

## Home-based Rehabilitation of Severely Malnourished Children in Resource Poor Setting

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**Objective:** To evaluate the feasibility and outcome of home-based rehabilitation of severely malnourished children.

**Design:** Prospective and observational.

**Setting:** Rehabilitation at home (16 weeks) following initial assessment or/and stabilization at hospital.

**Participants:** Thirty-four severely malnourished (weight for length <70% of WHO reference) children between the ages of 6 months to 5 years.

**Intervention:** Initial assessment of the patient was done in hospital. Those with complications or loss of appetite were admitted in hospital and managed as per WHO guidelines. After discharge, they were managed at home using home based diets. Those without complications and with preserved appetite were directly eligible for home-based rehabilitation. Follow up was done in hospital up to 16 weeks. Dietary intake, anthropometry and morbidities were recorded during follow-up.

**Results:** Of the enrolled 34 children, 19 children were admitted in hospital and 15 children were sent home after initial assessment in hospital. Five did not clear the initial stabilization phase (2 died, 3 left hospital). Finally 29

children qualified for home based rehabilitation out of which 26 completed 16 week follow-up. During the home based management phase, the reported mean ( $\pm$ SD) calorie intake increased from 100 ( $\pm$ 5) kcal/kg/d at entry point to 243 ( $\pm$ 13) kcal/kg/d at 16 weeks ( $P=0.000$ ). Similarly, reported protein intake increased from 1.1 ( $\pm$ 0.3) g/kg/d to 4.8 ( $\pm$ 0.3) g/kg/d ( $P=0.000$ ). During hospital stay ( $n=19$ ), children had weight gain of 9.0 ( $\pm$ 5.3) g/kg/d, while during home based follow up ( $n=29$ ), weight gain was 3.2 ( $\pm$ 1.5) g/kg/d only. During home based rehabilitation, only 3 (11.5%) children had weight gain of more than 5 g/kg/d by the end of 16 weeks. Weight for height percent increased from an average ( $\pm$ SD) of 62.9% ( $\pm$ 6.0%) to 80.3% ( $\pm$ 5.7%) after the completion of 16 weeks ( $P=0.000$ ). Thirteen (45%) children recovered completely from malnutrition achieving a weight for length of >80% whereas 15 (51.7%) recovered partly achieving weight for length >70%. There was no death during the home stabilization.

**Conclusion:** Home based management using home prepared food and hospital based follow up is associated with sub-optimal and slower recovery.

**Key words:** Community health services, Nutritional support, Protein energy malnutrition.

To rationalize the management of severely malnourished children, World Health Organization (WHO) proposed guidelines which state that a child with complications should be treated in hospital until the weight for length improves above 90% (1,2). However, this is seldom feasible because of bed shortage in hospitals and budgetary constraints. Prolonged hospital stay also carries the risk of nosocomial infections leading

to increased mortality. Admission of all children with severe malnutrition is thus not operationally feasible, and hence home-based management is an unavoidable alternative for a significant proportion of these subjects. Preliminary evidence from Bangladesh and Africa suggests that this alternative may be acceptable, cost-effective, and reduce morbidity and mortality (3-8). In a recent statement, WHO suggested that uncomplicated forms of severe

acute malnutrition can be treated in the community with ready-to-use therapeutic food (RUTF) or therapeutic diets using locally available nutrient dense foods under careful monitoring until they have gained adequate weight(9). However, the guidelines regarding early discharge from the hospital followed by home based management are lacking. The studies evaluating outcome of those discharged early from the hospital or those managed at home are scarce. The present study was thus conducted to evaluate the outcome and feasibility of home based rehabilitation of severely malnourished children. We hypothesized that it is possible to attain recovery and reduce mortality with home based rehabilitation.

## METHODS

The study was conducted between November 2006 to February 2008 in a prospective and observational manner. The setting was a tertiary care hospital in Delhi, North India. The hospital predominantly caters to poor urban population living in resettlement colonies and slums, and also rural families from neighbouring state of Uttar Pradesh. The study protocol was approved by Institutional Research Board, including ethical clearance. The study procedure was fully explained to the parents/caregivers, and informed written consent was obtained from the primary caregiver.

