ORIGINAL ARTICLE

A RANDOMIZED CONTROLLED FACILITY BASED TRIAL TO ASSESS THE IMPACT OF INDIGENOUSLY PREPARED READY TO USE THERAPEUTIC FOOD (RUTF) FOR CHILDREN WITH SEVERE ACUTE MALNUTRITION IN INDIA

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Abstract

Aim: Ready to Use Therapeutic Food (RUTF) is a standard of care for children with severe acute malnutrition (SAM) worldwide. There is limited data on its use in India, therefore we conducted this study to determine the efficacy of indigenously prepared RUTF also termed as Medical Nutrition Therapy (MNT).

Methods and Materials: Three hundred and twenty one children between 6 months – 5 years of age suffering from SAM were enrolled in the study of which 242 children who completed two weeks of intervention were analyzed. The study was a facility based open randomized controlled trial. Subjects were divided into two groups: study group (received MNT) and control group [received Standard Nutrition Therapy (SNT)] for eight weeks. Thereafter each patient was followed up for four months. Primary outcome variables were rate of weight gain in gm/kg/day, proportion of children achieving target weight and change in nutritional status.

Results: Of 242 patients, 138 completed eight weeks of intervention. At the end of two and four weeks, the rate of weight gain was significantly greater in MNT group i.e. 5.63 g/kg/day at 2 weeks (n=129) and 4.72 g/kg/day at 4 weeks (n=44) than in the SNT group i.e. 3.43 g/kg/day at 2 weeks (n=113) and 2.82 g/kg/day at 4 weeks (n=46) ($p<0.05$). Target weight was achieved in 61.2 % of children on MNT group as compared to 47.7% in SNT group. At 8 weeks, 82.8% of children on MNT moved out of SAM status compared to 64.4% of children on SNT ($p<0.005$).

Conclusion: MNT is significantly superior to SNT in promoting weight gain in SAM children. Indigenously prepared MNT is useful to treat SAM in children.

Keywords: Severe acute malnutrition, RUTF, MNT

Introduction

Under-nutrition is a major public health challenge in India. Over 33% of undernourished children globally are present in India. (1) According to National Family Health Survey -3, 6.4 % of children below five years of age have severe acute malnutrition (SAM) and 19.8 % have moderate acute malnutrition (MAM). This translates to about 8.1 million children with SAM. The prevalence of malnutrition, ranges from as high as 55 % in Madhya Pradesh to as low as 27 % in Kerala. (2) Conventionally it was thought that malnutrition is due to either protein or energy deficiency. However, recent research reveals that wasting and stunting are primarily due to deficiency of type II nutrients from very poor quality diets leading to loss of appetite, growth cessation, reductive adaptation to environmental stress, oxidative stress or infection. (3) World Health Organization (WHO) and United Nations Children's Fund (UNICEF) proposed diagnostic criteria for severe acute malnutrition in children aged 6 to 60 months, which included any one of the following criteria: (i) weight for height below or equal to -3 standard deviation (SD or Z scores) of the median WHO growth reference (2006); (ii) presence of bipedal edema and (iii) mid upper arm circumference (MUAC) below or equal to 115 mm. (4) Guidelines provided by WHO for management of children with severe acute malnutrition (SAM) suggests two formula diets, F75 and F100 during initial resuscitation and stabilization phase respectively. (5) Once the appetite has returned, for rapid gain of weight, these children require structured nutrition therapy which is ready-to-use therapeutic foods (RUTF). The evidence of these newer formula diets is lacking in Indian scenario hence the study was undertaken. RUTF is not available in India due to government restrictions. To address this limitation, we decided to devise a locally produced, lipid based, nutrient dense, protein rich, micronutrient fortified RUTF termed Medical Nutrition Therapy (MNT) and test its efficacy in children with SAM as compared to standard nutrition therapy (SNT).

Methods & Materials

This prospective, randomized controlled trial comparing the efficacy of MNT with SNT in children diagnosed as SAM (4) was conducted from March 2011 to June 2013. The trial was registered at Clinical Trials Registry-India [CTRI/2014/04/004523] and approved by the Staff Research Society Ethics committee of the LTM Medical College and LTM General Hospital. The study was conducted at the Nutrition Rehabilitation, Research and Training Centre (NRRTC) situated at Urban Health Centre, Dharavi associated with Lokmanya Tilak Municipal Medical College and General Hospital, a tertiary care hospital situated in Mumbai, India. Most of the patients coming to the center are from the lower socio-economic status due to close proximity of the hospital to Dharavi; one of the biggest Asian slums. MNT was prepared indigenously in the production unit. The equipment used for the production include a motorized grinder, planetary mixer, a filling, sealing and stamping machine. The ingredients used for preparing MNT were peanut paste (25%), skimmed milk powder (24%), powdered sugar (28%), soya bean oil (21%), and micronutrients (2%) which meet the WHO recommendations on RUTF composition and nutritive values. (6) The mixture per 100 grams provided 540 kcal and 16 gm of proteins. Table 1 shows the detailed nutrient composition of MNT. SNT consisted of a high protein and high calorie diet comprising of milk with sugar and oil, boiled eggs, banana, rice-green gram porridge with vegetables, jaggery (a form of non-refined sugar) and cooking oil. The diet provided 175 kcal /kg /day with a total nutritional value of 100 kcal with a protein content of 3 gm per 100 gm.

