Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Determinants and Outcome of Severe Acute Malnutrition of Children in Nutrition Rehabilitation Centre in Eastern India

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Received: February 2020
Accepted: February 2020

ABSTRACT

Background: Malnutrition, including severe acute malnutrition (SAM), continues to be a major cause of childhood morbidity and mortality in India and other developing countries. This has prompted the establishment of Nutrition Rehabilitation Centres (NRCs) in various places in our country. **Methods:** A prospective observational study was carried out on children of 1 month-6 years' age suffering from SAM and admitted at the NRC of a tertiary care institute in Kolkata. WHO criteria for both admission and discharge were rigorously followed. **Results:** From June 2018 to May 2019, a total of 93 cases were studied among which 6.5% cases had edema on admission. As per W/H –Z score, at discharge, 92.4% improved, 6.5% did not improve and 1.1% deteriorated; and at the end of 4 follow ups, 71.9% improved, 20.2% did not improve and 7.9% deteriorated. The overall mean weight gain among discharged children was 7.21 ± 3.03 g/kg/day and at the end of follow up, was 4.24 ± 2.51 g/kg/day. **Conclusion:** The gain in weight and the difference in MUAC from admission till discharge and from discharge till follow up were statistically significant. The important determinants of SAM were LBW, rural background, low maternal age of marriage, low level of education of parents, poverty, lack of exclusive breastfeeding(EBF) for first 6 months, introduction of prelacteal feeds, bottle feeding and late initiation of complementary feeding. Gender, caste, birth order, place of delivery (institutional / not) and timely initiation of breastfeeding were not found to have significant correlation with SAM.

Keywords: Child, Prospective studies, Nutritional Rehabilitation Centres, Severe Acute Malnutrition

INTRODUCTION

Severe Acute Malnutrition (SAM) is not only a form of severe malnutrition, rather it is a medico-social disorder. Lack of exclusive breastfeeding, late introduction of complementary feeds, feeding diluted feeds, repeated enteric and respiratory infections, ignorance and poverty are important factors responsible for SAM.[1] In 2018 globally,49 million children under five were malnourished, of which 17 million were severely malnourished. This translates into a prevalence of 7.3 per cent and 2.4 per cent, respectively.[2]In 2018, more than half of all malnourished children lived in South Asia and about one quarter in sub-Saharan Africa, with similar proportions for severely malnourished children2. Childhood undernutrition accounts for 45% of Under 5 mortality alone and remains a key public health challenge in India.[3] Maximum prevalence of wasting was seen in Jharkhand (29%) and minimum in Kerala (15.7%).[3]

Nutrition Rehabilitation Centre (NRC) is a unit in a health facility where children with SAM are admitted as per defined admission criteria and managed. Besides curative care, special focus is laid on timely, adequate and appropriate feeding for children and on improving the skills of mothers and caregivers on complete age appropriate caring and feeding practices. Once discharged from the NRC, the child continues to be in the Nutritional Rehabilitation program till she/he attains discharge criteria from the program.

Little information is available on the clinical profile and outcome of SAM in children although it remains a significant problem in India and West Bengal. Hence, this study has been undertaken to evaluate the clinical profile and outcome of children admitted with SAM in the Nutritional Rehabilitation Centre of a tertiary care institute in Kolkata.

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MATERIALS AND METHODS

With approval from the Institutional Ethics Committee, the study was initiated after taking informed consent from the parents of SAM children under 5 years of age admitted in the Nutrition Rehabilitation Centre of a tertiary care institute in Kolkata.

It was a prospective observational study with continuous data collection in the form of history taking, clinical examination and record review, over a study period of 12 months. Inclusion criteria for age 1 month-< 6 months were: 1) Weight for length/height < -3SD and/or 2) Bilateral pitting edema; for age 6 months – 5 years:1) Weight for length/height < -3SD and/or 2) Grossly visible severe wasting and/or 3) Mid upper arm circumference < 11.5cm and/or 4) Presence of bilateral edema.[4-7] Exclusion criteria were: 1) Parents not consenting to the study 2) Children with severe malformation 3) Children with immunodeficiency disease 4) Children with serious concomitant disease. After applying all subject selection criteria, the sample size attained was 93.