### *Inclusion criteria*

All consecutive children (6 months to 5 years) with severe malnutrition presenting to the Pediatric outpatient department (OPD) or emergency of hospital were eligible for inclusion. Severe malnutrition was defined as weight for height (or length) <70% of median(2). WHO multicentric growth standards were used as reference criteria(10).

Children were eligible for home management if: (i) mother or caretaker was not full-time employed, (ii) family was residing within 5 km of hospital premises, (iii) mother or caretaker was trainable to provide home-based diet, and (iv) family was financially able to provide the recommended home-based diet. Children having other diseases incriminated as cause of severe malnutrition, including cerebral palsy, congenital heart disorders, hemolytic anemia, malignancies, known metabolic

disorders, known malabsorption syndromes, chromosomal malformations, or chronic renal and hepatic disorders, were excluded.

Baseline data collected included demographic details and presence of associated symptoms, including fever, vomiting or diarrhea. Occupation, education and monthly income of parents were recorded and a socio-economic status was assigned based on revised Kuppaswamy classification(11). General hygiene of the household was assessed in terms of source of drinking water, water storage practices, and practice of hand washing. Clinical examination included anthropometry (weight, length, mid-arm circumference, chest circumference and head circumference), general physical examination and systemic examination. The weight was recorded in the nude on an electronic weighing scale (Goldtech, India) to the nearest 5 g. Length was recorded using an infantometer, and head, chest and mid-upper arm circumference were recorded using non-stretchable measuring tape using standard techniques(12). The same observer recorded all the measurements. Venous blood was drawn for estimation of hemoglobin, blood sugar, albumin and serum electrolytes. Cultures of the blood, and urine were taken. Chest X-ray and other relevant investigations were done as and when required.

### *Assessment and Management*

Initial assessment of the patient was done in hospital. Those with complications or loss of appetite were admitted in hospital and managed as per WHO guidelines as adapted by Indian Academy of Pediatrics (IAP)(3). After discharge, they were managed at home using home based diets. Those without complications and with preserved appetite were directly eligible for home-based rehabilitation after initial assessment in hospital.

*Initiation of cautious feeding:* Feeding was started with starter F-75 made at hospital kitchen using whole milk, sugar, oil and water as per recommended formula(1). As no mineral mix or micronutrient mix was available, potassium, magnesium and zinc were given separately as described above. Initially enough starter was given to provide 100 kcal/kg/day and 1-1.5 g protein/kg/day with 130 mL/kg/day of fluid

(when the child had severe edema 100 mL/kg/day was given). Breastfeeding was continued as usual wherever possible. Initially, the child was given feed more frequently with low volume, then gradually frequency of feeds was decreased and volume per feed was increased. As the patient started to regain appetite, the starter feed was changed with home-made food. Mother was counseled to provide type, frequency and quantity of food. Monitoring for amount of feed offered and left over, frequency of vomiting and watery stool were done.

*Discharge:* Child was considered for discharge when (i) the appetite had returned (easily consuming more than 80% of recommended feeds orally), (ii) child had started gaining weight (gain of at least 5 g/kg/day for 3 consecutive days), (iii) immunization had been initiated, (iv) all acute complications had been treated, (v) micronutrient supplementation was initiated, and (vi) mother had been counseled for home-based care(13).

### **Home-Based Rehabilitation**

All children directly enrolled for home-based rehabilitation and those discharged from hospital were eligible for home-based rehabilitation.

*Nutritional support:* Home based foods were advised to provide 150 kcal/kg/day and 2-3 g/kg/day of proteins. A diet chart was provided using home-based energy dense foods like *besan-panjiri*, *khichdi*, *parantha* enriching them with *jaggery* and *oil*. Energy dense feeding was gradually increased so as to provide approximately 150-220 kcal/kg/day and proteins 4-5 g/kg/day. Mother was given advice about type of food, quantity of food, and feeding frequency. No external support for procuring or making food was provided to the families. Daily multivitamin supplement was continued till 16 weeks.

