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Ready to use therapeutic food (RUTF) for outpatient-based nutritional rehabilitation of severe acute malnutrition in children aged 6-59 months

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***Abstract*---**Background: Severe acute malnutrition (SAM) affects nearly 20 million preschool-age children. Malnutrition is a risk factor in approximately one third of deaths in children who are under 5 years of age worldwide. In-hospital rehabilitation of children with SAM is not always desirable or practical, and home-based care can offer a better solution. Ready-to-use therapeutic food (RUTF) is a widely used option for home-based rehabilitation in children without medical complications and with good appetite. Aim of the Study: To assess the effectiveness of standard RUTF (plumpy nut) in outpatient management of SAM in children aged 6-59 months without medical complications and with good appetite. Type of the study:Cohort, prospective interventional study.Patients & Methods: A cohort prospective interventional study was carried out among children ages 6-59 months with SAM who were referred to nutritional rehabilitation ward in two hospitals in Baghdad , a Central Teaching Hospital for Pediatrics in Al-kurkh district and Fatima Al-Zahraa hospital for Obstetrics & Pediatrics in Al- Russafa district in an attempt to evaluate the acceptability and effectiveness of standard RUTF in outpatient management . This was done by monitoring the weight and length or height of (111) patients with SAM biweekly depending on WHO growth standards; Weight-for-Length (W/L) or weight-for-height (W/H) Reference Card. Not responding patients were given recipes of

Iraqi locally homemade high energy-dense food were designed in nutrition research institute , MOH. Results: A Total number of patients in the study were (111) , 10 patients developed diarrhea after 2nd week of treatment and admitted for inpatient care .7 patients lost to follow up after 2nd visit so these 17 patients were excluded from statistical analysis. A total No. included in statistical analysis were 94 patients with about equal male / female ratio ; 48 (51%) /46 (49%) . The mean of mid upper arm circumference (MUAC) in 1st visit was 12.7±1.07 cm with only 17 cases (18.08%) were < 11.5 cm .The highest affected age group was 1-2 years in 43 (45.74%). The home state was owned in highest proportion of patients 63 (67 %) but sharing with larger family in 55 (58 %) and overcrowded home (<3 rooms) in 65 (69.2 %).The recovery rate was 66 (70.2 %) while 28 (29.8 %) were disliked the taste of plumpy nut so they shifted to Iraqi locally prepared , home made foods . Conclusion: Standard RUTF (plumpy nut) is effective in outpatient management of SAM in children aged 6-59 months without medical complications and with good appetite . Recommendations: Increase availability of plumpy nut in malnutrition wards in our hospitals and do the best to avoid running out of stock. Increase awareness among pediatricians about the guidelines of treatment of malnourished patients and increase No. of malnutrition wards in our hospitals in future. Try to find ways to increase palatability of plumpy nut among our patients.

***Keywords*---**severe acute malnutrition, ready uptake therapeutic food, locally homemade prepared food, mid upper arm circumference.

Introduction

A global acute malnutrition or global wasting is a major underlying cause of death and illness, affecting about 52 million (8%) children under five worldwide, with relatively more prevalence in low-income to middle-income countries. A staggering 3.1 million (45%) of young lives are lost each year due to child undernutrition, making it the single greatest threat to their survival[1]. Malnourished children have a high risk of death and illness that necessitate nutritional intervention. Inpatient treatment of severe acute malnutrition (SAM) can be costly and disruptive to the families vs home based outpatient treatment is preferred. With the development of ready-to-use therapeutic foods (RUTF) since 1996 based on the composition of F-100, the WHO-recommended diet treatment of severe acute malnutrition in children 6 – 59 months of age without medical complications and with good appetite is increasingly provided on an outpatient basis [2].

According to the Global Hunger Index 2021, which was adopted by the International Food Policy Research Institute, Somalia was the most affected by hunger and malnutrition, with an index of 50.8. Yemen followed with an index of 45.1[3]. In Iraq, the percentage of moderate and severe wasting is (2.5%) while severe wasting is only (0.8%).The highest rate in Al-Najef government (2.9%) followed by Kirkuk (1.8%) then Al-Anbar, Sulaimaniyah & Karbala (1.1%)[4]. Successful management of SAM in children aims to restore their metabolism

through correction of electrolyte imbalance, reversal of metabolic abnormalities, restoration of organ functions, and then provision of balanced nutrition for catch-up growth; it also treats underlying infections and other medical conditions[5].

Patients and Methods

A cohort prospective interventional study was carried out among children ages 6-59 months referred to nutritional rehabilitation unit in two hospitals in Baghdad , a Central Teaching Hospital for Pediatrics in Al-kurkh district and Fatima Al-Zahraa hospital for Obstetrics & Pediatrics in Al- Russafa district. A questionnaire was filled by well trained staff to obtain basic demographic information, including the child's age, sex, history of physical illness, onset of complementary food, previous admission and family social background. Weight was measured by using WHO electronic scale . Length or height was measured by using a standard wooden length board provided by UNICEF. Length was dependent in < 2years old while height measurement in children > 2 years old. The dependent charts in the study are WHO growth standards ;W/L or W/H Reference Cards to identify SAM (<-3 SD).