The children enrolled in the study were examined by a pediatrician and weighed with an electronic weighing scale upto ±5gm error, length and height were measured by an infantometer and a stadiometer respectively with accuracy of ±1cm. Mid upper arm circumference was measured with non stretchable tape at midway between acromion and olecranon with ±1mm accuracy. Weight for height/length Z score was assessed using WHO growth charts. Demographic parameters recorded included age, sex, birth weight, birth order, maternal age, place of residence, religion and caste, marital status of mother (divorced/widowed), parental education and occupation, number of family members, family income and presence of sanitary latrine. Mode and place of delivery, measles vaccination, number of antenatal visits, feeding – initiation of breast feeding, colostrum feeding, prelacteals, mixed feeding, time of initiation of complementary feeding, type of complementary feed introduced, were noted. On examination, presence of edema at admission with skin and hair changes, duration of hospital stay were recorded. Outcome at discharge and at follow-up were noted.

Discharge criteria included: 1) weight-for-height/length ≥-2 Z scores and they have had no edema for at least 2 weeks, or 2) MUAC ≥125 mm and they have had no edema for at least 2 weeks.[7]

Statistical analysis was performed with the help of EPI INFO™ 3.5.3 software(CDC).

RESULTS

In the present study 93 subjects were included from June 2018 to May 2019. Most children were 13-24 months old (43%); the mean age at presentation being 18.51 ± 12.42 months, for boys 20 ± 13.53 months and for girls 17.14 ± 11.29 months; 47.3% children being male and 52.7% female. Children having birth weight < 2.5kg was 68.9%, 24.7%was ≥ 2.5kg and 6.45%were not weighed at birth, significantly correlating low birth weight with SAM (p=0.043). Children coming from rural areas were 68.8% and 31.2%were from urban areas;61.2% were Hindus and 38.8% Muslims; 60.2% children belonged to General caste, 39.8% Backward castes (SC, ST, OBC) and 4.3% did not know their caste.

Table 1: Demographic and Etiological Determinants of Sam in Children

	Parameter	No	Percent
1	Mother's education		
	Illiterate	25	26.9%
	Primary	53	56.9%
	Secondary	10	10.8%
	Higher Secondary	3	3.2%
	Graduate/Above	2	2.2%
2	Father's education		
	Illiterate	28	30.1%
	Primary	50	53.8%
	Secondary	10	10.8%
	Higher Secondary	3	3.2%
	Graduate/Above	2	2.2%
3	Monthly family income		
	≤ 2000	9	9.7%
	2001-3000	55	59.1%
	3001-4000	19	20.4%
	>4000	10	10.8%
4	Total Family Member		
	<5	29	31.2%
	≥5	64	68.8%
5	Maternal age at marriage		
	<18 years	69	74.2%
	≥18years	24	25.8%
6	Birth weight		
	<2.5kg	64	68.9%
	≥2.5kg	23	24.7%
6	Child's age on admission		
	1-<6 months	9	9.7%
	6-12 months	25	26.9%
	13-24 months	40	43.0%
	25-60 months	19	20.4%
7	Birth order		
	1-2	49	52.7%
	3	41	44%
	≥4	3	3.3%
9	EBF upto 6 months	6	6.5%
10	Prelacteal feeding	28	30.1%
11	Bottle feeding	74	79.6%
12	Complementary feeding		
	< 6 months	1	1.1%
	6 months	11	11.8%
	6-7months	60	63.9%
	≥7months	20	21.9%
13	Place of residence		
	Rural	64	68.8%
	Urban	29	31.2%

Cases of birth order 1-2 was 52.7% while 47.3% were of birth order ≥ 3. Out of the 93 mothers in the study, 1 was dead (1.1%), 4 divorced (4.3%) and none were widows. Most mothers (74.2%) were married at ages of less than 18 years. Mothers who

were illiterate was 26.9%, 56.9% had primary education, 10.8%had secondary education and 5.4% had above secondary level education. Most fathers (53.8%) had primary education, 30.1% were illiterate, 10.8% had secondary education and 5.3% above secondary education. Of 92 mothers, most were housewives (93.5%) and of 89 fathers, maximum were labourers (62.9%). Only 2.2% subjects had both parents working. Most cases belonged to low monthly income group, 68.8% families earning less than 3000 rupees only. A large family size of more than five members were found in 68.8% of subjects. Maximum families (n=76) had a sanitary latrine (83.9%). [Table 1]

Most SAM children (76.3%) in the study were delivered institutionally. Most were born through normal vaginal deliveries (NVD) (90.3%) while 9.7% were born by lower uterine Caesarean section (LUCS). Only 1.1% mothers had no antenatal visit, 33.3% mothers had < 2 visits and 65.6% had > 2 visits.

