

Nutritional Outcome and Growth Monitoring in **Under-Five Children of Severe Acute** Malnutrition with and without Edema in **Bangladesh: A Five-Year Retrospective Review** of Facility-Based Inpatient Care

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Abstract

Introduction: Severe acute malnutrition (SAM) is an important cause of death in children. Bangladesh has a huge burden of SAM in under-five children, but documentation of their protocolized management and outcome is not so frequent. Objective: Our aim was to identify the pattern of the nutritional outcome and growth monitoring of 0-59 months old children with severe acute malnutrition treated with identified medical complications where the presence or absence of edema is an important clinical factor. Methods: This was a facility-based retrospective observational study that was conducted in the Severe Acute Malnutrition block of Chittagong Medical College Hospital, Chittagong. Here, a total of 485 patients were admitted during the period from 2013 to 2017. Based on WHO & National guidelines, admission and discharge criteria were considered and determined. A structured and prescribed data format was prepared and data were collected from the hospital records. Daily clinical follow-ups and weight monitoring of the patients were also documented. Both descriptive and analytic analyses were executed. After Data collection, it was cleaned, edited, and stored in excel, epi-INFO, and analyzed by SPSS. P-value < 0.05 was considered to be statistically significant. **Results**: 54.84% of the admitted patients were cured and discharged during the study period. The mean age of the observed patients was 22.35 ± 15.8607 months. The majority of the patients came from rural areas and about 50% of them belonged to lower-middle-class families. The median weight gain of the children at SAM block during the clinical review was found to be moderate (7.35g/kg/day). About $2/3^{rd}$ of the admitted patients stayed in the hospital for two weeks. The mean duration of hospital stay (in days) of the patients with edema (15.64 ± SD 7.133 days) was higher than that of the patients without edema (9.47 ± SD 5.881 days). 4.3% of patients did not gain weight during their hospital stay, and overall 8.04% of patients died during this period. **Conclusion:** More than half of the admitted patients showed moderate to good weight gain during their hospital stay. Non-edematous patients started to gain weight early and their mean weight gain was also higher. A greater portion of patients who had edema was cured (117, 81.8%) but defaulter & death rates, where contributed to a significant overall outcome (188, 38.76%), were more in non-edematous patients.

Keywords

Severe Acute Malnutrition (SAM), Nutritional Outcome, Growth Monitoring

1. Introduction

Acute childhood malnutrition leads to a greater risk of death or disability from common pediatric illnesses such as pneumonia and diarrheal disease, and it shapes the long-term health of a child by compromising physical and intellectual development [1]. The condition carries a case fatality rate of 5% - 60% [2]. Severe acute malnutrition (SAM) is an important cause of death in children. SAM affects nearly 20 million pre-school-age children, mostly from the African and Southeast Asian regions [3]. Malnutrition contributes to approximately 8 million deaths in children under five years of age worldwide [4]. The overall risk of death among children with SAM is 9 times more than that of well-nourished children [5]. In Bangladesh, SAM in children has traditionally been managed at the facility level through inpatient therapeutic care [6]. Several researches on SAM have been conducted in Bangladesh, focusing on the risk factors and determinants of SAM, feeding behaviors in children under the age of five with SAM, infection patterns in children with SAM, efficacy of locally adapted dietary regimens in treating SAM patients, and so on. However, documentation of protocolized care of SAM children according to a set of guidelines, including their outcomes, is usually less. While the treatment of severe acute malnutrition (SAM) is well established, achieving desired outcomes has proven to be challenging. Severely malnourished children are about 10 times at higher risk of death than those not affected [7] [8]. Severe acute malnutrition has two main clinical manifestations, i.e. edematous and non-edematous. However, factors associated with edema are not well established [9]. Despite recent improvements in the protocols for treatment of SAM, case-fatality rates of 20% - 30% are still seen and are higher for edematous malnutrition [10]. Over 13 million children aged less than 5 years are affected by severe acute malnutrition (SAM) in low-income countries; its case fatality rate in this region is of great burden [11]. Approximately 3.1%

