) days, being significantly higher compared to the children who failed to recover as per the weight guidelines 14.59 (4.4) days ( $p < 0.001$ ). **Conclusion:** MTCs were effective in the management of children with SAM although the recovery rate through weight gain criterion was poor due to premature discharge and lack of follow-up suggestive of a high-burden of adverse social determinants and inadequate health system sensitization and preparedness.

## 1. Introduction

Malnutrition comprising of underweight (low weight for age), stunting (low height for age), and wasting (low weight for height) is a major public health challenge globally which affects 159 million under-5 children and is associated with 3.1 million annual deaths in this age-group [1,2].

The burden of child undernutrition as the most common type of malnutrition is the highest in the lower-middle income countries (LMICs) [3]. The National Family Health Survey (NFHS) – 5 (2019-2021), a large nationally representative cross-sectional survey in India has observed a reduction in

stunting from 38.4% to 35.5%, wasting from 21.0% to 19.3%, and underweight prevalence from 35.8% to 32.1% in comparison to NFHS-4 (2015-16) findings [4].

Severe acute malnutrition (SAM), according to the World Health Organization (WHO) is defined as very low weight for height (below -3 z scores of the median WHO growth standards), visible severe wasting, or the presence of nutritional oedema. Severe wasting accounts for one out of every five deaths of children under the age of five globally if appropriate care is not provided in time [5]. The likelihood of dying in early childhood or contracting infectious diseases is high in SAM. Additionally, SAM may interfere with a number of developmental processes, putting the child at

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risk for developing chronic illnesses as they grow, thereby, impairing their cognitive development [5,6].

Nutrition Rehabilitation Centres (NRCs) as part of the National Health Mission (NHM) in India are treatment facilities housed within district hospitals and community health centers for the referral, admission, and management of children with SAM and associated medical complications. There are around 1080 NRCs operational in the country, and as of 2020–21, an estimated 104,000 children with SAM have successfully received treatment in 1073 NRCs [7].

Jharkhand is an Eastern state of India having a population of ~32 million with one of the lowest per capita incomes in the country. Within this state, a total of 96 malnutrition treatment centers (MTCs), equivalent to NRCs were functional as of 2021. There is a paucity of data on the effectiveness of NRCs/MTCs in the management of SAM in India with the data for Eastern states of India such as Jharkhand being especially scarce [8–12]. Therefore, this study was conducted with the objective of assessing the functioning and effectiveness of facility (MTC) based management of children with SAM in terms of their recovery (anthropometric indicators), adherence to discharge and follow-up guidelines.

## 2. Methods

This secondary data analysis obtained data from the physical patient registers of two MTCs located in the Jamtara district of Jharkhand, that were selected conveniently. The variables that were included for extraction from the patient records were the age of the child, sex of the child, weight for height at admission and discharge, MUAC at admission and discharge, and the date of admission and discharge. The data were extracted from the period April 2, 2019, to April 11, 2020, and entered into Microsoft Excel 2016 software. During the study period (2019–2020), the bed occupancy of the first MTC ranged from 29% to 90.6%, and for the second MTC ranged 13.3% to 71.33%. All the MTC staff had received one-time district level training and three times state level training.

Admission criteria for children with SAM in the age group of 6–59 months as per programmatic guidelines include any of the following: (i) WFH < -3 SD (height 49 cm or above); (ii) MUAC <11.5 cm; (iii) Presence of bilateral pitting oedema; (iv) Visible severe wasting.

As per the WHO adapted country operational guidelines, children with SAM are discharged from MTCs on the recorded gain of  $\geq 15\%$  of the weight at the time of admission and weight gain of  $>8$  gm/kg/day for 3 consecutive days. In addition to weight gain, children should exhibit the following markers of improvement: (i) Oedema has subsided; (ii) The child is consuming enough nutritious food that the mother can cook at home; (iii) Every infection and other medical issue has been handled; (iv) Micronutrients are given to the child; (v) Vaccination updated as per age.