Out of the 93 SAM children, 78 received colostrum (83.9%). Breastfeeding was initiated within 1st hour of birth in NVD cases (84 children, 84.5%) and within 4 hr of birth in LUCS cases (9 children, 88.9%). Exclusive breastfeeding (EBF) for the first 6 months of life was given in only 6.5% cases. Prelacteal feeds were given in 30.1% cases. Within the first 6 months, mixed feeding was given in 87 cases (93.5%). Bottle feeding was used in 79.6% cases. Complementary feeding was started at 6 months in only 18.4% cases, at 7 months in 58.6% cases and > 7 months in 21.9% cases and before 6 months in 1.1% cases. Most common supplementary feed initiated in subjects <6months who were started on mixed feeding (87), was over diluted cow's milk in 60 (68.9%) cases and the rest 27 (31.2%) were given over diluted infant formula. Semisolid complementary food introduced was kichdi in 25 (26.9%) subjects, barley gruel in 22(23.7%) cases, sooji (semolina) gruel in 22 (23.65%) children and mashed biscuits in 24 (25.8%) subjects.

On admission6.5% cases had edema, 8.6% had skin changes and 5.4% had hair changes. Minimum stay of the SAM children at NRC was 14 days (22 cases, 23.7%) and maximum stay was 21 days (71 cases, 76.3%). In our study, the overall mean duration of stay for boys was 19.33 ±2.73 days and for girls 19.0 ± 3.19 days.

Out of 93 cases, total defaulters were 4.3% (n=4, 1 at discharge& 3 at follow-up). So the outcome has been calculated from 92 children at discharge and 89 children at the end of follow-up. In our study, we found that as per W/H –Z score, at discharge, 92.4% improved, 6.5% did not improve and 1.1% deteriorated. At the end of 4 follow ups, 71.9% improved, 20.2% did not improve and 7.9% deteriorated. Children admitted as complicated SAM were 8(8.6%). The improvement at discharge was 100% but at the end of follow-up, 12.5% deteriorated. [Table 2]

Table 2: Outcome as Per W/H –Z Score

Remarks	At Discharge (n=92)		At Follow-up (n=89)	
	Number	Percent	Number	Percent
Improved	85	92.4%	64	71.9%
No improvement	6	6.5%	18	20.2%
Deteriorated	1	1.1%	7	7.9%

In the present study, the overall mean weight on admission for the study subjects was 6.45 ±2.06 kg, 6.83 ± 2.34 kg for boys and 6.11 ± 1.73 kg for girls. The overall mean weight at discharge was 7.32 ± 2.26 kg, 7.69 ± 2.58 kg for boys and 6.98 ± 1.88 kg for girls. At the end of 4 follow ups, the overall mean weight was 7.99 ± 2.17 kg, 8.44 ± 2.45 kg for boys and 7.45 ± 1.76 kg for girls. There was a statistically significant difference between the weight of children at admission & discharge (t=22.22, p=0.0002), admission and follow up (t=22.41, p=0.0002), discharge & follow up (t=10.75, p=0.0009) and also for boys and girls separately in every aspect discussed above (p=0.0006). Individual age categories for weight gain on admission and discharge are discussed in [Table 3].

Table 3: Outcome-Weight

Age group	Weight on admission (kg)	Weight at discharge (kg)	Weight gain at discharge (g/kg/day)	Weight at follow-up (kg)	Weight gain at follow-up (g/kg/day)
0-<6 months	5.68 ± 1.91	6.51 ± 2.03	7.85 ± 2.48	7.01 ± 1.82	4.7 ± 3.65
6-12 months	7.09 ± 2.52	8.04 ± 2.68	7.74 ± 3.85	8.60 ± 2.63	4.47 ± 2.79
13-24 months	6.22 ± 1.74	7.03 ± 1.98	6.26 ± 2.41	7.65 ± 1.99	3.61 ± 1.52
25-60 months	6.47 ± 2.01	7.38 ± 2.19	8.1 ± 2.84	8.13 ± 1.91	4.93 ± 2.96

We also found that the overall mean weight gain among discharged children was 7.21 ± 3.03 g/kg/day, 6.91 ± 2.58 g/kg/day for boys and 7.49 ± 3.39 g/kg/day for girls. At the end of follow up, the overall mean weight gain was 4.24 ± 2.51 g/kg/day, 4.58 ± 2.86 g/kg/day for boys and 3.90 ± 2.09 g/kg/day for girls.

