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Original Research Article

Clinico-epidemiological profile and outcome of children with severe acute malnutrition

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ABSTRACT

Background: Severe acute malnutrition is a significant crisis which can cause great morbidity and mortality in children. The aim of this study was to study the clinic-epidemiological profile and outcome of these children in a tertiary care hospital.
Methods: The study was an observational prospective study conducted from November 2018 to April 2020. A total of 61 patients were enrolled in our study. All Children were managed in nutritional rehabilitation centre as per WHO protocol.
Results: Male to female ratio was 1:1.6. Majority of patients were of age less the 2 years (83.4%) and were of birth order 3 or more (65.5%). The mean age of presentation was 12.016±7.72 months. Mean duration of exclusively breast feeding in our study was 3.643±1.81 months. Weight-for-height <-3 SD was the most commonly used diagnostic criteria. 67.2% patients recovered completely, 24.6% patients recovered partially and 8.2% patients were defaulters. Mean duration of hospital stay of patients in our study was 12.918±7.9735 days and average weight gain in our study was 8.808±3.7312 g/kg/day. The most common presenting symptom in our study was fever (45.9%). The most common co-morbidity in our study was bronchopneumonia (27.9%).
Conclusions: The problem of severe malnutrition is multi-dimensional and inter-generational in nature. Most of patients come to hospital with complaints like fever, cough, loose motions, vomiting and are then discovered as patients of severe acute malnutrition. Thus, screening the patients who report to hospital with various complaints can help in early detection and proper rehabilitation. NRCs provide live-saving care for children with SAM as demonstrated by the high survival rates in this study.

Keywords: Severe acute malnutrition, Outcome, Nutritional rehabilitation centre

INTRODUCTION

As per definition of WHO and UNICEF, severe acute malnutrition includes severe wasting and nutritional edema. Severe wasting (marasmus) is defined as weight-for-height (WFH) below 3 standard deviations (SD or *Z*-scores) or mid upper arm circumference (MUAC) <115 mm.[1-3] Malnutrition in children is a significant crisis for which various factors like inadequate and inappropriate food intake, childhood diseases, harmful childcare practices, illiteracy, poverty, and overpopulation have been found culprits. Sex of the child, religion or the child's living conditions have not been found to cause much difference in the level of under nutrition. Under-nutrition generally decreases with the increasing mother's schooling, better nutritional status of the mother. Stunting and under-nutrition are higher in rural areas than in urban areas.[4] Childhood under-nutrition remains a key public health challenge in India and is a significant contributor of under-5 mortality as these children have significantly

higher risk of mortality and morbidity.[5] In 2019, at least 144 million under-five children were globally stunted and 47 million were wasted with Asia and Africa bearing the greatest share of all forms of malnutrition.[6] Data from developing countries indicate that 56% of child deaths are attributable to the malnutrition's potentiating effects, and 83% of these were attributable to mild-to-moderate malnutrition.[7] In India, National family health survey-4 shows that about 35.7% of the children in India under 5 years of age are underweight, 38.4% are stunted, and approximately 21% are moderately to severely wasted.[8] In Jammu and Kashmir, National Family Health Survey-5 shows that about 21% of the children in Jammu and Kashmir under 5 years of age are underweight, 26.9% are stunted, and 9.7% are severely wasted.[9] Management of children having malnutrition in nutrition rehabilitation centers (NRCs) has given promising results and can reduce mortality by 55% (95% CI 0.32-0.62) compared with conventional treatment protocol led care with family involvement in a supervised manner could be the key to proper management of malnutrition.[10] Severe acute malnutrition (SAM) is known to be a major risk factor for impaired motor, cognitive and socio-emotional development.[11]

Aim and objectives

Objectives of current study were to study the clinico-epidemiological profile and short-term outcome of patients with severe acute malnutrition and to study the underlying etiology of severe acute malnutrition.

METHODS

The study was conducted in the post graduate department of pediatrics and neonatology, G. B. Pant pediatric hospital, an associated hospital of Govt. medical college Srinagar. The study was an observational prospective study conducted from November 2018 to April 2020. Proper informed consent was taken from parents. No predetermined sample size was calculated. All the patients who fulfilled the inclusion criteria were included in the study, thus the sampling technique used was convenience sampling.

Inclusion criteria

Children in the age group of 1 month to 30 months who got admitted in GB Pant children hospital with diagnosis of severe acute malnutrition were included.