A total of 321 children with SAM were enrolled after an informed written consent by the caretakers. Patients with underlying chronic illness, those unable to take oral feeds, those already on nutritional supplements and children who failed appetite test for three consecutive

days were excluded from the study. The child was considered to have passed the appetite test if she/he was able to consume one-eighth of the recommended amount of nutritional therapy. (7,8) Initially children were treated with F75 equivalent diet composed of undiluted cow's milk, puffed rice powder, sugar, oil and micronutrient premix during the resuscitation phase for 2 days. They were subsequently fed F100 equivalent diet composed of undiluted cow's milk, sugar, oil and micronutrient premix during the stabilization phase till the child passed the appetite test. After passing the appetite test, children were randomized into the intervention and the control groups using a computer generated sequence to MNT or SNT diet respectively. All children were hospitalized for a period of two weeks or longer based on the complications. The children in the intervention group were administered MNT in a dose of 175 kcal/kg of the present weight for a period of eight weeks. All caregivers were counseled about the nutritional requirements along with good feeding practices and shifted to home based diet after eight weeks of either SNT or MNT. The children were monitored daily during hospitalization, weekly till 8 weeks of intervention when staying at home and monthly for the next four months. Anthropometric parameters (weight, length/ height, and mid-arm circumference) were recorded. The proportion of MNT intake was also monitored. The target weight was defined as a 15% increase in weight compared with the baseline.

Statistical Analysis

Data on baseline, day 14, day 28, day 42, day 56, and day 180 were used for the purpose of analysis. Data were analyzed using Graph pad 6 version, USA. Rate of gain in weight (gm/kg) was calculated by dividing gain in weight by basal weight. Descriptive statistics were given as Mean, Standard deviation (SD), Median and number of observations (n). Non-parametric test (2way ANOVA) was applied to compare mean weight gain and mean rate of gain in weight at all time points. Wilcoxon Signed Rank test was applied to rate of gain in weight values between two time points. All tests were two tailed. Level of significance was taken as $p<0.05$.

Table 1: Nutrient composition of Medical Nutrition Therapy (MNT) as per WHO recommendation.

Nutrient per 100 gm of MNT	
Energy	560 kcal
Protein	14.6 g
Carbohydrate	49 g
Fat	34.5 g
Sodium	135 mg
Potassium	1220 mg
Calcium	578 mg
Phosphorous	288 mg
Magnesium	85 mg
Iron	12 mg
Zinc	12 mg
Copper	1.5 mg
Selenium	20 mcg
Iodine	80 mcg
Vitamin A	1.1 mg
Vitamin D	17.1 mcg
Vitamin E	20.6 mg
Vitamin K	21 mcg
Vitamin B1	0.6 mg
Vitamin B2	1.9 mg
Vitamin C	53 mg
Vitamin B6	0.6 mg
Vitamin B12	1.76 mcg
Vitamin B9	210 mcg
Vitamin B3	5.31 mg
Vitamin B5	3.1 mg
Vitamin B7	66 mcg

Note: MNT – Medical Nutritional Therapy

Results

Out of 321 children enrolled in the study, 242 children who completed two weeks of treatment were included in the analysis as shown in Figure 1. Detailed baseline demographic data in both the groups is depicted in Table 2. The mean weight in MNT group increased from 6.7 kg at baseline to 7.9 kg at 8 weeks and 8.9 kg at 6 months. The mean weight in SNT group increased from 6.8 kg at baseline to 7.3 kg at the 8 weeks and to 8.1 kg at 6 months. The rate of weight gain in the first 4 weeks was significantly higher in the MNT group compared to the SNT group, more so in the initial 14 days of treatment. The rate of weight gain decreased steadily over the next 4 weeks till 6 months. Inspite of the rate of weight gain being higher in the MNT group compared to SNT group, the difference was statistically insignificant after 4 weeks (Table 3). Time frame to achieve the target weight is depicted in Table 4. At end of 8 weeks, only 17.1% of children in MNT group had SAM and 40.7% of children had weight for height above -2 Z score (which was considered as normal) whereas 35.4% in SNT group still had SAM and 19.3% had weight for height above -2 Z score. At the end of 6 months, 15.1% of children had SAM and 57.6% had weight for height above -2 Z score in MNT group as against 33.3% children with SAM and 44.4% children who had weight for height above -2 Z score in SNT group. ($p<0.056$).