*Sensory stimulation and emotional support:* Mother was counseled to give tender loving care to the child and to provide cheerful stimulating environment. Child was provided with toys as a part of structured play therapy. Toys like ring on a string, rattle and drum, in and out toy with blocks, posting bottle and doll were given.

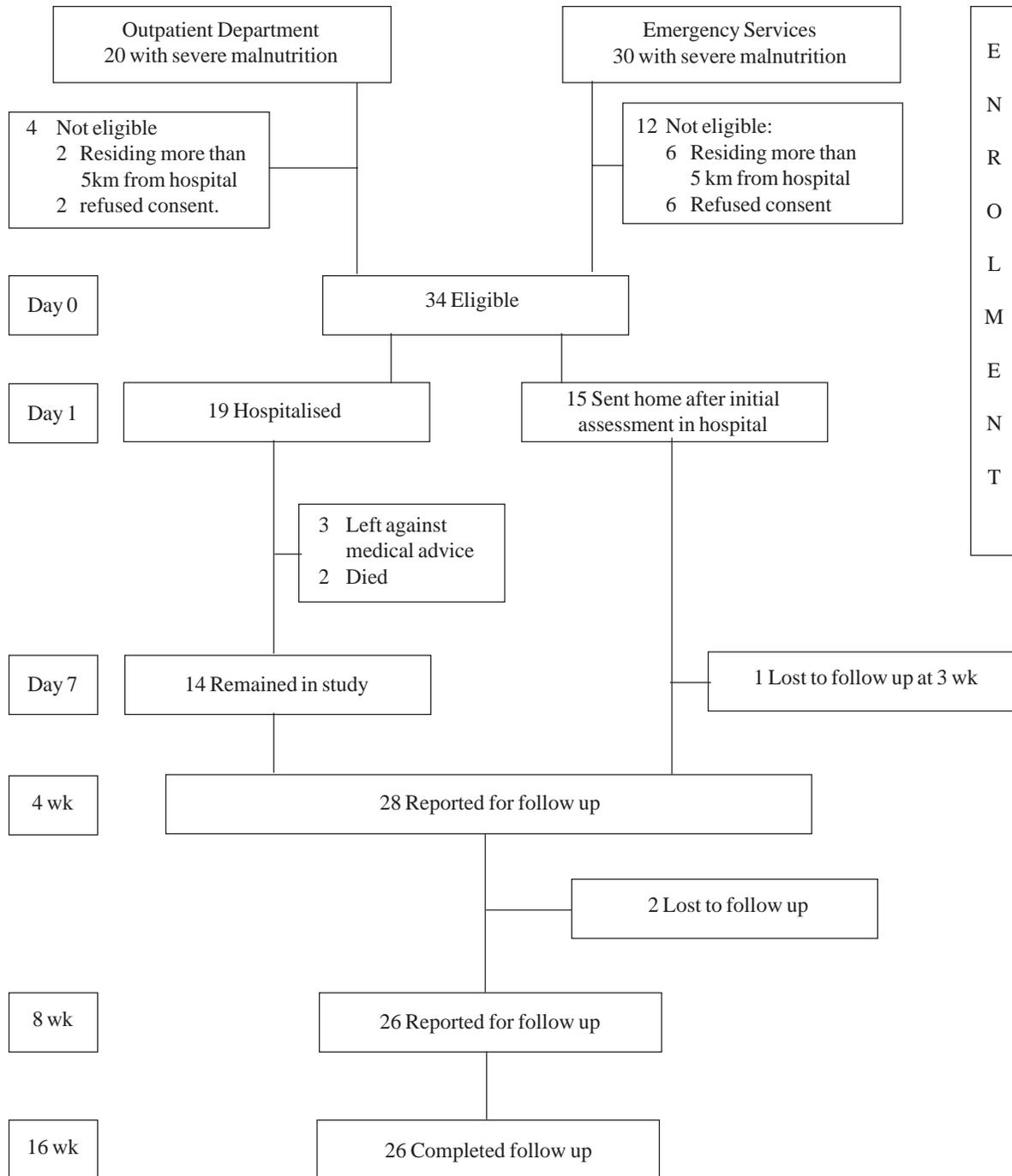
### **Follow-up**

Frequency of follow-up visits were: (i) 2 contacts/week separated by at least 48 hours in first two weeks, (ii) once a week for 3-8 weeks, (iii) and from 8 weeks till 16 weeks, every 4 weeks. At each visit, dietary intake was recorded by recall-method, and detailed general physical and systemic examination was done. Mother was recounselled about type, quantity and frequency of food to be given. Any medical problem identified during visits was treated. Measurement of weight, length, head circumference, chest-circumference and mid-arm circumference was done at each visit. Investigations of all children were repeated at 4 weeks and at 16 weeks. The child was stated to have recovered completely if child achieved weight for length >80% at the end of 16 weeks. The child was stated to be partially recovered if the weight for length remained between 70% to 80% after 16 weeks of follow-up. A weight gain of >5g/kg/d was defined as an acceptable weight gain(1,2).

*Statistical analysis:* Descriptive analysis was carried out for most outcomes. Calorie intake, protein intake, weight and weight-for-height percent at 16 weeks were compared from baseline by paired *t* test. Data were analyzed using SPSS 12.0 software.

### **RESULTS**

34 severely malnourished children formed the subjects for present study (**Fig 1**). 41% children were less than 1 year of age, and 62% were females. Of 34 children, only 3 (8.8%) were completely immunized, only 5 (14%) children were exclusively breastfed for 6 months, and around two-third were bottle-fed. Nearly half (53%) had access to safe water supply and two-thirds (64%) had facility