Published Online on 22 December 2016

Proc Indian Natn Sci Acad **82** No. 5 December 2016 pp. 1519-1528

DOI: 10.16943/ptinsa/2016/48884

Review Article

Management of Moderate and Severe Acute Malnutrition in Children

BHARATI KULKARNI*

Scientist E, Clinical Division, National Institute of Nutrition, Jamai Osmania P.O., Hyderabad 500 007, India

(Received on 30 May 2016; Accepted on 10 June 2016)

Moderate acute malnutrition (MAM) i.e. weight for height z-score (WHZ) between -2 and -3 and severe acute malnutrition (SAM) i.e. WHZ score <-3 in children have serious consequences, contributing to increased morbidity and mortality, and require targeted interventions. Children with SAM and associated medical complications are at high risk of mortality and need facility-based management. The paper describes the guidelines by World Health Organization (WHO) and Indian Academy of Paediatrics (IAP) for inpatient and community based management of SAM. Experience of nutrition rehabilitation at National Institute of Nutrition, Hyderabad, has shown that it is possible to treat SAM children using local foods. A few studies that have also assessed the effectiveness of the Ready to Use Therapeutic Foods (RUTF) for the management of SAM in Indian settings have shown low mortality and high cure rates in non-defaulting children. More evidence on the cost-effectiveness and sustainability of this intervention is, however, required. The prevalence of MAM is much larger than that of SAM and children with MAM are also vulnerable to enhanced risk of mortality and morbidity. WHO has recommended that children with MAM should receive nutrient-dense foods to meet their extra needs for weight gain, height gain and functional recovery; however, there is no definitive consensus on the most effective way to treat children with MAM. Finally, prevention of acute malnutrition requires a far wider spectrum of interventions beyond clinical management and need to focus on multi-sectoral actions.

Keywords: Severe Acute Malnutrition; Moderate Acute Malnutrition; Nutrition Rehabilitation; Childhood Under-Nutrition; RUTF

Extent and Causes of the Problem

Under-nutrition during childhood is a major public health problem in India. As per the National Family Health Survey-III (2005-2006) data, about 45% of children under 5 years of age were stunted (too short for their age), 40% were underweight (too light for their age) and nearly 23% were wasted (too thin for their height). Stunting indicates chronic malnutrition, wasting indicates acute malnutrition, and underweight reflects a combination of chronic and acute malnutrition. Among the children who were wasted, about 6.3% of the children below the age of 5 years were estimated to be suffering from severe acute malnutrition (SAM), while about 17% were suffering from moderate acute malnutrition (MAM).This indicates that, at a given point of time, about 8.1million children may suffer from SAM, whereas, more than 20 million children may suffer from MAM.

Both moderate and severe acute malnutrition have serious consequences, contributing to increased morbidity and mortality, and increased risk of disease in adulthood. Severe acute malnutrition is a potentially life-threatening condition and a major underlying cause of mortality in under-five children in India. It is well-known that, under-nutrition increases child mortality due to common morbidities including diarrhoea, acute respiratory infections, malaria, measles etc. It is estimated that, the mortality rates in children with SAM are about nine times higher than those in well-nourished children, who suffer from infectious illnesses (Black *et al*., 2008). Apart from contributing to childhood mortality, moderate and severe malnutrition have long-term impact on the health and well-being of an individual. A number of studies have shown that, malnourished children tend to become stunted adults and malnutrition in childhood is associated with

**Author for Correspondence: E-mail: dr.bharatikulkarni@gmail.com*

impairment of brain development, compromised intelligence quotient and poor scholastic performance (Grantham-Mcgregor *et al*., 1999).

Childhood under-nutrition is attributed to a myriad of causes including maternal under-nutrition resulting in low birth weight, sub-optimal dietary intakes, infections and poor access to health care etc. Studies from India have shown that dietary intakes of infants and young children in the country are grossly sub-optimal, both in rural and urban areas. Surveys carried out in the rural areas by the National Nutrition Monitoring Bureau (NNMB) in nine states in India show that the energy, protein, as well as micronutrient intakes among children in the age group of 1-6 years are grossly deficient, compared to the recommended dietary allowances (NNMB 2012). The foods eaten by children from the low-income group are mostly cereal-based and lack important micronutrients such as zinc, iron, vitamins A, B2, folic acid etc. In addition, the proteins are of low quality in terms of essential amino acid content. Recurrent infections and infestations observed in children in low-income settings further aggravate under-nutrition, pushing a moderately malnourished child towards severe acute malnutrition. Poverty is the overarching cause for moderate and severe acute malnutrition and the children presenting with these forms of malnutrition usually belong to the poorest stratum of the society. Nutrition-sensitive interventions aiming at poverty alleviation, improving water and sanitation and access to health services would contribute to long term prevention of childhood malnutrition, but, specific interventions targeted towards management of MAM and SAM are required to reduce mortality and other serious consequences associated with these forms of malnutrition. The magnitude of the problem and the serious life-threatening consequences associated with these forms of malnutrition, underline the urgent need of prevention, and management of moderate and severe acute malnutrition in the country.