(BDHS 2014) of under-5 children suffering from SAM only by weight-for-length or height z-score (WHZ) < -3 criteria and estimated to be a total of ~450,000. Because, there is no national information on the prevalence of SAM using mid-upper arm circumference (MUAC) and the presence of bipedal edema in under-5 children, thus the actual number of children suffering from SAM could be much higher than the current estimate. In children who are 6 - 59 months of age, severe acute malnutrition is defined by a very low weight-for-height/weight-for-length, clinical signs of bilateral pitting edema, or a very low mid-upper arm circumference. Edema is a swelling caused by the accumulation of fluid in the body tissues and can be categorized as Mild (+): edema in both feet/ankles. Moderate (++): edema in foot plus lower legs, hands, or lower arms. Severe (+++): generalized edema including feet, legs, hands, arms, and face. Children with severe acute malnutrition who have severe edema (+++) have an increased risk of mortality compared to children with severe acute malnutrition but with lesser degrees of edema [12]. The existing SAM management protocol allows both forms of SAM (edematous and non-edematous) to be treated in OTP through RUTF [13]. Severe acute malnutrition is defined in these guidelines as the presence of edema of both feet and severe wasting (weight-for-height/length < -3 SD or mid-upper arm circumference < 115 mm). SAM has various predictors of mortality, such as hypothermia, hypoglycemia, and diarrhea with clinical dehydration/dyselectrolytaemia, shock, HIV, pneumonia, and even decreased level of consciousness. During clinical evaluations, loss of appetite, severe pallor, nutritional edema, hypoxemia, etc. were also considered as predictors of mortality in SAM cases, according to various studies [14]-[20]. No distinction is made between the clinical conditions of kwashiorkor or severe wasting because their treatment is similar. Children who are <-3 SD weight-for-age may be stunted (short stature) but not severely wasted. Stunted children who are not severely wasted do not require hospital admission unless they have a serious illness [21]. Bangladesh has adopted the new World Health Organization (WHO) Growth Reference Standards (GRS), which should be used for determining the WLZ/WHZ.

2. Objectives

2.1. General Objective

To identify and monitor the nutritional outcome and anthropometric indices of the facility-based managed, 0 - 59 months old, both edematous & non-edematous severe acute malnutrition (SAM) children with medical complications.

2.2. Specific Objectives

To identify the socio-demographic differentials of the SAM patients.

To find out the proportion of edematous and non-edematous patients admitted with SAM.

To monitor the pattern of weight gain of the admitted SAM patients.

To measure the length of hospital stay of the SAM patients. To explore the outcome of both edematous & non-edematous SAM patients.

3. Methods

The study was conducted in the SAM block of Chittagong medical college hospital (CMCH). The CMCH is a tertiary level hospital with a total of 1313 beds, and it primarily receives patients from the city area of Chittagong, while also receiving patients from remote and hilly regions of Chittagong. The SAM block of Chittagong Medical College Hospital is situated in the Paediatrics pediatric inpatient department consisting of 8 beds, logistically supported by CONCERN worldwide, Bangladesh since December 2012. Institute of public health & nutrition (IPHN) and UNICEF are also giving support to SAM block. The SAM block of CMCH has 1 assistant professor on rotation, along with 2 medical officers who are also on rotation. There are 3 nurses on the SAM block, each covering an 8-hour shift, and the feeding schedule of the children is monitored 24 hours by the nurses. The feeding chart for each patient is hung on the wall, and the feeding is done in a 2/3/4 hours' gap according to necessity determined by the duty doctor. F-75/F-100 is also provided, and the measurement is noted in the wall chart daily. The milk necessary for the feeding is supplied by UNICEF, and if supply is interrupted, nurses prepare local alternative recipes according to the national guideline. Mixing blenders and other ingredients are provided by the hospital authority. There is no division of SAM block but there is a provision of outpatient services for the discharged patients. The current study period was from January 2013 to December 2017. A total of 485 patients were admitted to the SAM block during this period. 266 of the admitted patients were successfully discharged from the hospital. The sample size for this study was determined according to the formula used by L. Naing for prevalence studies [20]. A retrospective review of the hospital records of all these SAM patients was done. Here two different groups were identified: Group 1: SAM with edema and Group 2: SAM without edema. Secondary data of SAM was collected, analyzed, and interpreted. The study documented the management of SAM patients according to WHO guidelines, and all necessary variables were also recorded accordingly. Data were collected from hospital register books & also from hospital bed-head files. Socio-demographic profile, anthropometric indices, edema status, hospital stay duration, weight gain each day, days required to start weight gain were also collected noted as variables for the study. A clinical assistant (usually a post-graduate trainee doctor) fills the register books routinely. He/she gets special training periodically from IPHN personnel for appropriate documentation. The respective consultant/assistant professor supervises the data entry thrice a year. Being a retrospective one, data in the current study were rectified by discussing with the duty doctors of that tenure/from parents or caregivers over the telephone (Contact numbers are written in the register during admission)/during follow-up visits in the OPD.

