Child eating BP100 in Freetown TFC.

Stephanie Laquiere (ACF), Sierra Leone, 2001

Clinical Trial of BP100 vs F100 Milk for Rehabilitation of Severe Malnutrition

By Carlos Navarro-Colorado and Stéphanie Laquière

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We want to acknowledge ACF field staff in Sierra Leone for their support and effective work.

This article describes the main findings of a clinical trial by ACF in Sierra Leone, which compares the use of solid RUTF (BP100) with the standard F100 treatment, during the rehabilitation phase of a TFC.

Different modalities of home-based treatment of severe malnutrition are currently being developed in the field of nutrition in emergencies. A cornerstone of these new strategies is the use of a Ready to Use Therapeutic Food (RUTF), based on the specifications of F100. Since these RUTFs do not contain water, they are not liable to bacterial contamination. They can be stored and consumed at home without previous preparation.

Two commercially marketed RUTFs are currently being produced and used in the field, a peanut paste-based product (Plumpy'nut[1]) and a solid biscuit (BP100[2]) (see box 1). Several studies have looked at the use of peanut paste RUTF for the recovery of severe malnutrition in therapeutic feeding centres (TFCs) and in home-based programmes[3,4]. There is less information available on the use of solid RUTF in TFCs or at the community level. This study was designed to provide information on the use of solid RUTF in the recovery of severe malnutrition in children.

The specific objectives of this study were to compare the energy intakes of solid RUTF and F100, as well as water intakes, in children during the recovery phase of treatment of severe malnutrition. We also present a comparison of the weight gain of children on a diet containing solid RUTF and F100, compared with the standard diet of F100 alone.

Methods

The study was implemented in a TFC run by Action Contre la Faim in Freetown, Sierra Leone, between April and June 2001. The population being assisted in the TFC were displaced and resident people. All patients were of low socio-economic status and most were displaced by the war. The care-taker of each child was asked for consent to participate. None refused. The study was approved by Sierra Leone's Ministry of Public Health and Action Contre la Faim's Scientific Committee.

All non-breastfed children, aged between 12 and 59 months and approaching the end of transition phase of standard treatment (see box 2), were eligible for the study. On the second and last day of transition phase, the child was assessed for inclusion by a qualified nurse. Exclusion criteria included suspicion of tuberculosis (cough of more than 4 weeks), severe kwashiorkor (oedema above the knees), severe illness (i.e. measles) or persistence of vomiting or diarrhoea. Following informed consent from the care-taker, the patient was randomised to the mixed-diet group (Box 3) or the F100-only groups (Box 2).

All meals in both groups were supervised by ACF staff. Explanation was given to care-takers as to how to feed their child, and support was available from staff during the meals. In order to ensure that children would eat on the basis of appetite (ad libitum), an extra quantity of milk or biscuit was offered when the child finished the meal, until the child spontaneously refused any more. The children would drink F100 milk from a cup. RUTF biscuits were taken directly (with the hand) or crumbled on a plate and eaten with a spoon. All patients were given a cup with water to drink during and after the meal. Mothers were instructed to encourage the child to drink.

Outcome measurements

All patients were weighed, had their oedema assessed and received a medical examination every second day (more often if the child presented with a specific complaint). Each child in the mixed-diet and the F100-only groups was selected on day 6 of the rehabilitation phase for measurement of energy and water intake. Energy intake was calculated from the quantities eaten by the child during each meal. The quantity of water drunk by the child was also measured. Due to curfew and security reasons, the meals taken by the children at night could not be measured. Therefore, 4 meals per patient were measured on a single day for each patient. Recovery was assessed by monitoring weight and oedema. The child was discharged when oedema was completely resolved and weight-for-height was above 85 % of the median of NCHS reference

Box 1 Solid RUTF

The RUTF studied in this trial is a biscuit (BP100) presented in bars of 300 kcal (57 grams) (Compact, Bergen, Norway). The bar has an equivalent vitamin and mineral composition to F100, but is based on cooked wheat rather than milk. The product is given during the Rehabilitation phase ad libitum at a minimum of 200 kcal/kg/day. It can be diluted in hot water to prepare a porridge (dilution of one bar in 200 ml of boiled water) but cannot be stored once diluted in water.