Identification of Moderate and Severe Acute Malnutrition in Children

Identification of severe acute malnutrition or protein energy malnutrition relied on clinical criteria till 1990s. Three distinct forms of acute malnutrition based on clinical criteria are as follows (Waterlow *et al.*, 1992):

Marasmus: Severe form of acute malnutrition, characterized by wasting of body tissues – marasmic children are extremely thin.

Kwashiorker: Severe form of acute malnutrition characterized by bi-lateral oedema and weight for height greater than or equal to -2 SD.

Marasmic-Kwashiorker: Severe form of acute malnutrition characterized by bi-lateral oedema and weight for height of less than -2 SD.

The above clinical criteria, such as visible severe wasting and oedematous under-nutrition are subjective and health-care workers need elaborate training for identifying the clinical signs, suggestive of severe acute malnutrition.

Identification of moderate and severe acute malnutrition later shifted away from clinical classification of protein energy malnutrition and is currently based on anthropometric criteria.

The currently used diagnostic criteria for SAM and MAM in children, aged 6 to 60 months (proposed by World Health Organization (WHO)) and United Nations Children's Fund (UNICEF), are as follows (WHO and UNICEF 2009):

	Moderate Acute Malnutrition (MAM)	Severe Acute Malnutrition (SAM)
Weight for height or length	Between -2 and -3 SD or between 70% of the median WHO reference standard	Less than – 3 SD or <70% of the median WHO reference standard
Mid-upper Arm Circum-ference (MUAC)	Between 11.5cm to 12.5 cm	Less than 11.5cm
Nutritional Oedema	N/A	Bilateral

N/A: Not applicable

These anthropometric criteria are based on the observations that the risk of death increased with descending WHZ scores and quite steeply with WHZ score < -3 (Prudhon *et al*., 1996). However, it is widely believed that the use of WHZ score may be difficult at the community level, where the health workers have minimal formal education and are ill-equipped to measure the height of the children. Many

community-based management centres, therefore, favour measurement of MUAC as a screening tool. The use of MUAC is easy, fast to perform and can be done by health-care workers with limited numerical competency. Studies in Africa have indicated that, MUAC is a practical screening tool that performs reasonably well in predicting mortality among severely malnourished children (Berkley *et al*., 2005). However, the MUAC criterion, as a standalone indicator, has been criticized because it does not correlate very well with the WHZ score criteria. MUAC criterion tends to identify relatively younger children with less severe wasting as SAM, while older children with WHZ <3 may not be classified as SAM using MUAC criterion. Studies from India have demonstrated limited usefulness of MUAC as a screening tool used by frontline health workers to identify SAM (Dasgupta *et al*., 2013). This could be related to high levels of chronic under-nutrition or stunting in the Indian settings, in contrast to the epidemiologic profile of acute under-nutrition in African child population.

Current Strategies for Management of Severe Acute Malnutrition

Review of strategies for management of SAM in different settings shows that four delivery systems are commonly used. These include: (i) day-care, (ii) residential nutrition centres, (iii) health clinics, and (iv) domiciliary care.

Though hospital-based management or residential nutrition centres may be the most effective option to treat this potentially life-threatening form of malnutrition, it is not operationally feasible to treat such a large number of children in hospitals. Many of the community-based programs have shown success in the management of SAM in emergency and non-emergency situations, and therefore, it is no longer considered necessary to advise admission of all children with SAM in a healthcare facility. This becomes important, in view of the economic and social burden that hospitalization poses on families that are poor. Further, our country does not have sufficient hospital beds for offering inpatient care to all children with SAM. Indian Academy of Paediatrics (IAP) has, therefore, recommended an integrated management of malnutrition and has advised that, management of SAM should constitute an important component of Integrated Management of Neonatal and Childhood Illnesses (IMNCI) Program (Dalwai, Choudhury *et al*., 2013). It has been recommended that, management of SAM should not be a standalone program but should integrate with community management of therapeutic programs, and have linkages with child treatment centre, district hospitals and tertiary level centres, offering inpatient management for SAM.