3.1. Inclusion Criteria

All severe acute malnutrition patients aged 0 - 59 months with medical complications were registered and admitted to the SAM block of Chattogram Medical College hospital for facility-based management. WHO guideline was followed to fulfill the clinical criteria for the hospital admission.

3.2. Exclusion Criteria

Children greater than 5 years of age and children less than 5 years of age who were not SAM as per WHO guideline and had no medical complications & those who were not admitted in SAM block were excluded from the study.

4. Results

During the study period, a total of 485 patients were admitted to SAM block. More than 50% of the patients were between 6 - 24 months old. Admitted patients showed a male-female ratio of 1.3:1. About 50% of the patients belonged to lower middle-class families. The socioeconomic status of the patients was determined after combining observations of monthly income, owned assets, and type of residence. The majority of the admitted patients came from rural areas. SAM without edema constituted the major bulk of the patients. Only 9.48% (n = 46) of the admitted patients needed to stay in the SAM block for longer than 3 weeks duration as recommended in the guideline. Defaulter & death cases showed shorter hospital stays. The mean duration of hospital stay (in days) of the patients with edema was higher than that of the patients without edema. Assuming equal variances, to see whether this difference was statistically significant or not an Independent-Sample T-Test was done. The difference that the Independent-Sample T-Test revealed was statistically significant, where t = (438,485) = -9.878, p = 0.002. The average weight gain in the SAM block was found at 6.8g/kg daily or a median of 7.35 g/kg daily. The cure rate was more among the admitted SAM patients who had edema (117, 81.8%), but the overall defaulter rate (129, 37.7%) & death rate (29, 8.5%) were more among the admitted non-edematous SAM patients. To see the difference whether it was statistically significant or not, a chi-square test was done. The chi-square test revealed that the difference was statistically significant where χ^2 (3, 485) = 61.886, df = 3, p < 0.001. Septicemia & bronchopneumonia with heart failure were the major causes of death in the admitted patients.