Exclusion criteria

Children less than 1 month and more than 30 months were excluded as we simultaneously calculated the developmental quotient of these patients by DASII (developmental assessment scale for Indian infants) which is applicable for only 1 month to 30 month age group.

Procedure

Following definition of severe acute malnutrition was used: children 6-30 months with any of the following: mid upper arm circumference (MUAC) <115 mm or 11.5 cm with or without any grade of edema. Weight-for-Length (WFH) <-3SD with or without any grade of edema. Bilateral nutritional pitting edema +/++ (children with edema +++ always need inpatient care) with any of the following complications: anorexia (loss of appetite), fever (39 degree C) or hypothermia (<35 C), persistent vomiting, severe dehydration based on history and clinical examination, not alert, very weak, apathetic, unconscious, convulsions, hypoglycemia, severe anemia (severe palmar pallor), severe pneumonia, extensive superficial infection requiring IM medications and any other general sign that a clinician thinks requires admission for further assessment or care. Infants 1-6 month: infant is too weak or feeble to suckle effectively (independently of his/her weight-for-length) or WFL (weight-for-length) < -3SD (in infants >45 cm) or visible severe wasting in infants <45cm or presence of edema both feet. Children were managed in nutritional rehabilitation centre (NRC) both medically and nutritionally as per WHO guidelines. Very sick children were managed in emergency or PICU and after stabilization, were shifted to nutritional rehabilitation centre. Detailed history, physical examination findings and anthropometric measurements (weight, height, mid upper arm circumference for >6 months) were recorded at the time of admission. Body weight was recorded using electronic weighing machine with accuracy of ±10 grams. Height/length was measured by a stadiometer/ infantometer with accuracy of ±1cm. Mid upper arm circumference (MUAC) was measured midway between olecranon process and acromian process with measuring tape with an accuracy of ±1 mm. Weight for height/length Z score was assessed using WHO charts. All children were assessed daily for weight gain, improvement in clinical status, feeding problem, compliance with the treatment and improvement in the appetite.

Statistical analysis

Chi square test was used to see the association between two categorical variables. Where ever, Chi square was not feasible, Fishers exact test was used. To compare a continuous variable between two groups, t- test was used. Bar charts and pie charts were also used to describe the data, p value of 0.05 or lesser was considered to be statistically significant.

RESULTS

A total of 61 patients were enrolled in our study. Out of which, 38 (62.3%) were males and 23(37.7%) were females with male to female ratio of 1:1.6. Majority of patients were of age less the 2 years (83.4%) and were of birth order 3 or more (65.5%). The mean age of

presentation was 12.016±7.72 months. Mean duration of exclusively breast feeding in our study was 3.643±1.81 months. 68.9% patients were on mixed feeding and the most common supplementary milk was cow's milk.

Table 1: Age based distribution.

Age group (months)	N	%
1-6	18	29.5
6-12	14	23.0
12-24	19	31.1
>24	10	16.4
Total	61	100.0

Mean age of start of complementary feeding in our study was 7.11±1.2 months.

Weight-for-Height <-3 SD was the most commonly used diagnostic criteria. Out of 61 patients, 41 (67.2%) patients recovered completely, 15 (24.6%) patients recovered partially and 5 (8.2%) patients were defaulters. Mean duration of hospital stay of patients in our study was 12.918±7.9735 days and average weight gain in our study was 8.808±3.7312 g/kg/day. The most common presenting symptoms in our study were fever (45.9%) followed by loose motions (26.2%) and cough (26.2%). The most common findings on examination of patients in our study were visible severe wasting (41%), signs of vitamin D deficiency (31.1%), signs of vitamin B deficiency (27.9%), dehydration (23%), signs of vitamin A deficiency (21.3%) and pallor (14.8%).

Anemia was present in 65.6% of patients. Most common electrolyte disturbance in our patients was hyopkalemia (19.7%) followed by hyponatermia (9.8%). The most common co-morbidity in our study was bronchopneumonia (27.9%) followed by acute gastroenteritis (21.3%) and failure to thrive (18%).

Table 2: Diagnostic criteria.

Age (months)	Criteria for diagnosis				
	MUAC N (%)	Weight-for-height (<3 SD) (N%)	Both (N%)	Edema (N%)	Visible severe wasting (N%)
>6	25 (58.1)	36 (83.7)	21 (48.8)	3 (6.97)	NA
<6	NA	18 (100)	NA	2 (11.1)	8 (44.4)

Table 3: Symptoms.