Active early detection of children with SAM is recommended to ensure that, these children will be identified before they develop medical complications. This would mean management of many of them before their prognosis worsens and it would also reduce the need for hospitalized care and the cost of case management (Puett *et al*., 2013). It is important that, health professionals and healthcare providers should detect children with SAM at every opportunity provided by health contacts. This can be undertaken at every health facility, as well as in the community and at ICDS centres by healthcare workers.

After diagnosis of SAM, the children need to be categorized into “complicated” and “uncomplicated” cases to decide the need for treating children in hospital or community set-up.

1) Uncomplicated cases-Children with SAM, above the age of six months who satisfy the following conditions, may be categorised as “uncomplicated”. Child should be (i) alert, (ii) have good appetite, (iii) clinically assessed to be well (absence of general danger signs such as cough and difficult/fast breathing, cold to touch and severe dehydration), and, absence of severe anaemia (iv) living in a conducive home environment. Home-based management could be feasible, acceptable, and a cost-effective option for children categorised as “uncomplicated”.

2) Complicated cases - Many advanced cases of SAM are complicated by concurrent infective illness, particularly acute respiratory infection, diarrhoea and gram-negative septicaemia. Some of them have severe electrolyte imbalance. The risk of mortality is high in these children and hospital-based treatment is essential for these complicated cases. In addition, all children less than six months and children who do not fulfil the criteria for uncomplicated cases should be considered as complicated, because of the high risk of mortality.

An important criterion to differentiate a complicated case from an uncomplicated case of SAM is an "appetite test". Children with SAM who have poor appetite, are at high risk of death as they will not consume sufficient amounts of food at home to prevent further deterioration of their health. This test is usually conducted in a quiet area with ready-to-use therapeutic food (RUTF). A child, not consuming the minimum recommended amount of RUTF (depending on child's weight) is labelled as 'failed appetite test' and is referred for in-patient care.

Figure 1 represents the framework of triage recommended after the identification of a SAM child in the community, or in any facility that the child is brought initially to decide whether the child can be managed at home, or requires a facility-based care.

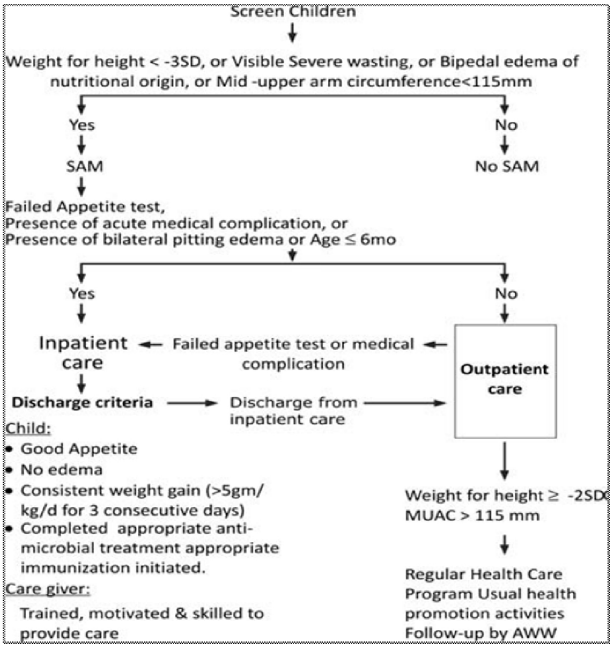

Fig. 1: Identification and management of children with severe acute malnutrition (SAM). Reference: (Dalwai *et al.*, 2013), Reproduced with permission of the journal

Management of Complicated Cases

The WHO/IAP guidelines for hospital-based management of complicated cases of SAM are divided into ten essential steps in two phases (stabilization and rehabilitation) (WHO 2003; Bhatnagar *et al.*, 2007). These are as follows:

1. Treat/prevent hypoglycaemia (low blood glucose levels)
2. Treat/prevent hypothermia (low body temperature)
3. Treat/prevent dehydration
4. Correct electrolyte imbalance
5. Treat/prevent infection
6. Correct micronutrient deficiencies
7. Start cautious feeding
8. Achieve catch-up growth
9. Provide sensory stimulation and emotional support
10. Prepare for follow-up after recovery

The time-frame for initiating and achieving these ten steps is indicated in Fig. 2.