Inclusion criteria

All patients 6-59 mo. old with wt / Ht or length <-3 SD with no complications and passed appetite test successfully for standard RUTF (Plmpy nut) .

Exclusion Criteria

Children known to have chronic illness, including cardiac disease, congenital abnormalities, cerebral palsy, or cancer were excluded from the study. By far the most important criterion to decide if a patient should be sent to in- or out- patient management is the appetite Test. Appetite test is recommended by WHO was done by asking the mother to sit quietly for as long as it takes (usually 15 minutes up to one hour) .The child needs to be offered plenty of water to drink from a cup as he/she is taking the RUTF. The amount of plumpy nut to be offered for the patient according to the table No (1)[6].

Table 1
The amount of plumpy nut to be taken in appetite test [6]

Plumpy'nut	
Body weight (Kg)	Sachets
Less than 4 kg	1/8 to ¼
4 – 6.9	¼ to 1/3
7 – 9.9	1/3 to ½
10 – 14.9	½ to ¾
15 - 29	¾ to 1
Over 30 kg	>1

Assessment of the patient according to following observations in table (2).

Table 2
Appetite Test[7]

Appetite	Observation	Action
Good	Child takes the RUTF eagerly	Outpatient Therapeutic Programme (OTP)
Poor	Child takes RUTF with persistent encouragement	Child may continue in (OTP) but must be observed carefully for any weight loss or clinical deterioration
Refused	Child refuses RUTF even after persistent encouragement	Transfer to inpatient care

Plumpy Nut is a ready-to-use therapeutic food spread produced by Nutriset and presented in individual sachets. It is a paste of groundnut composed of vegetable fat, peanut butter, skimmed milk powder, lactoserum, maltodextrin, sugar, mineral and vitamin complex. It is specifically designed to treat acute malnutrition without complications. It is nutritionally equivalent to F-100 (therapeutic milk used for in-patient care in Phase 2). The typical composition (ingredient % of weight) of RUTF is whole milk powder 30%; sugar 28%; vegetable oil 15.4%; peanut paste 25%; and mineral vitamin mix 1.6%. One sachet has an energy value of 500Kcal , and 92 g in weight. RUTF is given at 170 kcal/kg per day.The calculated sachets were provided for 2 weeks [5] .

Table 3
The recommended daily intake of plumpy nut [5]

Weight (kg)	RUTF sachets (92 g)	
	Sachets/day	Sachets /week
3-3.4	11/4	8
3.5-4.9	1 1/2	10
5-6.9	2	15
7-9.9	3	20
>10	4	30

The care giver advised that RUTF should be taken 2 hours before or after a family meal and if possible during the night because many local foods contain anti-nutrients which can impair the absorption of the nutrients from the RUTF and reduce the appetite. As RUTF contains all the nutrients that are needed to recover in adequate amounts, other foods are not necessary for full recovery. However, the child often wishes to take food with the rest of the family; this is perfectly acceptable but the additional local foods should be nutrient-dense. The follow-up was done biweekly. A response is determined according to WHO guideline:

- Good weight gain: 10 g/kg/day or more.
- Moderate weight gain: 5 up to10 g/kg/day
- Poor weight gain: Less than 5 g/kg/day[8]

Weight gain was calculated by monitoring the weight and height or length and compare with previous reading. Recovery is defined when the patient reached a target wt. (-1 SD) WFL or WFH, WHO reference Cards [9]. Analysis of data was done by SPSS. Independent sample t test used to measure the means difference. Ethics approval was received from Ministry of Health (MOH) . Consent was obtained from all the caregivers or parents of the participating children before recruitment into the study.