The overall mean MUAC on admission was 11.12 ± 1.19 cm, 11.11 ± 1.43 cm for boys &11.2 ± 0.96 cm for girls and at discharge 12.24 ± 1.22 cm, 12.22 ± 1.40 cm for boys & 12.25 ± 1.06 cm for girls. After follow up, the MUAC was 12.65 ± 1.13 cm, for boys 12.71 ± 1.14 cm and for girls 12.58 ± 1.13 cm. Individual age categories for increase in MUAC on

admission and discharge are discussed in Table 4. The difference of MUAC between admission and follow up (t=13.10, p=0.0003) and discharge and follow up (t=3.97, p=0.0006) were statistically significant. Out of 93 cases, MUAC on admission were applicable in 88 cases (5 cases below 6 months), and total defaulters were 4, 1 at discharge & 3 at follow up. So the outcome was calculated out of87 children at discharge and 84 children at the end of follow-up.

Table 4: Outcome-Muac

Age group	MUAC on admission (cm)	MUAC at discharge (cm)	MUAC at follow up (cm)
1-<6 months	10.95 ± 0.75	12.35 ± 1.04	11.61 ± 1.41
6-12 months	11.36 ± 1.25	12.57 ± 1.24	12.78 ± 1.09
13-24 months	11.01 ± 1.17	12.04 ± 1.24	12.63 ± 1.13
25-60 months	11.12 ± 1.19	12.15 ± 1.23	12.65 ± 1.13

DISCUSSION

In the present study, 93 SAM children were assessed to find out the epidemiological determinants of SAM and the outcome of such children after treatment at a NRC of a tertiary care institute.

Regarding age, gender and caste, out of total 93 children, 36.6% were 0-6 months old, 43% 13-24 months old and 20.4% 25-60 months old; 43.7% were males and 52.7 % were females; 61.2% were Hindus while 38.8% were Muslims; 60.2% were from general caste, 19.4% SCs, 4.3% STs and 11.8% OBCs. Taneja G, Dixit S and others analyzed data from over 100 children and had very similar findings in terms of age and gender. However, the caste distribution findings were different (41% SC, 25% OBC and 25% ST).[8]

In the current study, most children (68.8%) were from rural areas. This matched the findings of a cross-sectional study on 261 infants in Uganda conducted by Kikafunda JK, Walker AF and others.[9] However, Janevic T, Petrovic O et.al. in a study in Serbia on 1192 children under five years, found that children from urban settlements had thrice the likelihood of being wasted compared to rural children.[10]

Jesmin A, Yamamoto SS and others in a cross-sectional study in over 380 children in Bangladesh found that more than 20% had low birth weight while the current study found that 68.9% cases were low birth weight which is significantly correlated (p=0.043).[11]

The present study did not show any correlation of higher birth order and partial immunization with SAM, 52.7% cases being of birth order 1-2, 47.3% cases of birth order ≥3 and 82.3% children having received measles vaccine. However, studies in India and other developing countries suggest otherwise.[12-15]

The present study (paternal illiteracy 30.1%, maternal illiteracy 26.9%) matched studies in Ethiopia and other African,[16-20] Southeast Asian and Latin American countries in that each showed both paternal and maternal education determined child nutrition.[21-23] But studies in Serbia,[10] Bangladesh and in India by Mishra K. et.al. found that only maternal education was important.[15,24] Again, a recent study in Nepal found that paternal education and not maternal education was an important determinant of SAM.[25]

According to our study, mothers were mostly housewives (93.5%) and fathers were either labourers (62.9%) or farmers (21.3%). The findings were similar in the studies conducted by Taneja G, Dixit S et al and Solomon A, Zemene Tin Ethiopia.[8,16]

The present study found a strong correlation between childhood SAM and low economic background. 68.8% cases had a monthly family income of ≤3000 rupees. Similar findings were made in studies in Nepal, Nigeria, Sudan, Zimbabwe, Ethiopia and Bangladesh.[16,24-28]

A large family size (≥5) was associated with an increased risk of SAM in our study (68.8% cases) similar to studies conducted in Ethiopia, Nigeria and Bangladesh.[17,19,21,26]

Our study showed that most mothers (74.2%) married ≤18 years, although 65.5% mothers had > 2 antenatal visits and 76.3% delivered institutionally. So child health was adversely affected if the mother was too young similar to the findings of a study in Nepal but not due to lack of basic pregnancy care,[25] unlike in a study in Southern Ethiopia by Gugsa Y where the prevalence of stunting was more among children of mothers who had no antenatal visit (47.3%).[29]

In the present study, 4.3% mothers were divorced, 1.1% dead and none a widow. An Ethiopian study also supports that marital status does not have any significant influence on the child nutrition.[16]

Though in different studies in Iran[30] and Malawi,[31] a significant association was found between unhygienic latrine and severe malnutrition, the current study found that 83.9% households had a sanitary latrine.