5. Discussion

Maximum studies on severe acute malnutrition have focused on children under the age of five years. An orderly review was conducted to observe admission and discharge criteria for severe acute malnutrition in children who are 6 - 59 months old [22]. The exploration documented 11 relevant epidemiological studies. Three of the 11 studies used cut-off values for admission that did not resemble the WHO definition of severe acute malnutrition, namely mid-upper arm circumference < 120 mm, mid-upper arm circumference < 130 mm, and weight-for-height <-2 Z-score [23] [24] [25]. The present study identifies the nutritional outcome and monitors anthropometric indices of the facility-based managed severe acute malnutrition (SAM) children with medical complications, aged 0 - 59 months, with or without edema. A total of 485 patients were admitted to the SAM block from January 2013-December 2017. Among them, 266 patients were successfully discharged from the hospital. According to the guidelines, admitted patients needed to stay in the SAM block for at least 3 weeks to complete the phases of protocolized management. Lack of compliance in this respect might have influenced the number of admitted patients during the study period. A decrease in the SAM block patients was observed in the last three years of the study, while over 35% of the admitted participants were admitted in the year 2013 (Table 1). This continuous decrease might be a result of multiple contributing factors, like parents not being optimally motivated to keep their children in the hospital for 2 - 3 weeks. Another contributing factor might be an overall improvement in the community guidelines and nutritional services in recent years. More than half of the admitted patients belonged to 6 - 24 months of age and the mean age + SD was found to be 22.354 ± 15.8607 months (Figure 1). The mean age of the patients with edema ($22.427 \pm SD$ 16.6677 months) was higher than that of the patients without edema (22.323 \pm SD 15.5359 months) but it was not statistically significant. Weaning of the babies should start from 6 months of age and should continue up to 24 months. Malnutrition in this age may result from faulty & inappropriate weaning practices. Overall male patients were slightly predominant (57.31%) (Figure 2). More than one-fourth of the treated patients were admitted with edematous malnutrition (Figure 3). The

Year	No of Patients	Percentage
2013	170	35.05
2014	139	28.66
2015	72	14.85
2016	64	13.20
2017	40	8.25
Total	485	100

Table 1. Total admitted patients (2013-2017) (n = 485).



Figure 1. Age distribution of admitted patients (n = 485).

presence of edema prevents weight loss in children. This lack of visible weight loss often leads to less admission and later recognition by their guardians. A higher prevalence of malnutrition was observed in patients from rural areas, as 63.9% of the participants were from rural areas (Figure 4). The socioeconomic status of the patients also seemed to play an important role in the prevalence of malnutrition. Almost half of the admitted participants (48.6%) were from lower-middle class families. 23.4% were from lower-class families and 25.3% were from upper-middle-class families (Table 2). and only 2.7% of the participants were from upper-class families (Table 3). The prevalence of malnutrition was extremely low in upper-class families. Cluster family, fewer earning members, close successive siblings, maternal busyness in household chores, and lack of proper nutritional knowledge might be some of the underlying contributing factors. Following WHO guidelines recommendation, a majority (90%) of the patients had up to 3 weeks of hospital stay (Table 4). The average stay in the nutrition block was 11.29 ± 6.873 days. The mean ± SD duration of hospital stay of the edematous patients (15.64 \pm 7.133 days) was higher than that of the non-edematous patients (9.47 \pm 5.881 days) (Table 5). The edematous patients at first lose edema, then start gaining weight & recover slowly. The average weight gain of the admitted patients



Figure 2. Sex distribution of admitted patients (n = 485).



Figure 3. Edematous versus non-edematous patients (n = 485).



Figure 4. Residence of admitted patients (n = 485).

was 6.8 g/kg/day or a median of 7.35 g/kg/day both of which can be considered moderate (**Table 6**). (Weight gain of >10 g/kg/day is considered good, 5 - 10 g/kg/day is moderate and <5 g/kg/day is poor.) 4.3% of patients did not gain weight during the hospital stay. Procedures to evaluate the weight gain were not, however, uniform across the studies. The 2009 joint United Nations statement projected using a single discharge criterion of 15% (or 20%, depending on the local context) weight gain over edema-free weight on enrolment, for children admitted based on weight-for-height or mid-upper arm circumference, as well as an absence of edema for 2 weeks. More than three-fourth of edematous patients required 6 - 10 days to start gaining weight whereas half of the non-edematous patients started to gain weight in 3 - 5 days (**Table 7**). SAM patients with edema are more complicated & show late weight gain due to the presence of edema. An

Tab	le 2.	Socioeconor	nic status of	the	families	of ac	lmitted	patients	(n = -	485)).
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Socioeconomic Status	No. of Families	Percentage
Lower class	113	23.30
Lower middle class	236	48.66
Upper middle class	123	25.36
Upper class	13	2.68

Table 3. Association between respondent's edema and age in months (n = 485).