Results

A Total number of patients in the study were (111) , 10 patients developed diarrhea after 2nd week of treatment and admitted for inpatient care .7 patients lost to follow up after 2nd visit so these 17 patients were excluded from statistical analysis. A total No. included in statistical analysis were 94 patients with about equal sex ratio ; 48 male (51%) and 46 female (49%) . The mean of mid upper arm circumference (MUAC) in 1st visit was 12.7±1.07 cm with only 17 cases (18.08%) were < 11.5 cm .The highest affected age group was 1-2 years in 43 (45.74%) followed by > 2 years 31 (35.1 %) and the least age group was 6-12 months 18 cases (19.1%). Most of the cases 40 (42.6%) were weaning from breast & bottle feeding and they depend on foods as a primary source of energy while only 10 cases (10.6%) were breast fed in comparison with bottle feeding constituting 36 (38.3%).Start of complementary feeding was mostly > 6 months of age in 57 (60.6%) . Ranking of patients among other family members was 4th or 5th in 58 (61.7%) . Previous admissions to hospital were twice in 33 (35.1%) , mostly because of AGE but the higher percentage 61 (64.9%) had no admission and referred only for management of SAM . The care giver was the mother in the majority of the patients 72 (76.6%). In regard to mother's criteria & housing , a relatively higher percentage 49 (52.1%) were >25 years old with primary school as level of education and the majority 88 (93.6%) were housewives .The monthly income in most families was <500000 IQ dinnar in 69 (73.4%) . The source of drinking water was filtered in the majority of families 85 (90.4%).The home state was owned in highest proportion of patients 63 (67 %) but sharing with larger family in 55 (58.5%) and overcrowded home (<3 rooms) in 65 (69.2 %).

The cases were distributed throughout whole areas in Baghdad but mostly in Al-Saader city and surroundings 35 (37.2 %) in Al-Russafa district while Abu-Grabe in 8 (8.5 %) in Al Kurkh district. The recovery rate was 66 (70.2 %) while 28 (29.8 %) were disliked the taste of plumpy nut so they shifted to Iraqi locally prepared , home made foods .Although they were not the aim of the study but ethically they were followed up in whom the recovery rate was 17 patients (60.7%) by reaching a target weight within 6-8 weeks of treatment .

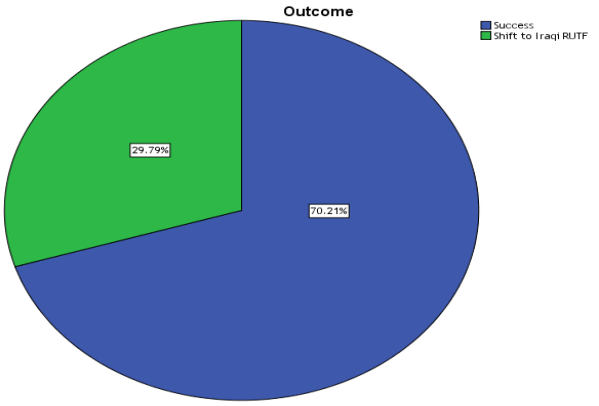

Figure 1. Patients outcome at the end of study

In regard to sex and end relationship, the results showed that the males were higher in recovery than females 35(53.1 %) vs 31 (46.9 %).

Table 4
Sex and Outcome relationship

			End		Total
			Success	Shift to Iraqi RUTF	
Sex	male	Count	35	13	48
		% within Sex	72.9%	27.1%	100.0%
	female	Count	31	15	46
		% within Sex	67.4%	32.6%	100.0%
Total		Count	66	28	94
		% within Sex	70.2%	29.8%	100.0%

In regard to age and end relationship, a higher rate 31cases (46.9 %) in recovery group was 1-2 years age group. In those who shifted to Iraqi home made locally prepared food, the least age group was 6-12 months 3 cases (10.7%).

Table 5
Age and Outcome Relationship

			End		Total
			Success	Shift to Iraqi RUTF	
Age	6mo- 12 mo	Count	15	3	18
		% within Age	83.3%	16.7%	100.0%
	1-2yr	Count	31	12	43
		% within Age	72.1%	27.9%	100.0%
	>2yr	Count	20	13	33

Total	% within Age	60.6%	39.4%	100.0%
	Count	66	28	94
	% within Age	70.2%	29.8%	100.0%

The mean weight & length or height on admission was (8.1±2.1) (60±12.2) respectively. The mean target weight was (5.4±2.6). The overall mean weight gain in the study was 6.45±4 kg. The weight gain was <5 g/kg/day in a higher rate 28 (42.5%); 5-10 g/kg/day in 22 (33.3%) and >10 g/kg/day in 16 (24.2%). The mean duration of treatment was 5.6±3.2 weeks.

Table 6
Response to treatment

Poor Response	Moderate response	Good response
< 5g/kg/day	5-10 g/kg/day	>10 g/kg/day
28 (42.5%)	22 (33.3%)	16 (24.2%)

Regarding relationship of overcrowding and weight gain . There were 46 patients (69.7%) who lived in overcrowded house (<3 rooms) showed less weight gain 5.97±4.25 g/kg/d than those who lived (>3 rooms) in 20 patients (30.3%) 7.35±3.60 g/kg/d .