of separate toilet. Anthropometry of study subjects at presentation (*n*=34) is given in **Table I**. At first assessment, all children were anemic (Hb <11 g/dL). Thrombocytopenia (platelet count <150 × 10<sup>9</sup>/L) was observed in 6 (17.6%), hypoglycemia in 3 (8.9%), hyponatremia (Na<sup>+</sup> <130 mEq/L) in 4 (11.8%), hypernatremia (Na<sup>+</sup> >150 mEq/L) in 7 (21%), hypokalemia (K<sup>+</sup> <3.5 mEq/L) in 11 (32%), and hyperkalemia in (K<sup>+</sup> >5.5 mEq/L) 4 (11.8%)



**FIG. 1** Study flow chart.

children. Blood culture at presentation was positive in 7 (21%) children, urine culture was positive in 2 (5.9%), and stool demonstrated ova/cyst in 3 (8.8%) children. At 16 weeks, hematological, biochemical and microbiological profile was normal in all children.

Of 34 patients, 19 were admitted and treated in hospital. The mean ( $\pm$ SD) duration of hospitalization was 5.4 ( $\pm$ 2.2) days (median: 6 d; IQR: 4-7 d). Two children had edema during presentation, which settled on day 5 and 8 of admission. Two children died during hospital stay and another 3 children left

**TABLE I** BASELINE CHARACTERISTICS AND ANTHROPOMETRY OF STUDY SUBJECTS AT PRESENTATION

Characteristics	Admitted (n=19) mean (SD)	Directly Recruited (n=15) mean (SD)	Total (n=34) mean (SD)
Age (mo)	18.7 (10.0)	21.9 (14.4)	20.1 (12.1)
Males (%)	8 (42.1)	5 (33.3)	13 (38.2)
Weight (kg)	5.2 (1.3)	5.1 (1.6)	5.1 (1.4)
Weight for age (%)	47.5 (7.2)	48.1 (7.5)	47.9 (7.4)
Length (cm)	70.3 (7.4)	69 (9.9)	69.7 (8.4)
Length for age (%)	85.9 (6.2)	85.1 (5.9)	85.5 (6.1)
Weight for length (%)	62.5 (6.4)	65 (3.8)	63.7 (5.5)
Chest circumference (cm)	39.7 (3.7)	40.1 (4.1)	39.8 (3.8)
Mid-arm circumference (cm)	9.3 (1.2)	9.3 (0.9)	9.3 (1)

against medical advice. Thus fourteen children thus were finally discharged. Fifteen children were not hospitalized and sent home after initial assessment in hospital. These 29 children were eligible for home based rehabilitation. Of these, 26 children completed the follow up (**Fig.1**).

