Quantification of edema in edematous severe acute malnutrition children aged 6 months to 5 years

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ABSTRACT

Background: Malnutrition is rampant in India, and edematous severe acute malnutrition (SAM) is associated with high morbidity and mortality. Clinical grading of edema in these children is known, but still, no quantification has been described. **Objective:** The objective of this study was to quantify the edema in children with edematous SAM (E-SAM). **Materials and Methods:** This prospective study was conducted over a period of 1 year in 2016 at a malnutrition treatment center of tertiary hospital attached to a medical college. 50 children were selected with E-SAM between 6 months and 5 years of age. The sick children, needing intensive care unit care and having edema other than nutritional cause, were excluded from the study. These children were examined daily for any change in the status of edema by comparing the change in the weight, which was t aken using electronic weighing scale. The weight at which child has no edema and no fall in weight for 2 consecutive days was defined as dry weight of the child. All the children were evaluated regarding the onset of loss of edema, days taken for complete disappearance of edema, weight loss per day, mean loss of weight, etc. **Results:** Of 50 children with E-SAM, 28 were male and 22 were females. Mean age of children was 16.5±11.04 months. The admitted children had +2 edema (26%), followed by +3 edema (17%), while only 7 (14%) children had +1 edema. The mean age of moderate-to-severe edematous children was 13 months. These children started losing edema by day 3 (3.22±0.9) and the mean number of days for complete disappearance of edema was 10.02±2.8 days. The mean percent weight loss was 1% per day and did not vary with different grades of edema ($p>0.5$). The percentage loss of total weight was maximum for children with +3 edema being 13%, followed by 10% in +2, and 5% in +1 edema which was statistically significant ($p=0.004$). **Conclusions:** E-SAM children have grade +1, +2, and +3 edema which are equivalent to 5%, 10%, and >10% over to their actual weight, respectively, and younger children are more susceptible to moderate-to-severe edema.

Key words: *Edema Quantification, Edema, Severe Acute Malnutrition*

Edematous malnutrition, represented by its most severe form of kwashiorkor, is rampant in many parts of the world and is associated with a high case fatality rate. In addition to edema, the hallmarks of the condition include dermatosis, diarrhea, and fatty liver [1]. Widespread in sub-Saharan Africa and common in Southeast Asia and Central America, kwashiorkor occurs in young children living in areas with endemic food insecurity or famine; prevalence varies by geographic area, with reported levels ranging up to 6% in some chronic food-insecure communities and occasionally to one quarter of young children in areas facing famine [2].

Edematous severe acute malnutrition (E-SAM) is associated with increased morbidity and mortality due to difficulty in the assessment of their edema and their fluid management. The median case fatality rate in children under 5 years is approximately 23.5% in SAM, which may reach 50% in edematous malnutrition [3]. Clinically, this edema is being graded in SAM children as mild (+1), moderate (+2), and severe (+3), but exact quantification of edema fluid is not known. There is no such study regarding the quantification of edema in these malnourished children, so we planned this study to find out a way for easy assessment of edema in these children, which will be helpful in better management of children with E-SAM.

MATERIALS AND METHODS

This prospective study was conducted over a period of 1 year in 2016, at malnutrition treatment center of tertiary hospital attached to a medical college. SAM children were taken based on weight for height/length Z- score <-3 SD standard deviation and/or mid-upper arm circumference <11.5 cm and/or bilateral nutritional pedal edema [4]. After calculating the sample size using Epi info software, total 50 E-SAM children were enrolled. Children with age below 6 months and above 5 years, refusal for consent, critically sick requiring intensive care unit for stabilization, and having edema other than nutritional cause were excluded from the study. A written informed consent was taken from parents of all study children who fulfilled the inclusion criteria. Proper ethical clearance was taken

from the ethical committee of institute before starting the study.

A thorough history of feeding, socioeconomic background, immunization, and receiving supplementary nutrition from anganwadi centre (AWC) was taken. These children were examined thoroughly by health personnel who was trained in facility-based SAM management. Anthropometric variables were noted down. Edema was checked by pressing the thumb gently over the top of the foot for few seconds. The child has edema if a pit (dent) remains over the foot after lifting off the thumb. The extent of edema is rated in following way: +1 mild: Both feet, +2 moderate: Both feet, plus lower legs, hands, or lower arms, and +3 severe: Generalized edema including feet, legs, hands, arms, and face [5].

These children were followed daily for any change in the status of edema clinically and by comparing the change in the weight, which was taken using electronic weighing scale. These children were managed following the WHO protocols for the management of SAM children [5]. The weight, at which child has no edema and no fall in weight for 2 consecutive days, was defined as dry weight of the child. All the children were evaluated regarding the onset of loss of edema, days taken for complete disappearance of edema, weight loss per day, and mean loss of weight, etc.

Data were collected for all the children with E-SAM, and it was arranged and entered into data spreadsheets than the results were calculated accordingly using standard software of biostatics (SPSS version 20).

RESULTS

Of 50 children chosen for the study with E-SAM, 28 male and 22 were females. Mean age of children was 16.5±11.04 months. Mean anthropometric variables of the study population were as given in Table 1.

Most of the children admitted had +2 edema 26 (52%) with a mean age of 15.92 months, followed by +3 edema 17 (34%) with mean age of 13.29 months, while only 7 (14%) children had +1 edema with mean age of 26.7 months.

These children started losing edema by day 3 (3.22±0.9) and the mean number of days for complete disappearance of edema was 10.02±2.8 days. The onset of loss of edema was earliest in children with +1 edema (2.9±0.7) and was last in children with +3 edema (3.28±0.9) days. Children with +1 edema their dry weight at the earliest, in 8.96±2.4 days; children with +3 edema, it was last to dry with mean duration of 10.02 days.