Symptom	N	%
Loss of appetite	31	50.8
Fever	28	45.9
Cough	16	26.2
Loose stools	16	26.2
Vomiting	15	24.6
Failure to gain weight	14	23.0
Fast breathing	13	21.3
Seizures	9	14.8
Oral thrush	5	8.2
Edema	5	8.2
Ear discharge	1	1.6

Table 4: Examination findings.

Symptom	N	%
Visible severe wasting	25	41.0
Signs of vitamin D deficiency	19	31.1
Signs of vitamin B deficiency	17	27.9
Dehydration	14	23.0
Signs of vitamin A deficiency	13	21.3
Pallor	9	14.8
Hypothermia	9	14.8
Abdominal distension	7	11.5
Respiratory distress	7	11.5
Rash	3	4.9
Signs of vitamin C deficiency	1	1.6
Shock	1	1.6

Table 5: Lab abnormalities.

Lab parameters	N	%
Anemia	40	65.6
Hypokalemia	12	19.7
Hypoglycemia	11	18.0
Hypocalcemia	7	11.5
Hypoalbuminemia	7	11.5
Hyponatremia	6	9.8
Acute kidney injury	4	6.6
Hypernatremia	3	4.9
Hyperkalemia	1	1.6

Table 6: Comorbidities.

Comorbidity	N	%
Bronchopneumonia	17	27.9
Acute gastroenteritis	13	21.3
Failure to thrive	11	18.0
Global developmental delay	8	14.8
Congenital heart disease	5	8.2
Tuberculosis	4	6.6
Acute kidney injury	4	6.6
Cerebral palsy	3	4.9
UTI	3	4.9
Worm infestation	3	4.9
chronic diarrhea	2	3.3
renal tubular acidosis	2	3.3
Scabies	2	3.3
Metabolic disorder (IEM)	2	3.3
Pancytopenia	2	3.3

Table 7: Possible etiological risk factors.

Risk factors	N	%
Lack of exclusive breastfeeding	48	79
Bottle Feeding	32	52.5
Pre-lacteals	8	13.1
Inadequacy of complimentary feeding	34	79
Birth order ≥ 3	40	65.5
Mother's illiteracy	35	57.4
Rural background	48	79
Lack of proper immunization	32	52.5
Low socioeconomic status	59	96.7

Table 8: Short term outcome.

Outcomes	N	%
Complete recovery	41	67.2
Partial recovery	15	24.6
Defaulters	5	8.2
Total	61	100.0

Table 9: Rate of weight gain in patients.

Risk factors (g/kg/day)	N	%
<5	5	8.20
5-10	35	57.38
10-15	16	26.23
>15	3	4.92
Loss of weight	2	3.28
Total	61	100

Table 10: Duration of hospital stay.

Duration of hospital stay (days)	N	%
<7	9	14.75
7-14	34	55.74
>14	18	29.51
Total	61	100.00

The main possible etiological risk factors for SAM in our study were low socioeconomic status of the families (95.1%), rural background (79%), inadequacy of complementary feeding (79%), lack of exclusive breastfeeding (79%), birth order of 3 or more (65.5%), mothers' illiteracy (57.4%), bottle feeding (52.5%), improper immunization (52.5%), giving pre-lacteals (13.1%) and various co-morbidities.