Studies in Ghana,[18] Bangladesh and Ethiopia concluded that time of initiation of breastfeeding,[21,32] whether colostrum was given, age of introduction of complementary feeding, formula feeding and bottle feeding had significant association with child nutrition. In the present study, although 83.9% children received colostrum, 84.5% NVD babies breastfed within 1st hour of birth and 88.9% LUCS babies within 4 hours of birth, only 6.5% received EBF for first 6 months, prelacteal feeds given in 30.1%, bottle feeding in 79.6%and mixed feeding in 93.5% and complementary feeding

initiated at 6 months in only 18.4%.This somewhat matched the findings of Solomon Amsalu and Zemene T where 72% SAM children were breastfed within the first hour and 52% were kept on EBF; however, prelacteal feeds were given to 23.5%, complementary feeding was initiated late in 23% and bottle feeding given in 22.5%.[16] A study in Nepal showed that rather than initiation of breastfeeding, colostrum feeding and exclusive breastfeeding, it was the delay in initiation of complementary feeding that was an important determinant of SAM.[25]

On admission, few children had edema (6.5%), skin changes (8.6%) and hair changes (5.4%). Aguayo VM, Agarwal V, et al in a study at NRC of Madhya Pradesh found that 2.2% children had edema and 23.4% other medical complications.[33]

The defaulter rate was 4.3% with similar findings (4.4%) in a study at NRC in Allahabad, UP, India by Maurya M, Singh DK et al.[36] The overall mean duration of stay at NRC was 19.33 ±2.99 days. Taneja G, Dixit S et.al. found this to be 13.81 ± 2.73 days in their study comprising 7 NRCs in Madhya Pradesh8. A similar Ethiopian study with an outpatient therapeutic program had mean length of stay of 44.15 ± 8.77 days.[35]

At discharge, as per W/H –Z score, 92.4% SAM cases improved, 6.5% did not improve and 1.1% deteriorated. At the end of 4 follow-ups, 71.9% improved, 20.2% did not improve and 7.9% deteriorated. Comparatively, the recovery rate was lower (68.8%) in the study done by Maurya M, Singh DK et al in NRCs of UP.[36]

The overall mean weight on admission was 6.45 ± 2.06 kg; 7.32 ± 2.26 kg at discharge and 7.99 ± 2.17 kg at the end of 4 follow-ups. The weight gain was 7.21 ± 3.03 g/kg/day from admission to discharge and 4.24 ± 2.51 g/kg/day from discharge to follow-up. The overall mean MUAC on admission was 11.12 ± 1.19 cm which increased to 12.24 ± 1.22 cm at discharge and 12.65 ± 1.13 cm at the end of follow-up. The above differences in weight and MUAC were statistically significant and also for boys and girls separately in every above aspect. Taneja G, Dixit S et al in their study similarly found statistically significant increase in weight and MUAC in SAM children after treatment at NRC.[8] The average weight gain in the MTC (Malnutrition Treatment Centre) facility in a Jharkhand study was 3.8 ± 5.9 g/kg/d and after discharge was 0.6 ± 2.1 g/kg/d38. The overall mean rate of weight gain was.5 (±3.45) g/kg/day in a similar study in Ethiopia.[35] Meanwhile, a Nigerian study has confirmed that MUAC can be used for both admitting and discharging criteria in nutrition rehabilitation programs using MUAC < 115 mm for admission.[37]

CONCLUSION

In this study, we found that there was no significant difference in gender distribution among SAM children, mean age of cases was 18.51 ± 12.42 months. We also found that most of the SAM children treated in our NRC associated with poor economic background, low level of parental education, large family size, early maternal age of marriage, bottle feeding, late initiation of complementary feeding, significant correlation with low birth weight and lack of EBF. A statistically significant difference was observed for weight and MUAC at discharge vs admission, follow-up vs admission and follow-up vs discharge. The average weight gain during the stay at the centre was 7.21 ± 3.03 g/kg/day and 11 children (11.8%) lost weight within 60 days of discharge from NRC.

Thus, though the NRC is effective for the management of SAM, there is opportunity to improve the outcome, especially during follow-up.

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How to cite this article: Sen S, Chatterjee K, Dutta A. Determinants and Outcome of Severe Acute Malnutrition of Children in Nutrition Rehabilitation Centre in Eastern India. Ann. Int. Med. Den. Res. 2020; 6(2):PE16-PE21.

Source of Support: Nil, **Conflict of Interest:** None declared