Frontline workers including both Anganwadi workers (AWWs) of the Integrated Child Development Services (ICDS) scheme and the Accredited Social Health Activists (ASHA) identify SAM-affected children in the community and facilitate their visits to the suitable MTCs. Children are screened for SAM again at MTC by a physician or nurse and admitted if they meet the admission criteria.

Treatment protocols being followed by MTCs are in accordance with the guidelines issued by the Ministry of Health and Family Welfare (MoHFW), Government of India. One physician, one counsellor, three to four ANM, and a cook are available at each of the MTCs to manage the SAM patients. Children admitted to the MTC receive medical treatment, nutritional support, and micronutrients comprising iron, zinc, magnesium, multivitamins, and supplements with folic acid. Furthermore, the children are given therapeutic foods like F-100, F-75, and others as per their nutritional requirements. Nurses and counsellors hold sessions with caregivers to educate them on child feeding, illness management, and vaccinations during their stay at the MTCs. After children are released from MTC, ASHAs are required to follow up with children at regular intervals, up to four times every 15 days, and escort them to the MTCs for routine check-ups for which they receive performance-based incentives [13].

### 2.1. Operational definition

Recovered cases: Children with SAM with a weight gain of  $\geq 15\%$  of the admission weight after a stay at an MTC were considered recovered cases.

### 2.2. Statistical analysis

Descriptive analysis was performed to describe the distribution of children with SAM according to demographic characteristics and summarize anthropometric measurements at the time of admission and discharge. Continuous variables were reported as mean (standard deviation) for normal distribution or median (Interquartile Range) for non-normal distribution and categorical variables as frequency and proportions. The paired t-test was used to compare the change in weight and the Wilcoxon signed-rank test to compare the change in MUAC was used to compare the anthropometric markers at admission and discharge. A Chi-square test was performed to assess differences in proportion. A P-value of  $<0.05$  was considered statistically significant. Data were analyzed with Stata 15.1 (StataCorp, USA).

### 2.3. Ethical considerations

The study was approved by the Institutional Ethics Committee, Indian Institute of Public Health-Delhi. Administrative permission to access the data from the MTCs was also obtained.

## 3. Results

A total of 245 children were included in the analysis having a mean (SD) age of 1.52 (0.73) years. Male children comprised 44.9% and female children 55.1% of the study sample. Anganwadi workers referred the majority of children—approximately 55.1%—followed by caregivers, who referred 22.4% of the children. The mean (SD) weight and mean (SD) MUAC at admission were 7.45 (2.43) kg and 11.31 (1.02) cm, respectively. Furthermore, 93 (38%) children had MUAC measurements that were less than 11.5 cm. The mean (SD) height of the children was  $77.25 \pm 13.25$  cm while 152 (62%) children had a Z Score for weight for height below -3 SD.

The length of stay of study participants is reported in Table 1. The mean (SD) duration of stay at the MTC was 17.16 (5.76) days. Among the 236 children admitted, 110 (46.7%) were admitted for more than 15 days, 119 (50.4%) for 8 to 15 days, and 7 (2.9%) for less than a week. Duration of stay at MTCs did not differ significantly between boys and girls ( $p = 0.61$ ) or younger ( $<2$  years) and older children ( $p = 0.32$ ).

The changes in anthropometric indicators at the time of discharge from MTCs are reported in Table 2. During discharge, the mean (SD) weight of the children was 8.49 (2.6) kg which was higher than that at admission. The mean weight at the time of admission and discharge differed by  $-0.98$  ( $-1.04$ ,  $-0.93$ ) kg which was statistically significant, although a modest effect size. At admission and discharge, the mean MUAC varied by  $-0.31 \pm 0.37$  cm. A statistically significant difference between the mean MUAC at admission and discharge was found by the Wilcoxon signed-rank test (Z statistic =  $-13.44$ , P-value =  $<0.001$ ), indicating that the nutritional intervention at MTC had a significant impact on MUAC, though the effect size is small. Improvement in weight and MUAC measurements were consistent across boys and girls and younger and older children.