DISCUSSION

In our study, males were more than females (62.3% vs. 37.7%) with a ratio of 1.65:1. Similarly, Choudhary et al, Ashraf et al, Ahmad et al, Goyal et al, Devi et al and Aneja et al described higher incidence of malnutrition in males (74.6%, 53.7%, 54.8, 84.3%, 57.7%, 55.5% respectively) in their hospital-based studies.[12-17] This is possibly due to parents giving more importance and seek more medical care for male child. In our study, the mean age of presentation was 12.016±7.72 months. Maximum number of children belonged to age group of 12-24 months, which consisted of 19 (31%) patients.18 (29.5 %) patients were in the age group of 1-6 months, 14 (23%) patients in the age group of 6-12 months and 10 (16.4%) patients were in between 24 -30 months. These results were in similarity with the studies done by Choudhary et al, Mamidi et al and Das et al, where majority of patients (96%, 71% and 76.35% respectively) were below 24 months. This is due to higher calorie requirement in the initial years of life.[12,18,19] In our study, 47.5% of patients were fully immunized, 39.3% of patients were partially immunized and 13.1% of patients were not immunized at all. Aprameya et al and Kumar et al reported that 84.6% and 42.3% of SAM children were completely immunized in their studies.[20,21] However, in a study done by Das et al 6.35% of children were unimmunized and 85.71% were partially immunized.[19] These differences are due to regional variation in awareness among people about immunization. 57.4% of mothers were illiterate whereas 42.6% of mothers were literate in our study. Das et al and Goyal et al in their studies reported mother's literacy rate as 23.01% and 60.6% respectively.[15,19] This is due to regional variation of literacy rates. Father's education was not studied as in almost all cases caretaker was mother. In our study, 34 (55.7%) of patients belonged to Kuppuswamy scale IV (upper lower), 19 (31.1%) belonged to Kuppuswamy scale III (lower middle), 5 (8.19%) belonged to Kuppuswamy scale V (lower) and only 3 (4.9%) belonged to Kuppuswamy scale II (upper middle). Modified Kuppuswamy classification is on the basis of education, occupation and income. Thus majority (95.1%) of patients in our study belonged to class III or above. Similarly, in the study done by Das et al, 98.1% patients belonged to lower socio-economic strata (Kuppuswamy scale III, IV, V). Chowdhury et al, Ahmad et al, Goyal et al and Devi et al reported 96%, 83.6%, 76%, 89.8% patients belonging to lower socio-economic strata.[12,15-19] Out of 43 patients, 38 (88.3%) patients were already started on complementary feeding at the time of admission. Mean age of start of complementary feeding in our study was 7.11±1.2 months. This was in concordance to the study done by Das et al where 81.27% children had been initiated on complementary feeds when admitted, compared to 63.5% in the study by Chowdhury et al.[12,19] Adequacy of complementary feeding was found in 30% children in the study by Das et al and 53.97% in the study by Devi et al both of these values were better than 21% in our study.[16,19] The most common complementary food used in our study was rice. Same was in the study done by Chowdhury et al and Rasania et al.[12,19-22] The most common presenting symptom of patients in our study was fever (45.9%) followed by loose motions and cough. Each of latter two were present in 26.2% of patients. Vomiting was the presenting symptom in 24.6% of patients followed by failure to gain weight in 23% of patient. Other presenting symptoms were fast breathing (21.3%) and abnormal body movements (14.8%). Anorexia was present in 50.8% of patients