Table 7
Relationship of crowding with weight gain

	N	Wt gain g/kg/d	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
<3	46	5.9776	4.25005	.62664	4.7155	7.2397	.00	24.80
>3	20	7.3507	3.60982	.80718	5.6612	9.0401	2.10	13.50
Total	66	6.4550	4.08861	.49950	5.4577	7.4523	.00	24.80

Discussion

SAM remains a major killer of children under five years of age. Until recently, treatment has been restricted to facility-based approaches, greatly limiting its coverage and impact. New evidence suggests, however, that large numbers of children with SAM can be treated in their communities without being admitted to a health facility or a therapeutic feeding centre [10].Since 2007, WHO has recommended (RUTF) for home-based management of uncomplicated SAM and the community-based management of acute malnutrition has become the standard of care for the management of (SAM) [10]. Young children are particularly susceptible to malnutrition if complementary foods are of low nutrient density and have low bioavailability of micronutrients or if they are introduced too early or too late, or are contaminated [9].This was in compatible with the results revealed that a higher rate of affected age group was 1-2 years old (45.74%) which is a time of feeding of dense nutrient foods that the infant should be fed .Instead ,they either depend mostly on breast or bottle feeding or improperly fed unhealthy foods. A clue to that the most resulted cases were weaning (42.6%) & bottle fed (38.3%).

The results shows that the ranking of patient among other family members was 4th or 5th in (61.7%) mostly cared by the mother in (76.6%) . The majority of mothers were housewives (93.6%) with primary school graduations (52.1%) .All of these lead to conclusion that illiteracy and no enough time spent by the mother for the care of the child leading to under nutrition and SAM. The interpretation of socioeconomic conditions showed a significant relationship between SAM and low monthly income (73.4%) with p value (0.089) .The home status was owned in (67 %) but sharing with larger family in 55 (58.5%) and overcrowded home (<3 rooms) in 65 (69.2 %) with significant p value (0.042) means that low socioeconomic status and overcrowding might significantly contribute to the development of SAM. This is approved by finding that Al-Saader city which is the most overcrowded area in Baghdad was the most distinct area of distribution (37.2 %).

The recovery rate was 66 patients (70.2 %) .This was in agree with Potani I etal [11] (77.8%) but lower than Irena AH etal [12](81.9%), and Bahwere P etal [13](90.3%) in 24-59 months old & (75.1%) in 6-23months old. The low palatability of plumpy nut might explain the low recovery rate. There was a low acceptability of taste of plumpy nut in 28 patients (29.8 %) which is higher than Potani I etal [11] (4.6%) , Irena AH etal [12] study (1.2%), Borg B etal[14] study in combodia , Nga TT etal [15] (16.2%) study in Vietnam , Sigh S etal[16] study among Cambodian children and Bahwere P etal [13](13.3%) . Iraq, as the other countries in the world, tried to find substitutes of standard RUTF in form of four recipes from local ingredients, compatible with specific nutritional compositions of standard RUTF which are more acceptable by our children. These recipes were so effective in those patients 28 (29.8 %) with low acceptability of plumpy nut in whom the recovery rate was 17 patients (60.7%) by reaching a target weight within 6-8 weeks of treatment .This was in consistent with another study[17] done in 2018 in Iraq to assess the effectiveness of these recipes which revealed (86.8%) recovery rate.

The mean of MUAC was (12.7±1.07) cm, same as in Hossain M etal [18] study. There was a significant relationship between inpatient care (10) patients who are not included in statistical analysis and low MUAC (<11.5 cm) with P value (0.02) .This is in consistent with WHO guideline that revealed Children with a MUAC less than 115 mm have a highly elevated risk of morbidity and death compared to those who are above[19]. A response to treatment depends on WHO recommendations of weight gain which include <5g/kg/day considered poor response, 5-10 g/kg/day considered moderate response and >10 g/kg/day considered good response. However the overall mean weight gain was 6.45±4 kg g/kg/day which is considered moderate response in consistent with Hossain M etal study[18] (5.2 ± 4.6) but in contrast to other studies e.g Irena AH etal [12] (3.4), Bahwere P etal[13] (1.2), Sigh S etal[16] (1.06) studies . There was a poor response (<5g/kg/day)in (42.5%) of patients .This might be a result of low acceptability of plumpy nut by Iraqi children. The mean duration of treatment was 5.6±3.2 weeks . This is in consistent with WHO manual of management of SAM which suggest a 6 weeks period to catch up growth .The same conclusion reached by Sigh S etal[16] (56 days) , Irena AH etal [12] (35 days) , Hossain M etal [18] (39±30days) .There was a significant relationship between MUAC and duration of treatment with P value 0.000.

Conclusion

Standard RUTF (plumpy nut) is effective in outpatient management of SAM in children aged 6-59 months without medical complications and with good appetite. A locally homemade recipes which are recommended by nutrition research institute, MOH as effective as standard RUTF in management of uncomplicated SAM.

Recommendations

Increase availability of plumpy nut in malnutrition wards in our hospitals and do the best to avoid running out of stock. Increase awareness among pediatricians about the guidelines of treatment of malnourished patients and increase No. of malnutrition wards in our hospitals in future.Try to find ways to increase palatability of plumpy nut among our patients.

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