**Dietary intake :** The mean calorie and protein intake of study subjects who completed 16 weeks follow-up (N=26) at enrolment, day 3, day 7, 3 week, 6 week, 12 week and 16 week is shown in **Table II**. During the home based management phase, the mean ( $\pm$ SD) calorie intake increased from 100 ( $\pm$ 5) kcal/kg/d at enrolment to 243 ( $\pm$ 13) kcal/kg/d at 16 weeks ( $P<0.001$ ). Similarly, protein intake increased from 1.1 ( $\pm$ 0.3) g/kg/d to 4.8 ( $\pm$ 0.3) g/kg/d ( $P<0.001$ ).

**Anthropometry:** The mean ( $\pm$ SD) weight (kg) and weight for length (%) of study subjects at enrolment,

day 3, day 7, week 3, week 6, week 12 and week 16 is also shown in **Table II**. Weight gain during hospital stay was 9.0 ( $\pm$ 5.3) g/kg/d, while during home-based rehabilitation, average weight gain was 3.2 ( $\pm$ 1.5) g/kg/d. During home based rehabilitation, only 3 (11.5%) children achieved weight gain of more than 5 g/kg/d, while 26 (89.5%) children had weight gain of less than 5 g/kg/d.

The recovery was complete in 13 (44.8%) children. Of these, 2 children achieved  $\geq$ 80% weight for length at 6 weeks, 1 child at 7 weeks, 1 child at 8 weeks, 3 at 12 weeks and 6 children at 16 weeks follow-up. The mean ( $\pm$ SD) weight for length in these children at 16 weeks was 85% ( $\pm$ 3.9%). The mean ( $\pm$ SD) time needed to achieve 80% weight for length was 12 ( $\pm$ 3) weeks. Of those who recovered completely, 4 children went up to achieve  $>$ 90% of weight for length by the end of 16 week follow-up. **Partial recovery** occurred in 15/29 (51.7%) children

**TABLE II** CHANGES IN CALORIES AND PROTEIN INTAKE, WEIGHT, AND WEIGHT FOR LENGTH DURING FOLLOW UP (N=26)

Days of enrolment	Calories (kcal/kg/day)	Protein (g/kg/day)	Weight (kg)	Weight for height/length
Baseline	100.0 (5.0)	1.1 (0.3)	4.97 (1.4)	62.9 (6.0)
3 days	117.3 (4.5)	1.3 (0.2)	5.07 (1.4)	64.2 (5.8)
7 days	140.0 (13.2)	1.6 (0.2)	5.20 (1.4)	65.6 (5.6)
3 week	161.5 (17.8)	2.4 (0.3)	5.45 (1.4)	68.7 (5.6)
6 weeks	184.6 (18.1)	3.3 (0.2)	5.79 (1.4)	72.7 (5.7)
12 weeks	225.2 (20.6)	4.4 (0.4)	6.36 (1.4)	77.1 (4.8)
16 weeks	242.8* (13.1)	4.8* (0.3)	6.70* (1.5)	80.3* (5.7)

\*Significantly ( $P<0.001$ ) higher than baseline values by paired t test. Values represent mean (SD).

who achieved weight for length of between 70-80%. One child (3.5%) continued to have severe malnutrition even after 16 weeks. **Fig. 2** compares the number of children with % weight for length (<70%, 70-80%, >80%) at 4, 8, 12, and 16 weeks of follow up.

Three children were lost to follow-up (1 at 3 weeks, and 2 at 4 weeks). However, all these 3 children had crossed the 70% weight for length barrier before opting out of the study, and thus were classified as having partial recovery.