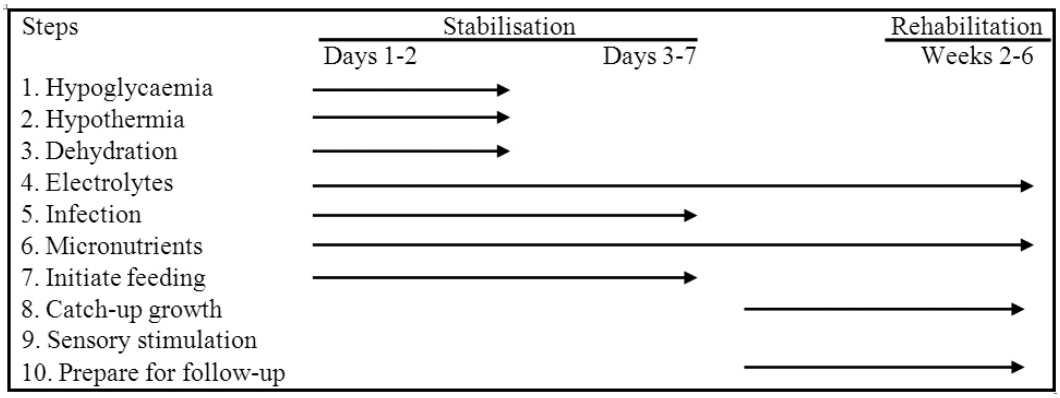

Fig. 2: Ten essential steps for hospital-based management of complicated cases of severe acute malnutrition. Reference: (Ashworth *et al.*, 1996), Reproduced with permission of the author

All severely malnourished children with complications are at risk of low blood sugar levels, which is associated with high mortality in these children. Assessment of blood glucose levels and prompt correction using glucose solution and early feeding is utmost important. It is also important to keep these children warm, and carefully treat the dehydration and electrolyte imbalance, if present. All the SAM children are likely to be immune-compromised and need treatment with appropriate broad-spectrum antibiotics (WHO, 2003).

Correction of electrolyte imbalance is an important part of management of SAM, as all severely malnourished children have excess body sodium and are deficient in potassium and magnesium. Supplementation with potassium and magnesium is therefore necessary for at least two weeks. WHO recommends preparation of an electrolyte-mineral solution, containing potassium, magnesium, zinc, copper, selenium to be added to the feeds (WHO, 2003).

All severely malnourished children also suffer from massive vitamin and mineral deficiencies and correction of these deficiencies is an important part of treatment of SAM. Up to twice the recommended daily allowance of various vitamins and minerals need to be used. Although anaemia is common in these children, iron is withheld initially, because giving iron may make the infections worse. Iron supplementation should be started when the child has a good appetite and starts gaining weight (usually by week 2). Following schedule for micronutrient supplementation is recommended by WHO:

- Vitamin A orally on day1 : for children with age >1 year - 200,000 IU; age 6-12 months - 100,000 IU; age 0-5 months - 50,000 IU), unless, there is definite evidence that a dose has been given in the last month.
- Daily supplementation with multi-vitamin supplement containing vitamins A, C, E, B12, folic acid etc. is essential. In addition, minerals such as iron, copper, zinc need to be supplemented in appropriate doses.

Role of Diet

Severe acute malnutrition in children is a complex medical condition; nutrient absorption and metabolism are severely compromised in these children, due to pathological changes in the gut epithelium and other organs including liver. Appropriate feeding is therefore crucial for the successful recovery from SAM. In addition, for the rapid weight gain necessary for complete recovery from SAM, the nutrient requirements of these children are more than double, than that of normally nourished age matched children. However, the pathological changes in the gut epithelium and electrolyte and mineral imbalances commonly observed in these children necessitate cautious feeding. A gradual increase in calorie intake is recommended to avoid the risk of heart failure, which can occur if children suddenly consume huge amounts of food. The most important aspect of feeding SAM children is to provide energy-dense foods, since the energy intake is the most important determinant of the rate of recovery. As the children are also deficient in protein and various micronutrients, including potassium, magnesium, iron and zinc, all of these must also be additionally administered in increased amounts.