though it was not the presenting symptom in many. 8.25% of patients had oral thrush.1.6 % of patients had ear discharge. Bernal et al and Bagga et al in their studies also reported diarrhea and fever as most common presenting symptom.[23,24] Ashraf et al also reported that diarrhea (25.8%) and fever/vomiting (30.9%) were the common presenting symptom in malnourished children. In our study, most common vitamin deficiency was that of vitamin D followed by vitamin B and vitamin A.[25] The main signs of vitamin deficiency in our study were glossitis, chelitis, angular stomatitis and conjunctival xerosis. Chainani et al in their study compared different vitamin deficiency between malnourished and normally nourished children and observed prevalence of vitamin A deficiency in (15.7% v/s 1.8%), vitamin B in (7.6% v/s 0.4%), vitamin D in (11.9% v/s 2%) and vitamin C in (1.1% v/s 0%) children.[26] Mathur et al, Singh et al, Choudhary et al and Chandna et al also reported that angular stomatitis, xerosis of conjunctiva, cheliosis and glossitis were the most common vitamin deficiency signs.[27-30] Anemia was present in 65.6% of patients, out of which 22.5% had hemoglobin of less than or equal to 7 whereas rest of the 77.5% had hemoglobin >7. This was similar to the study done by Soni et al in which incidence of anemia was 60% in malnourished children and among them majority (69.2%) of children had hemoglobin level between 5 gm/dl to 7 gm/dl.[31] Anemia in PEM has been attributed to a number of factors including nutritional deficiencies, infections, blood loss, hemolysis, and erythroid hypoplasia, ineffective erythropoiesis due to vitamin B12 and folic acid deficiency and adaptation to lower metabolic oxygen requirements. Hypoglycemia was present in 18% of patients in our study. Most common electrolyte disturbance in our patients was hyopkalemia (19.7%) followed by hyponatremia (9.8%). Hypernatremia was present in 4.9% whereas hyperkalemia was present in 1.6% of patients. The main possible etiological risk factors for SAM in our study had following distribution: low socioeconomic status of the families (95.1%), rural background (79%), inadequacy of complementary feeding (79%), lack of exclusive breastfeeding (79%), birth order of 3 or more (65.5%), mothers' illiteracy (57.4%), bottle feeding (52.5%), improper immunization (52.5%), giving pre-lacteals (13.1%) and various co-morbidities. This was in similarity to a case control study in north India by Mishra et al with 76 SAM cases, in which multivariate analysis revealed that the risk of SAM was independently associated with illiteracy among mothers, incomplete immunization, practice of bottle feeding, consistency of complementary feeding, deprivation of colostrum and receipt of pre-lacteal feeds at birth.[34] Jamro et al also reported that SAM was more in patients whose mother was illiterate, parent's income was less than 5000/month, family size with more than 4 or more children and recurrent diarrhea.[35] The most common co-morbidity in our study was bronchopneumonia (27.9%) followed by acute gastroenteritis (21.3%) and failure to thrive (18%). Global developmental delay was present in 14.8% patients. Congenital heart disease was present in 5 (8.2%) patients. Tuberculosis and acute kidney injury were each present in 6.6% patients. Cerebral palsy, UTI, worm infestation was present each in 4.9% patients. Chronic diarrhea, renal tubular acidosis, scabies, inborn Error of Metabolism and pancytopenia were each present in 3.3% of patients. Dhanalakshmi et al and Bharathi et al similarly reported pneumonia in 35.75% and 33.36% of cases respectively as most common complication followed by diarrhea in 28.49% and 18.89% respectively.[32,33] However Choudhary et al reported gastrointestinal infection (60%) as the most common co-morbidity followed by respiratory tract infection (52%), UTI (4%) and otitis. Out of 61 patients, 41 67.2%) patients recovered completely, 15 (24.6%) patients recovered partially and 5 (8.2%) patients were defaulters.[12] None of study participant died during the study period. All these parameters are good and acceptable as per WHO protocol. Complete recovery was defined when child had achieved weight gain of >15%. The recovery rate in our study was good, 67.2% as against the study done Saaka et al where it was 33.6%.[40] The defaulter rate was also better in our study, 8.2%, when compared to 53% in the Saaka et al, Dhanalakshmi et al had recovery rate of 81%, the death rate of 6.52%, the defaulter rate of 12.09% in their study.[32,36] Average weight gain in our study was 8.808±3.7312 g/kg/day. Out of 61 patients, 5 (8.1%) patients had poor weight gain of <5 g/kg/day, 35 (57.37%) patients had moderate weight gain of 5-10 g/kg/day, 16 (26.22%) patients had good weight gain of 10-15 g/kg/day, 3 (4.9%) patients had weight gain of >15 g/kg/day whereas 2 (3.2%) patients had loss of weight during the study period. The latter two patients had edema on admission and loss of weight was due to decrease in edema. Completely recovered patients had mean weight gain of 9.65±3.93g/ kg/day whereas partially recovered patients had mean weight gain of 6.90±2.78 g/kg/day.[18] The mean weight gain of patients in our study was better than Mamidi et al who had mean weight gain of 5 g/kg/day. Eight percent children did not gain weight, 44% children had poor catch up growth (<5 g/kg/day), 35% children had moderate catch up growth (5-10 g/kg/day) and 12% had rapid catch-up growth (>10 g/kg/day) in their study. Dhanalakshmi et al had mean weight gain of only 4.4g/kg/day in their study.[32] Likewise, in another studies by Savadogo et al and Patel et al it was observed that mean weight gain was 10.18 and 9.0 gm/kg/day respectively.[37,38] In our study, we found that male patients, patients with MUAC >11.5 cm, patients of lesser age, patients with more duration of hospital stay, patients with more hemoglobin at admission had more weight gain. However, it was not statistically significant. Patients with various co-morbidities like congenital heart disease, tuberculosis, cerebral palsy and global developmental delay had less weight gain in our study.

Limitations

The limitations of this study were its small sample size and exclusion of patients above 30 months age.

CONCLUSION

SAM is multifactorial and is more prevalent in younger age group with mean age of presentation of 12.016±7.72 months in our study. 67.2% patients recovered completely in our study. The most common presenting symptoms in our study were fever (45.9%) Most of patients come to hospital with complaints like fever, cough, loose motions, vomiting and are then discovered as patients of severe acute malnutrition. Thus, screening the patients who report to hospital with various complaints can help in early detection and proper rehabilitation. NRCs provide live-saving care for children with SAM as demonstrated by the high survival rates in this study.

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