	Presence of edema	Frequency	Mean	Std. deviation	df, t	Р
Age of the patient	Absent	342	22.323	15.5359	483	0 115*
in months	Present	143	22.427	16.6677	-0.065	0.115

*Statistically not significant.

Table 4. Duration of hospital stay of the patients (n = 485).

Duration (week)	Nol. of patients	Percentage	
<1	146	30.10%	
1 - 2	187	38.56%	
>2 - 3	106	21.86%	
>3	46	9.48%	

Table 5. Association between respondent's edema and duration of hospital stay days (n = 485).

Presence of	Frequency	Mean	Std.	df, t	P edema	deviation
Duration of hospital stay in days	Absent	342	9.47	5.881	483,	0.002*
	Present	143	15.64	7.133	9.878	0.002*

*Statistically significant.

orderly review inspected the sign on the success of supervision of children who are more than 6 months of age with basic edematous malnutrition grade +/++,1 in ambulatory settings [26]. Eight reports of them defined consequences of children with SAM who had bilateral edema and who was treated as outpatients. Among basic cases of edematous malnourished children, recovery rates were more than 88% and case-fatality rates remained below 4%. Classification of edema varied among the studies and in some studies, it was not clear if children with severe edema were left out from outpatient treatment. These outcomes are consistent with those recommended in the Sphere guidelines and the Prudhon index for case-fatality rates [27] [28]. Writers suggested that this was because of sharing ready-to-use therapeutic food at home or lacking of food supplementation in the home-based treatment group [29]. The present study shows that 39.7% (193) of the admitted patients recovered according to the set discharge criteria as per guidelines. But another clinically stable 73 patients had to be discharged on request of the caregivers due to some unavoidable personal issues (Table 8). Their general condition was presumed to be satisfactory for discharge. So, despite not achieving the target body weight for discharge, their discharge with advice was considered as routine. Accumulating both of these groups, more than half of the admitted children (266, 54.84%) were routinely discharged from the unit. A total of 149 (30.72%) patients left against medical advice before completion of the treatment or recovery of the illness (Table 8). Financial loss for working mothers/caregivers, family problems like other kids at home, slow improvement of the patient, new complications, etc. were reported to be the causes of early leave from the nutrition block. Thirty-nine (39) patients died with a moderate case-fatality rate of 8.04% during the review. (Case fatality rate: >20% = unacceptable, 11% - 20% = poor, 5% - 10% = moderate, <5% = good) Septicemia & bronchopneumonia with heart failure were found to be the major causes of death (Table 9). Acute Gastroenteritis was present in over 60% of the participants, either during or after the admission. Dyselectrolytemia and diarrhea were also common among the patients, and a majority of acute GE patients

Table 6. Weight gain pattern of admitted patients (n = 485).

Wt. gain (gm/kg/day)	No. of patients	Percentage	
<5	163	33.61	
5 - 10	151	31.13	
>10	171	35.26	

Table 7. Days required to start weight gain (n = 464).

Days	Non-Edematous patient (%)	Edematous patient (%)	Total	%
3 - 5	167 (50.9)	9 (6.6)	176	37.9
6 - 10	146(44.5)	104(76.4)	250	52.8
>10	15(4.8)	23(16.9)	38	8.1

had electrolyte imbalance, but sodium levels were unable to be monitored as the data was retrospective in nature. In the present study, ventricular septal defect (VSD) and tetralogy of fallot (TOF) contributed to mortality. Septicemia was defined by the presence of multiple inflammatory response syndrome criteria or confirmed invasive infection. Nearly all patients with septicemia died due to septicemic shock. Patients of acute GE with dyselectrolytemia had a hypovolemic shock, and 2 patients of congenital heart disease with bronchopneumonia had associated shock initially. Although shock was observed in the deceased patients, it was not a direct cause of death for any participants. >50% of the cured patients stayed for 1-2 weeks in the hospital, > 50% of the default patients who left against medical advice did so within one week of hospital stay & > 70% of death occurred within 1 week of admission (Table 10). All the death cases are presumed to be complicated due to poor nutritional status as the majority occurred early after admission. It is revealed that good motivation for the need for a hospital stay before admission in the SAM block can overcome the high defaulter