The percentage weight fall per day was 0.91±0.28 %/day, and it was not significant in different grades of edema. The percentage loss of total weight was maximum for children with +3 edema being 13%, followed by 10% in +2 edema, and 5% in +1 edema as shown in in Table 2. This was statistically significant (p=0.004) with different grades of edema. There was one child with a weight loss of 30% in grade +3 edema category.

Table 1: Mean anthropometric variables of study population

Anthropometric variables	Mean±SD
Age (months)	16.54±11.04
Weight (kg)	6.77±1.42
Height/length (cm)	71.25±7.24
MUAC (cm)	11.57±1.11
BMI (kg/m^2)	13.36±2.13

MUAC: Mid-upper arm circumference, BMI: Body mass index

Of total 50 children, only 20 (40.0%) children received supplementary nutrition from AWC and out of these 20, only 3 (6.0%) children were eaten the received supplementary nutrition, in rest of the 17 (34.0%) cases, this received nutrition was distributed in other family members. 60% of the children did not receive supplementary nutrition (Table 3).

In 6 m - 2 years age group, 34 out of 41 children were on breastfeeding and 20 children were receiving complementary feeding when they develop edema. In 2–5 years age group, 2 out of 9 children were on breastfeeding and all nine children were receiving complementary feeding (Table 4). Complementary feed in most of the children was diluted milk and biscuits.

DISCUSSION

We found that the mean weight loss in E-SAM children with +1 edema was 5%, with +2 edema was 10%, and children with +3 edema had a mean loss of 13% of their admission weight. The edema usually start to reduce by day 3 (3.22±0.9) and it takes around 10 days (10.02±2.8) for complete disappearance of edema. On an average, daily weight loss per day was 1% of their previous day weight in all grades of edema. Furthermore, we observed that younger the child, more severe the edema as mostly moderate-to-severe E-SAM children were in 6–24 months age group with mean age of 13 months.

Till now, only qualitative criteria are there for the assessment of edema in these children; no quantitative criteria are available. Children who have only +1 or +2 bilateral pitting edema but present with medical complications or have no appetite should be admitted for inpatient care, and children who have +1 or +2 bilateral pitting edema but who have no medical complications and have appetite should be managed as outpatients. Children with SAM who have severe bilateral edema +3, even if they present with no medical complications and have appetite, should be admitted for inpatient care [6].

Kwashiorkor represents the worst form of edematous malnutrition and its genesis is multifactorial. The high morbidity and mortality require calculating exact fluid status, which can be helpful in medical management of these sick children. These children are in a state of reductive adaptation, and hence, overzealous introduction of a diet rich in calories and proteins can precipitate refeeding syndrome [7].

A review of the literature that has appeared over the past five decades indicates that the median case fatality from severe malnutrition has remained unchanged over this period and is typically 20–30%, with the highest levels (50–60%) being among those with edematous malnutrition [8]. Younger children are more sufferer of moderate-to-severe edema, this can be explained by the fact that up to 6 months breast milk provides adequate qualitative

Table 2: Edema quantification of E-SAM children

Grade of edema (n=50)	Mean age (months)	Admission weight (kg)	Dry weight (kg)	Total percentage fall of weight	Onset of edema loss (days)	Complete disappearance of edema (days)	Percentage weight fall per day (g/day)
+1 Mild (7)	26.7±17.84	7.54±1.58	7.19±1.6	5±3.36	2.96±0.67	8.96±2.45	0.78±0.26
+2 Moderate (26)	15.92±12.38	6.95±1.42	6.33±1.44	10±5.35	3±0.91	10.02±2.79	0.91±0.3
+3 Severe (17)	13.29±11.34	6.18±1.15	5.48±1.12	13±5.33	3.28±0.94	10.17±2.79	0.91±0.28
Mean	16.54±11.04	6.77±1.42	6.16±1.44	11±5.35	3.22±0.91	10.02±2.79	0.91±0.28
p	0.074	0.061	0.019	0.004 (CI: 9.47–12.52)	0.558	0.6	0.546

E-SAM: Edematous severe acute malnutrition, CI: Confidence intervel

Table 3: Supplementary nutrition received at AWC

Supplementary nutrition	Number of children	Total (%)
Received		
Eaten by child	3	20 (40.00)
Not eaten by child	17	
Not received	30	30 (60.00)

AWC: Anganwadi centre

Table 4: Feeding pattern in SAM children

Age group (m)	Number of children	Breastfeeding		Complementary feeding
		Yes	No	
6–<12	21	19	2	7
12–<24	20	15	5	13
24–60	9	2	7	9

SAM: Severe acute malnutrition

protein and ratio of protein to energy (P: E) is maintained. After 6 months, once they are being shifted to complementary feeding, many of these children due to their economic constraints do not get adequate calories as well as protein and their P: E intake ratio is disturbed. In our area, most of the tribal children during complementary feed received only diluted milk and biscuits which clearly show disturbed P: E ratio.

Elizabeth has reported the changing profile of undernutrition and E-SAM and found in her study that out of 121 SAM children, 37 have E-SAM. 10 cases died and one 3-month-old E-SAM, who died had florid keratomalacia. The imbalance in the dietary ratio of P: E has been clearly implicated in the pathogenesis of E-SAM [9], the PE ratio is a convenient and useful descriptor of one aspect of dietary quality in human nutrition [10].

CONCLUSION

This study concludes that E-SAM children as grade +1, +2, and +3 edema are equivalent to 5%, 10%, and >10% over to their actual weight, respectively, and younger children are more susceptible for moderate-to-severe edema. Hence, all E-SAM children should be quantified depending on their clinical edema grading and percentage of how much excess fluid they are having.

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