A total of 105 of the 237 children with SAM recovered (44.3%), meeting the weight gain criterion for discharge. The proportion of male children (35.2%,  $n = 37/105$ ) achieving  $\geq 15\%$  weight gain was lower compared to female children (51.5%,  $n = 68/132$ ), and this difference was statistically significant ( $p < 0.001$ ). The mean (SD) duration of stay of children who recovered and were discharged was 20.43 (5.64) days, compared to 14.59 (4.40) days in children who failed to recover with  $\geq 15\%$  weight gain at the time of discharge ( $p$ -value  $< 0.001$ ). The proportion of those who recovered was higher in those who stayed for more than 15 days (70.9%) compared to those who stayed between 8–15 days (21%) ( $p <$

**Table 1**  
Length of stay at Malnutrition Treatment Centre(MTC), stratified by age and gender in children with SAM.

Length of stay at the MTCs (in days)	Total N = 236*	Male n = 104		Female n = 132	
		1–2 year	3–4 year	1–2 year	3–4 year
		n = 87	n = 17	n = 117	n = 15
Mean ± SD	17.16 ± 5.76	16.78 ± 5.45	16.70 ± 4.35	17.78 ± 5.85	15.06 ± 7.76
Median (IQR)	15 (15,21)	15 (15,19)	15 (15,17)	15 (15,23)	15 (12,17)
Up to 7 days	7 (2.9%)	2 (2.3%)	0	3 (2.6%)	2 (13.3%)
8 to 15 days	119 (50.4%)	45 (51.7%)	10 (58.9%)	56 (47.9%)	8 (53.3%)
More than 15 days	110 (46.7%)	40 (46%)	7 (41.2%)	58 (49.6%)	5 (33.3%)

\* Indicates missing data for 9 children

**Table 2**  
Distribution of factors associated with change in anthropometric measurements during admission at MTC amongst children with SAM.

	Total	At admission	At discharge	Mean difference (CI)	P-value
Weight					
Overall	237*	7.5 ± 2.41	8.49 ± 2.60	-0.98 (-1.04, -0.93) t = -34.44	<0.001
Sex					
Male	105	7.87 ± 2.7	8.86 ± 2.86	-0.98 ± 0.36	<0.001
Female	132	7.20 ± 2.12	8.19 ± 2.33	-0.98 ± 0.49	<0.001
Age					
1–2 years	205	6.99 ± 2.03	7.95 ± 2.21	-0.95 ± 0.43	<0.001
3–4 years	32	10.78 ± 2.05	11.96 ± 2.19	-1.17 ± 0.44	<0.001
MUAC <sup>a</sup>					
Overall	234*	11.34 ± 0.97	11.66 ± 1.03	-0.31 ± 0.37 Z = -13.44	<0.001
Sex					
Male	103	11.30 ± 1.18	11.57 ± 1.23	-0.27 ± 0.34	<0.001
Female	131	11.37 ± 0.77	11.72 ± 0.84	-0.35 ± 0.39	<0.001
Age					
1–2 years	202	11.30 ± 1.00	11.63 ± 1.07	-0.33 ± 0.39	<0.001
3–4 years	32	11.61 ± 0.67	11.80 ± 0.72	-0.18 ± 0.20	<0.001

Mean difference in weight = mean weight at admission – mean weight at discharge; Mean difference in MUAC = mean MUAC at admission – mean MUAC at discharge; P-value of <0.05 was considered significant

\* Indicates missing data.

<sup>a</sup> Indicates use of Wilcoxon signed-rank test.

0.001). However, the length of stay in children admitted at the MTCs was not associated with child gender (Table 3).