Table 1: Formula diets recommended by Indian Academy of Paediatrics for management of children with SAM

Diet contents (per 100 ml)	F75	F100
Cow's milk or equivalent (ml) (approximate measure of one katori)	30(1/3)	75(1/2)
Sugar (g) (approximate measure of one level teaspoon)	6(1)	2.5(1/2)
Cereal: Powdered puffed rice* (g) (approximate measure of one level teaspoon)	2.5(3/4)	7(2)
Vegetable oil (g)(approximate measure of one level teaspoon)	2.5(1/2)	2.5(1/2)
Water: make up to (ml)	100	100
Energy (kcal)	75	100
Protein (g)	1.1	2.9
Lactose (g)	1.2	3

Reference: (Bhatnagar *et al*., 2007).
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WHO recommends milk-based feeds, with adequate quantities of added minerals and vitamins for the complicated cases of SAM, treated at health-care facilities. These formula diets are labelled as F75 (formula providing 75 KCal/100 ml), in the initial stabilization phase and F100 (formula providing 100 KCal/100 ml) in later rehabilitation phase, for rapid recovery (WHO, 2003). IAP has recommended a

modified feeding protocol for feeding of SAM children (Bhatnagar *et al.*, 2007). Table 1 summarizes composition of IAP recommended formulae. Appropriate quantities of concentrated electrolyte-mineral solution containing potassium, magnesium, zinc, copper, selenium should be added to these formulae for replenishing the electrolyte-mineral balance. The children should be fed every 2 hours with adequate precautions to ensure that the feeding is continued throughout night. All severely malnourished children are at risk of hypothermia, due to a lowered metabolic rate and decreased body fat. Hypothermia is one of the important causes of death in children with SAM, and it is therefore necessary to ensure that the children are kept warm. After initial treatment to stabilize the clinical condition of the child and replenishment of micronutrient deficiencies (which usually occurs within first 2-3 days), the cautious milk-based feeds can be replaced by catch up diets that provide sufficient amounts of energy, protein and micronutrients for rapid weight gain.

Children with severe acute malnutrition who are admitted to hospital can be transferred to outpatient care when their medical complications, including oedema, are resolving and they have a good appetite, as well as are clinically well and alert. As per the updated recommendations by the WHO, the decision to transfer children from inpatient to outpatient care should be determined by their clinical condition, and not on the basis of specific anthropometric outcomes (WHO, 2013).

NIN Experience of Hospital-based Management of Children with SAM using Local Energy Dense Foods

Treatment of SAM has been an important area of research at the National Institute of Nutrition (NIN), Hyderabad. A large number of studies on rehabilitation of SAM children have been carried out by NIN in collaboration with Niloufer Hospital (a state-run tertiary care hospital in Hyderabad) to assess the efficacy of various diets in PEM rehabilitation (Venkatachalam *et al.*, 1956; Srikantia and Gopalan, 1960; Reddy and Bhaskaram, 1982). The protocols on optimal diet, based on these studies, are in practice since late 1970s.

The feeding protocol follows the WHO/ IAP recommendations on caloric and protein content of the diets, but it is modified to include locally available foods, so that it is possible for families to maintain it at home, after discharge from the hospital. The diets are cooked by the nurses in the ward, and mothers often participate in the preparation of feeds. A child is initially put on a maintenance diet of about100 Kcal/ kg/day, which is slowly increased up to 170-220 Kcal/ kg/day. A typical diet of a child weighing 7kg consists of 350ml of milk (fortified with groundnut oil to increase the energy density), 250g of *khichdi* (rice and *dal* in 2:1 ratio with oil added), 1-2 slices of bread, 2 eggs and a banana, which provides around 170 to 200kcal/kg/day and 3 to 4grams of protein/kg/day. Children are fed every two hours initially and once appetite improves, they are fed ad libitum. The children receive a massive dose of vitamin A, as per the WHO guidelines, and Potassium Chloride is also given daily as per the recommended dose. Micronutrients are provided in the form of multivitamin-multimineral syrups containing; zinc sulphate, nicotinamide, thiamine hydrochloride, riboflavin, pyridoxine, copper sulphate, potassium iodide, selenium, cyanocobalamin, Vitamin A, cholecalciferol and calcium. Folic acid is given regularly but, iron is withheld during the initial phase of rehabilitation. Iron supplementation is started once the child starts gaining weight.