Figure 1: Flow diagram of patient recruitment in the study

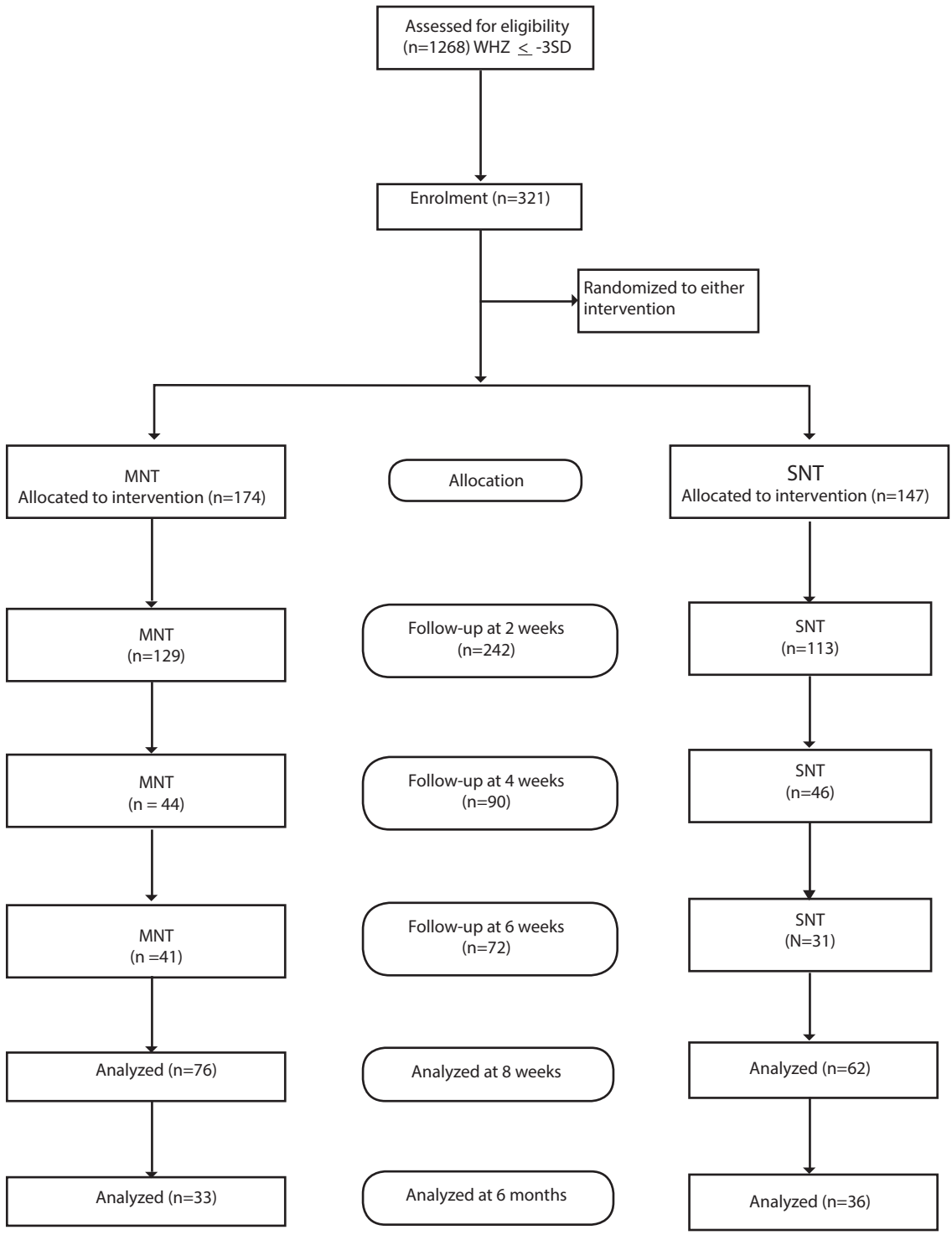

Figure (1) : Flow diagram of participant progress throughout the study.