Information on follow-up at MTC post-discharge was available for 100 (40.8%) children out of 245 who had at least one follow-up visit after discharge. Of these, 56 (22.9%) had all the prescribed four visits, 5 (2.04%) had three visits, 12 (4.9%) had two, and 27 (11%) had only one visit. The mean weight and MUAC of the children who had at least one follow-up visit (n = 100) and also those who had all four follow-up visits (n = 56)

**Table 3**  
Distribution of factors associated with recovery in children with SAM.

	Total N = 237*	Recovered	Not Recovered	P value
		≥ 15%	<15%	
		n = 105	n = 132	
Gender				
Male	105	37(35.2%)	68(64.8%)	0.01
Female	132	68(51.5%)	64(48.5%)	
Age				
1-2 year	205	97(47.3%)	108(52.7%)	0.01
3-4 year	32	8(25%)	24(75%)	
Length of stay				
≤ 7 days	7	1(14.3%)	6(85.7%)	<0.001
8–15 days	119	25(21%)	94(79%)	
>15 days	110	78(70.9%)	32(29.1%)	

\* Missing data for 8 children.

showed a significant improvement from the time of admission to their last follow-up visit post discharge (p = 0.001) (Table 4).

#### 4. Discussion

Overall, an improvement in the anthropometric indicators following therapy at MTC was noted in the under-5 children with SAM although the effect size was modest. Similar findings were observed in other Indian studies that also reported a statistically significant increase in weight from the time of admission to discharge at the MTC/NRC [8–12]. Taneja et al. found a statistically significant difference between the weight (t = 14.552, P < 0.001) and MUAC (t = 9.548, P < 0.001) of children irrespective of gender at admission and discharge in a study that included data from 100 SAM-affected children admitted to seven different NRCs from the state of Madhya Pradesh in India. The mean weight and MUAC at admission and discharge, for boys and girls separately, were found to differ statistically significantly [12]. Similar findings were observed in a study by Panda et al. which included 353 Children with SAM admitted to a nutrition rehabilitation centre in Cuttack, Odisha [8]. The findings from the present study corroborate that from previous studies, and also indicate, the applicability of the NRC/MTC model in low-resource settings.

In this study, a majority (53.7%) of the under-5 children were discharged without achieving the recommended ≥ 15% weight gain necessary for recovery since the time of admission. Similar observations were reported in a study in Uttar Pradesh, India conducted in 12 Nutritional Rehabilitation Centers wherein a majority (53.2%) of the children were prematurely discharged without achieving the standard recovery criterion (weight gain > 15% weight) [9]. A systematic review inclusive of 54 studies conducted among children with SAM in sub-Saharan Africa reported 71.2% (95% CI: 68.5–73.8) recovery in under-5 children admitted for therapy although there was significant regional heterogeneity [14]. Older age children were also more likely to respond to therapy and show expected weight gain compared to younger age children. In contrast, in the present study, when compared to Children with SAM older than 2 years (n = 8/32, 25%), a higher proportion of children under 2 years (n = 97/205, 47.3%) attained the weight gain criterion (p = 0.01).

Furthermore, we observed that in a majority of the children discharged without adherence to the minimum 15% weight gain discharge criterion,

**Table 4**  
Improvement in anthropometric indicators from time of admission to discharge.

Indicators	At Admission	At Discharge	At last follow-up
At-least one follow-up visit to MTC after discharge (n = 100)			
Weight (kg)	7.67	8.57	8.86
MUAC (cm)	11.16	11.31	11.6
Length (cm)	78.26	78.29	79.5
Four follow-up visits after discharge from MTC (n = 56)			
Weight (kg)	7.85	8.74	9.13
MUAC (cm)	11.30	11.46	11.66
Length (cm)	79.14	79.14	80.55