Appropriate medical care is provided to children during their stay at the nutrition ward. All the children are weighed each morning on an electronic weighing scale (SECA, Hamburg, Germany) to the nearest gram. Length/height are measured on admission and discharge. Dietary intakes and weight gains of the children are carefully monitored and appropriate changes are done in the diets of children, who fail to achieve adequate caloric intakes and weight gain.

A retrospective study at NIN analyzed hospital records of children admitted to nutrition ward during the period of January 2001 to December 2005 (Mamidi *et al.*, 2010). Data was available on 309 children, who stayed in the nutrition ward for $\geq$ 7 days. Among them, 53% were boys, 18% had oedema and 20% had severe anaemia (haemoglobin <7g/dL). The calorie and protein intake calculated in a sub-sample during nutrition rehabilitation were (mean ± SD) 178 ± 54 kcal/kg/day and 4.1 ± 1.9 g/kg/day, respectively. The average rate of weight gain was about 5g/kg/day, which is similar to the reports published from other nutrition rehabilitation centres. The study, thus

indicated that, the diet based on local energy-dense foods can be suitable for the nutrition rehabilitation of severely malnourished children. Another study from this centre on the children treated with the local foods assessed the composition of weight gain (i.e. fat and lean mass) in these children (Radhakrishna *et al*., 2010). The study was carried out to address the concerns that rapid catch up growth during nutrition rehabilitation of severely malnourished children may be associated with disproportionately higher amounts of body fat deposition. In this study, the body composition was assessed using skin-fold thickness measurements in 80 children admitted at the nutrition ward at baseline, and after one month of intensive feeding with energy dense local foods. The study indicated that, about 40% of the total weight gain was contributed by fat mass in these children. This could have long-term implications for insulin sensitivity and cardiovascular risk in later life.

Community-based Management of Severe Acute Malnutrition

Given the large number of children suffering from SAM, hospital-based treatment of all the children is not operationally feasible. Hospital-based management of SAM lasts for 2-3 weeks (plus follow-up) and involves substantial burden, including, opportunity costs and social dislocation. Community-based management of acute malnutrition (CMAM) is, therefore, an unavoidable alternative for a large proportion of these children. Moreover, complicated cases of SAM need continued community-based care after their discharge from the facility-based care. Evidence suggests, that more than 80 % of total SAM cases are without medical complications and can be successfully managed at the home (WHO, 2007).

CMAM comprises of three key elements: (*i*) feeding energy dense micronutrient rich foods, (*ii*) community engagement and mobilization, and (*iii*) screening for malnutrition in communities. Early detection, coupled with decentralized treatment, makes it possible to start management of severe acute malnutrition, before the onset of life-threatening complications. Community health workers can be trained to screen children, using MUAC tapes and encourage parents to access decentralized services for management of SAM.

Development of ready-to-use therapeutic food (RUTF) has made it possible to move much of the management of SAM out of hospitals. RUTF has been used as a substitute to therapeutic diets (F-75/F-100) in African settings and these foods have been found to be effective for community-based care of children, with SAM in studies conducted in Africa (Briend *et al*., 1999; Dossou *et al*., 2003). RUTF is a mixture of milk powder, vegetable oil, sugar, peanut butter, and powdered vitamins and minerals, and is energy-dense food providing 5.5Kcal/g. Almost 55-60% of calories are derived from fat, whereas, 10-12% of calories are contributed by proteins, derived from skimmed milk, which provides most of the required essential amino acids. As it does not need to be prepared in any way prior to consumption, it is practical to use it where cooking fuel and facilities are limiting constraints. The decentralized production of RUTF using local crops has been tried in African settings, which reduces the cost of RUTF. The limited preliminary evidence based on a few studies carried out in India suggests that, locally produced RUTF could be acceptable and effective in community-based management of uncomplicated SAM (Shewade *et al*., 2013; Weber *et al*., 2016). More information based on well-designed studies, assessing the efficacy of RUTF in weight gain and physiologic and immunological recovery is, however, required. Studies are currently ongoing in India, to develop energy-dense therapeutic foods based on local ingredients, and evaluate their efficacy for management of SAM children. Results of these studies would be helpful for guiding the strategies for community-based management of SAM in India.