**DISCUSSION**

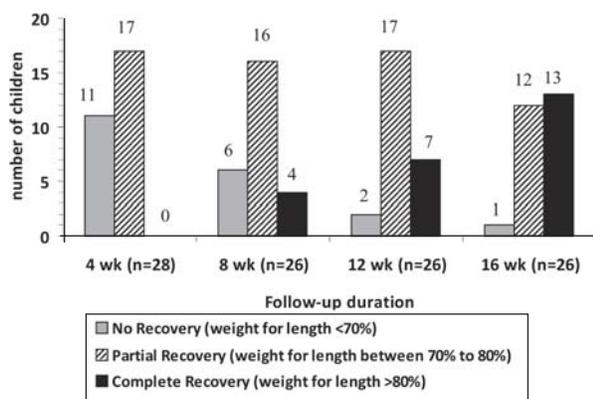
The present study assessed the efficacy of home-based rehabilitation after initial assessment or following discharge from a hospital. We aimed to assess the outcome of home-based management using home-based foods in real life situation as no external monetary support or food was provided during this phase. No home visits were done. Using this strategy, majority of children failed to achieve weight gain of more than 5 g/kg/d; the standard criteria for effectiveness as defined by WHO(1). Also, less than half of children achieved >80% weight for length after follow-up of 16 weeks. The mean weight gain during home based rehabilitation was also less than weight gain during hospital stay.

The mean weight gain in our study (3.2 g/kg/d) was less than that by Gaboulaud, *et al.* (3) (9.7 g/kg/d), Ashraf, *et al.* (4) (6 g/kg/d), and Khanum, *et al.*(7) (4 g/kg/d). Also, the mean duration for achieving weight for length >80% was more in our study in

comparison to earlier studies from Bangladesh(4,7). The reasons for early recovery and more weight gain in former studies could be the involvement of salaried health care workers from community in giving proper training and advice. These workers had regular home visits, whereas in our study, home visits during follow-up were not done. Non-availability of ready to use therapeutic food (RUTF) and no external support to the families in form of food or money could be a possible reason of inadequate weight gain in our study. In our patients, weight gain was inadequate during follow-up in most, despite history of consuming adequate calories and proteins from home-based foods. This could be attributed to the poor reliability of dietary recall method as well as lack of a mechanism of monitoring their food preparation and techniques of feeding in our study. It is possible that the foods were not sufficiently energy dense, and the adequate numbers of feedings were not provided due to social constraints. Linear programming analysis of diets from Africa and Bangladesh has suggested that several home prepared diets for severely malnourished children do not achieve the nutrient density required for successful rehabilitation(14). Persistent infections were unlikely as we could not find any such evidence during follow up, and no child on home-based management died.

In a recent review by Ashworth(15), thirty-three studies of community-based rehabilitation were examined and summarized for the period of 1980-2005; eleven (33%) programs were considered effective. The two indicators of effectiveness that were set for this review were mortality <5% and weight gain ≥5 g/kg/day. Of the sub-sample of programs reported since 1995, 8 of 13 (62%) were effective. Most effective programs utilized RUTF or provided mechanisms for procuring/preparing energy dense foods. None of the programs operating within routine health systems without external assistance was effective.

A potential limitation of our study was that we did not evaluate the outcomes in a comparative manner, and thus the efficacy of the management was not directly compared with hospital care or any other effective approach. The sample size was also small to do any subgroup analysis. The strength of



**Fig.2** Number of children achieving complete or partial recovery during follow-up.

**WHAT IS ALREADY KNOWN?**

- Home management of uncomplicated severe malnutrition is a feasible option. Ready-to-use therapeutic food (RUTF) is an effective option in controlled settings.

**WHAT THIS STUDY ADDS?**

- Home based management using home prepared food and hospital based follow up is associated with sub-optimal and slower recovery.

our study was that it was done in realistic scenario without actually providing the food or financial support. This has important operational implications as most facilities managing severely malnourished children in India currently do not provide therapeutic nutrition, and only rely on nutritional advice/counseling.