the average duration of stay was significantly lower compared to those who attained  $\geq 15\%$  weight gain since admission ( $p < 0.001$ ). These findings suggest that a majority of the under-5 children with SAM admitted at MTC did not achieve the necessary weight gain and either left the facility or were discharged prematurely in opposition to the standard treatment and discharge guidelines. However, the reasons for non-adherence to the discharge guidelines could not be ascertained in this secondary data analysis. Possible factors include the parental opposition to prolonged stay in the MTC since most of the population is poor and dependent on agricultural or daily wages who had difficulty in meeting their means of subsistence due to the lost opportunity cost when staying away from their work. Another factor could be the facilities had a high patient load that overburdened the available resources and prompted early discharge by the healthcare managers. However, the bed occupancy rates of the MTCs were on the lower side suggestive of feasibility of improved efficiency of available resources translating into comparatively better health outcomes in SAM children. Measures including conscientious identification of SAM children in communities by frontline workers with their prompt referral and admission to MTC, oversight for ensuring adherence to program discharge guidelines by MTC staff, and economic support and sensitization of caregivers to preclude possible social pressures mediating premature discharge should be explored.

In our analysis with the available data, we found the discharged children had significant weight gain and increase in MUAC on follow-up. Consequently, future studies should also ascertain the health of children prospectively and especially compare the groups that were discharged while adhering to standard guidelines and those discharged prematurely without adherence to MTC/NRC patient management guidelines.

Another retrospective study conducted among children with SAM in a referral hospital in Ethiopia reported a recovery rate of 51.9% with a median recovery time of 16 days (95% CI: 14.233–17.767). The study population failed to meet the acceptable recovery rate threshold as per the Sphere International Standards which recommends  $>75\%$  of recovery from SAM. It was observed that children with anaemia, those not provided plump nuts, or those who failed to gain more than 8 g/kg/day had a decreased probability of recovering [15].

The current study observed poor compliance to follow-up of the children after discharge. Various reasons, such as parent or caregiver concern over loss of wages and their lack of awareness or ignorance of the need for follow-up, long distance to the facility without regular transport, and lack of timely release of incentive to ASHA workers may have contributed to low follow-up, although these factors could not be assessed in this secondary data analysis. In another study conducted in Jharkhand by Chaturvedi et al., wherein 150 SAM kids who were admitted to 14 MTCs between December 2011 and January 2012 were assessed, only 22% of the children met the recommended weight gain criterion which was much lower than both national and international standards. Only 19% of the children in that study had attended all three follow-up visits to MTC, while 41% had not attended any follow-up visits at all. The lack of caregivers to accompany malnourished children to MTCs and low awareness of the requirement for multiple follow-up visits were a few of the factors that were found to be associated with reduced follow-ups [11].

The present study has certain limitations. The sample was from only two MTCs with a small sample size that restricts its generalizability. Oedema-related data were not recorded which precluded observation of change in that outcome. The presence of comorbidities in severely malnourished children or those with complications can impair their weight gain but the data was not available with us. These findings suggest the need of adopting an electronic record system to maintain patient records in MTCs that can also enable automated reminders for timely follow-up of discharged children who are still at risk of undernutrition and disease. In this analysis, data on follow-up was missing for 145 children but the extent of missing data whether due to loss to follow-up or failure of recording of this information at the MTC could not be independently verified. Moreover, we assumed this data to be missing at random type.

In conclusion, MTCs are effective in the management of children with SAM but non-adherence to discharge criteria was observed in a significant proportion of cases. Support for parents and caregivers of children and their sensitization is necessary for ensuring admission and stay of the admitted children within MTCs for the recommended period to improve their likelihood of complete recovery. Integration of the strategy of Community Management of Acute Malnutrition (CMAM) that entails community mobilization for this pivotal public health problem should be explored in Indian health settings [15]. Refresher training of healthcare providers posted at MTCs and promoting strict compliance to guidelines for admission and discharge warrant stringent application and these process related indicators should be used for comprehensive situation analysis in these settings. Mechanisms for capturing information on changes in dietary habits of children post-discharge warrant further inquiry. Strengthening of sensitization of ASHA workers and their incentive structure and reinforcing caregiver education on post-discharge care of children at home and the importance of follow-up is needed.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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