Management of MAM

Moderate acute malnutrition (MAM) is more prevalent than severe acute malnutrition (SAM), and affects approximately 64% of all those categorized as having acute malnutrition (Black *et al*., 2013). Although the children with MAM are less wasted and generally do not have clinical complications associated with SAM, they are also in a highly vulnerable state, and need to be treated before their condition progresses to SAM. Compared to well-nourished children, children with MAM have a three-fold increased risk of mortality, increased risk of infections and impaired physical and cognitive development (Black *et al*., 2008). Whilst the contribution of SAM to global mortality and

morbidity has been widely recognized with resulting international treatment protocols (WHO 2007), the management of MAM remains debatable (Kennedy *et al*., 2015; Webb, 2015).

Although, there is no need to feed moderately wasted children with therapeutic foods that are used to treat SAM, they require a higher intake of energy and essential nutrients than children who are not malnourished. Ideally, their dietary management should be based on the use of locally available, macro- and micronutrient-dense foods, including breastmilk, in case of infants. In settings with food shortage, specially formulated supplementary foods are used to facilitate the recovery of moderately wasted children. Different food strategies have been used for the nutritional recovery of children with MAM, such as lipid-based nutrient supplements or blended foods, which can be provided as a single food, or as a complement to the usual diet. However, there is no definitive consensus on the most effective way to treat children with MAM (Lazzerini *et al*., 2013). WHO highlights that, "currently there are no evidence-informed recommendations on the composition of supplementary foods, specially designed for the management of children, with moderate acute malnutrition" (WHO, 2012). On the basis of available information, WHO has recommended that, children with moderate acute malnutrition should receive nutrient-dense foods to meet their extra needs for weight and height gain, and also, functional recovery. Animal-source foods are more likely to meet the amino acid and other nutrient needs of recovering children. Supplementary feeding programs using different products, such as fortified blended flours and ready-to-use supplementary foods (RUSFs) are the most commonly used approach for treating MAM. The World Health Organization has issued guidance on the recommended nutrient composition of such supplements (Table 2) (WHO, 2012).

Other approaches are also currently being assessed for their effectiveness in the prevention and treatment of MAM, delivered both with and without nutritional supplements. For example, some studies have suggested that, nutrition counselling, particularly focusing on improving infant and young child feeding practices, may be as effective as specialized food-based interventions for the treatment of MAM (Roy *et al*., 2005; Prasad and Sinha, 2015).

Table 2: Recommended nutrient composition of the ready-to-use supplementary foods (RUSFs) for children with moderate acute malnutrition (MAM)

	Nutrients/1000 KCal	
Energy (kJ)	Minimum	Maximum
Protein (g)	20	43
Lipid (g)	25	65
Minerals		
Potassium (mg)	1500	2200
Calcium (mg)	1000	1400
Phosphorus (mg)	850	1400
Magnesium (mg)	280	420
Zinc (mg)	20	35
Copper (mg)	1	3.5
Iodine (µg)	150	350
Selenium (µg)	35	90
Iron (mg)	18	30
Vitamins		
Thiamine (mg)	>1	
Riboflavin (mg)	>1	
Vitamin B-6 (mg)	>2	
Vitamin B-12 (µg)	>5	
Vitamin C (mg)	>150	
Folic acid (µg)	>400	
Niacin (mg)	>25	
Biotin (µg)	>20	
Pantothenic acid (mg)	>5	
Retinol (µg)	2000	3000
Vitamin D (µg)	20	60
Vitamin K (µg)	>50	
Vitamin E (mg)	>30	

Reference: (WHO, 2012)

Prevention of Acute Malnutrition

Management and prevention of SAM and MAM is an important public health and development priority. In India, the problem of acute malnutrition is complicated by co-existing chronic malnutrition as majority of the children with SAM and MAM also suffer from stunting. There is growing recognition that it can be counter-productive to see wasting as a distinct problem from chronic manifestations of under-nutrition (such as stunting or micronutrient deficiencies), since such problems often co-exist among affected

vulnerable communities and this 'divide' in interests can in turn lead to a separation in policies and programming (Webb 2015).

Prevention of acute malnutrition, with coexisting chronic malnutrition, requires a far wider spectrum of interventions beyond clinical management, and need to focus on multi-sectoral actions for improving child feeding practices, promoting dietary diversity and reducing exposure to illnesses. Diverse strategies, including a combination of food security, behaviour change, water and sanitation, medical, cash-based, surveillance approaches etc., are therefore recommended (De Pee *et al*., 2015; Tonguet-Papucci *et al*., 2015).

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