We conclude that home-based management (directly or following early discharge from hospital) using home prepared food and hospital based follow up is associated with sub-optimal and slow recovery. There should be effective monitoring system and mechanism for providing energy dense foods/ RUTF to strengthen the community based management of severely malnourished children. Effectiveness of community-based rehabilitation may require careful planning and additional resources, including nutrition educators. Provision of RUTF might help in strengthening the implementation process but its cost, logistics of procurement and distribution, sustainability, and consequences of withdrawal would need to be carefully considered. Future research should include comparative evaluation of different strategies in a controlled manner and operational research to strengthen the existing home and hospital based approaches.

*Contributors:* PG and DS conceptualized and supervised the study. DP and KS collected the data and followed up the patients. DP and KS prepared the initial draft of manuscript which was revised by PG and DS. All authors approved the final manuscript.

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*Competing interests:* None stated.

**REFERENCES**

1. Ashworth A, Khanum S, Jackson A, Schofield C.

Guidelines for the Inpatient Treatment of Severely Malnourished Children. Geneva: World Health Organization; 2003.

2. Bhatnagar S, Lodha R, Choudhary P, Sachdev HPS, Shah N, Narayan S, *et al.* IAP Guidelines 2006 on Hospital based Management of Severely Malnourished Children (adapted from WHO guidelines). *Indian Pediatr* 2007; 44: 443- 461.
3. Gabouland V, Dan-Bouzoua N, Brasher G, Fedida G, Gergonne B, Brown V. Could nutritional rehabilitation at home complement or replace centre-based therapeutic feeding programmes for severe malnutrition? *J Trop Pediatr* 2007; 53: 49-51.
4. Ashraf H, Ahmed T, Hossain MI, Alam NH, Mahmud R, Kamal SM, *et al.* Day-care management of children with severe malnutrition in an urban health clinic in Dhaka, Bangladesh. *J Trop Pediatr* 2007; 53: 171-178.
5. Orach C, Kolsteren P. Outpatient care of severely malnourished children. *Lancet* 2002; 360: 1800-1801.
6. Ashworth A, Khanum S. Cost effective treatment of severely malnourished children: what is best approach? *Health Policy Plan* 1997; 12: 115-121.
7. Khanum S, Ashworth A, Hultly SR. Controlled trial of three approaches to the treatment of severe malnutrition. *Lancet* 1994; 344: 1728-1732.
8. Bredow M, Jackson A. Community-based, effective, low cost approach to the treatment of severe malnutrition in rural Jamaica. *Arch Dis Child* 1994; 71: 297-303.
9. Community-Based Management Of Severe Acute Malnutrition: A Joint Statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children's Fund. World Health Organization; 2007.

10. de Onis M, Garza C, Onyango AW, Martorell R. WHO Child Growth Standards. *Acta Paediatr* 2006; 95 (Suppl 450): 1-104.
  11. Mishra D, Singh HP. Kuppaswamy's socio-economic status scale: A revision. *Indian J Pediatr* 2003; 70: 273-274.
  12. Physical Status: The Use and Interpretation of Anthropometry- Report of a WHO Expert Committee. WHO Technical Report Series; 854. Geneva: World Health Organization; 1995.
  13. Gupta P, Shah D, Sachdev HPS, Kapil U. National Workshop on Development of Guidelines for Effective Home Based Care and Treatment of Children Suffering from Severe Acute Malnutrition. *Indian Pediatr* 2006; 43: 131-139.
  14. Ferguson EL, Briand A, Darmon N. Can optimal combinations of local foods achieve the nutrient density of the F100 catch-up diet for severe malnutrition? *J Pediatr Gastroenterol Nutr* 2008; 46: 447-452.
  15. Ashworth A. Efficacy and effectiveness of community-based treatment of severe malnutrition. *Food Nutr Bull* 2006; 27(3 Suppl): S24-S48.
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