Year	Cured	Death	Defaulter	Others
2013	91	19	51	09
2014	76	07	50	06
2015	37	05	21	09
2016	44	04	11	05
2017	18	04	16	02
Total	266 3		149	31
Percentage	54.84	8.04	30.72	6.39

Table 8. Exit pattern of admitted patients (n = 485).

Table 9. Causes of death of the participants (n = 39).

Causes of death	N	%
Septicemia	10	25.64
Bronchopneumonia with Heart failure	09	23.07
Congenital Heart disease with Bronchopneumia	05	12.82
Encephalitis	03	7.69
Acute gastroenteritis with Dyselectrolytaemia	02	5.12
Acute Bacterial Meningitis	02	5.12
Severe anemia with Heart failure	03	7.69
CP with Aspiration pneumonia	02	5.12
Measles with Encephalitis	01	2.56
Disseminated TB	01	2.56
Tubercular Meningitis	01	2.56

rate. SAM patients with edema were cured more than the patients without edema (117. 81.4%).

But defaulter and death cases were observed more in non-edematous SAM patients (129, 37.7% & 29, 8.5%) (Table 11).

Hospital stay (week)	Cured (% of total cured)	Defaulter (% of defaulters)	Death (% defaulters)
<1	02(0.75)	77(51.67)	28 (71.79)
1 - 2	153 (57.51)	51 (34.22)	10(25.64)
>2	111 (41.72)	21 (14.09)	1 (2.56)

Table 10. Exit profile according to hospital stay (n = 454).

Table 11. Association between presence of edema and outcome of management (n = 485).

Presence	D	eath	Def	faulter	С	ured	0	thers	1	ſotal	df, χ^2	P value
of edema	N	%	N	%	N	%	N	%	N	%	3, 61.886	<0.001*
Absent	29	8.5%	129	37.7%	153	44.7%	31	9.1%	342	63.7%		
Present	10	7%	16	11.2%	117	81.8%	0	0%	176	36.3%		
Total	39	8%	145	29.9%	270	55.7%	31	6.4%	485	100.0%		

*Statistically significant.

6. Limitations of the Study

The study was conducted in a single hospital with small sample size. So, the results may not represent the whole community. Being retrospective, it reviewed the hospital records which were not uniform. Daily follow-ups of the patients were also not documented uniformly. Measures to improve weight gain (like frequent monitoring of all aspects of feeding & adequacy of multivitamins, addressing untreated infections including HIV & behavioral problems), whether taken or not, could not be evaluated. Assessment of "Sensory stimulation and emotional support", a very important step in SAM management and outcome, was not possible by such a retrospective study.

7. Conclusion

The overall recovery rate in the SAM block was found to be 55.73%, where 81.8% of children was of SAM with edema and 44.7% was without edema. The hospital stay of edematous SAM patients was significantly higher than that of the non-edematous SAM patients. The average weight gain was 6.8 g/kg/day and the defaulter rate (29.9%) were below acceptable standards, both of which affected the cumulative outcome. Death rate was not unacceptable rather considered modarate.

8. Recommendations

Further prospective studies are recommended. Emphasis should be given to pre-

dictors of recovery rate like routine antibiotics administration, prompt co-morbidity management, caregivers, motivation & counseling, etc. Caregivers should be positively motivated before entry into the SAM block & such motivation should be continued during the hospital stay. A discharge form should be kept for easy visualization of overall progress. Regular counseling sessions & follow-up sessions for the caregivers may be organized for a better outcome.

Ethical Approval

The study was approved by the Institutional Ethics Committee and the Bangladesh National Institute for Medical Research (NIMR)

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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