Table 2: Baseline demographics of patients enrolled in the study

		MNT (%) (n=129)	SNT (%) (n=113)
Age	6-12 months	33 (25.6)	45 (39.8)
	1-3yrs	74 (57.4%)	54 (47.8%)
	3-5yrs	22 (17.1)	14 (12.4)
Sex	Male	69 (53.4)	54 (47.7)
	Female	60 (46.5)	59 (52.2)
Anthropometric measures	Weight (kg)	6.7 $\pm$ 1.8	6.8 $\pm$ 2.0
	Height (cms)	73.5 $\pm$ 10.2	75.4 $\pm$ 13.4
	MUAC (cms)	11.2 $\pm$ 1.2	11.6 $\pm$ 1.7
	Target weight (kg)	7.7 $\pm$ 2.1	8.5 $\pm$ 3.4

Note: MNT- Medical Nutrition Therapy, SNT- Standard Nutrition Therapy, MUAC- Mid-upper arm circumference

Table 3: Comparison of Mean weight and Rate of Weight gain in children on MNT and SNT

Time Frame	Mean weight (kg) in MNT group (n=129)	Mean weight (kg) in SNT group (n=113)	Rate of weight gain (gm/kg/day) in MNT group (n=129)	Rate of weight gain (gm/kg/day) in SNT (n=113)	P value
On Admission	6.7	6.76	-	-	-
2 weeks	7.22	7.07	5.63	3.43	<0.05
4 weeks	7.26	6.83	4.72	2.82	<0.05
6 weeks	7.67	7.18	4.22	2.98	>0.05
8 weeks	7.93	7.29	3.45	2.38	>0.05
6 months	8.92	8.05	1.75	1.67	>0.05

Note: MNT- Medical Nutrition Therapy, SNT- Standard Nutrition Therapy

Table 4: Time frame taken to achieve target weight

	Children on MNT who achieved target weight (n=129) (%)	Children on SNT who achieved target weight (n=113) (%)
Total	78 (61.2)	54 (47.7)
2 weeks	25 (32)	2 (3.7)
3 weeks	7 (8.9)	6 (11.1)
4 weeks	4 (5.1)	2 (3.7)
5 weeks	11 (14.1)	4 (7.4)
6 weeks	2 (2.5)	6 (11.1)
7 weeks	2 (2.5)	0
8 weeks	7 (8.9)	7 (12.9)
6 months	20 (25.6)	27 (30)

Note: MNT- Medical Nutrition Therapy, SNT- Standard Nutrition Therapy

Discussion

The overall mean rate of weight gain in our study was 4.5 gm/kg/d in MNT group during intervention. This is comparable to study done by Ciliberto (2.8 g/kg/d) (9), but lesser than observed by Diop et al (15.6 g/kg/d) (10), Manary et al (7.00 g/kg/d) (11) and Thakur et al (9.59 g/kg/d). (12) Catch up growth took place early in MNT as compared to SNT. Similar observations are seen in study done by Patel et al who also observed the weight gain of 9 gm/kg/day during hospital stay and 3.2 gm/kg/day during home based follow-up. (13) In MNT group, the target weight achievement was faster and in a larger proportion of children as compared to the SNT group. Recovery rate at the end of 6 months was 84.8% in MNT group which is comparable to 88.5% recovery rate as reported by Tarun et al. (14) Change in nutrition status reveals that MNT has early impact and rapid improvement in the nutritional status of children. The reason why MNT performed better than SNT could be that SAM children have a smaller stomach capacity, therefore they cannot consume larger volume of SNT that will be required to provide them the necessary calories. On the other hand, MNT being an energy dense food provides the equivalent calories in smaller volumes. Micronutrients present in MNT restore the physiological function and improve appetite. Probably, mother perceived MNT as a drug and hence was more vigilant and persistent in feeding it to the child. Compliance in both the groups was comparable and not satisfactory. Most of our parents belong to low-income group and most of them were staying far away from our hospital. Once the patients got better, the mothers were reluctant to get the child to the hospital after discharge. Limitation of our study was that incentive and compensation for loss of wages were not given. We did not have outreach workers for regular home visit.

Conclusion

We conclude that indigenously prepared MNT in a facility based followed by home based management is definitely superior in promoting rapid initial weight gain and maintaining the rate of weight gain. The target weight achievement was faster in MNT group. Standard nutrition therapy is associated with suboptimal and slow recovery. Hence MNT i.e. RUTF must be considered as a standard of care across India.

Acknowledgement

We like to thank the Dean of LTMG Hospital for providing us with the required infrastructure to conduct the study. A special thanks to Dr Maninder Sethia for the statistical analysis of the study.

Funding

The study was funded by Toddler Food Partners based at Minneapolis, USA.

Conflict of Interest

None

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DOI : 10.7199/ped.oncall.2016.61