Box 2 Standard treatment in TFC (F100-only group)

Patients were admitted to the TFC if they presented with severe malnutrition (weight-for-height below 70% of the median of NCHS reference data or bilateral oedema suggestive of kwashiorkor).
The standard treatment started with a stabilisation phase, comprising of dietary treatment with F75 milk (80 kcal/kg/day in 8 feeds), plus systematic antibiotics, and treatment of acute conditions (i.e. hypoglycaemia, hypothermia, dehydration) until recovery of appetite. This phase lasted 4 days on average.
The patient would then stay for two days in the transition phase with the same dosage of F100 milk.
Finally, during the rehabilitation phase, F100 milk was given ad libitum, at a minimum of 200 kcal/kg/day for six meals. One meal of 300 ml of CSB porridge (380 kcal) was also provided.

Box 3 Rehabilitation study diet (Mixed-diet group).

Admission criteria and treatment in Phase I and Transition Phase were as standard (Box 2).
During the first 3 days of the Rehabilitation phase, patients in the study group received a standard diet, with one of the meals replaced by the equivalent quantity (in kcals) of BP100. From day 4 of treatment, the patient received six alternate meals of F100 and BP100. The order of the meals was altered each day to avoid potential bias related to the timing of the meals. As in the control group, total energy intake was aimed to provide a minimum of 200 kcal/kg/day. They also received the CSB porridge in the same quantity and at the same time as the control group.

[1] Produced by Nutriset, France
[2] Produced by Compact, Norway
[3] Briend A, Lacsala R, Prudhon C, Mounier B, Grellety Y, Golden MH. Ready-to-use therapeutic food for treatment of marasmus [letter]. Lancet 1999, 353, 1767-1768
[4] Manary MJ, Ndkeha MJ, Ashorn P, Maleta K, Briend A. Home based therapy for severe malnutrition with ready-to-use food. Arch Dis Child 2004, 89, 557-61

Table 1 Baseline characteristics of subjects on admission

	Control group (F100 only) (n = 26)		Study group (Mixed diet) (n = 25)		p-value
	mean (sd)	95 % CI	mean (sd)	95 % CI	
Age (months)	26.5 (11.6)	21.8, 31.2	23.4 (9.2)	19.6, 27.2	0.2958
WHZ*	-3.1 (0.58)	-3.3, -2.8	-3.4 (0.75)	-3.7, -3.0	0.0740
HAZ**	-2.7 (1.46)	-3.3 , -2.1	-3.0 (1.17)	-3.5, -2.6	0.3697
Height (cm)	78.1 (7.87)	74.9, 81.2	75.2 (5.23)	73.0, 77.3	0.1328
Weight (kg)	7.5 (1.68)	6.9, 8.2	6.7 (1.3)	6.1, 7.2	0.0472
	n %		*n %*		
Oedema	15 (58)		15 (60)		
Gender (boys/girls)	13 / 13		14 / 11		

* WHZ = Weight for Height in Z-scores of the NCHS reference population
** HAZ = Height for Age in Z-scores of the NCHS reference population

Table 2 Energy intake and water intake per meal in the mixed-diet group (25 children, 4 meals per child)*

	n	Energy Intake (kcal/kg/meal)		Water intake (total)* (ml/kg/meal)	
		mean (sd)	95% CI	mean (sd)	95% CI
F100 meals	50	39.2 (10.39)	36.28, 42.17	41.6 (15.1)	37.29, 45.84
BP100 meals	50	60.9 (32.10)	52.83, 70.09	18.8 (10.9)	15.65, 21.88

* For F100 meals, this quantity includes the water diluted for the preparation of the diluted milk consumed by the child (calculated from the total intake) and the water taken directly from the cup.

Table 3 Weight gain in the F100-only and mixed-diet groups*

		F100-only group			Mixed-diet group			
		n	mean (sd)	95 % CI	n	mean (sd)	95 % CI	p
All children		24	9.3 (2.9)	8.1-10.6	19	11.6 (4.4)	9.4-13.7	0.0525
By age group:	12-23m	11	9.4 (3.5)	7.1-11.6	11	10.3 (3.3)	8.1-12.5	0.5633
	24-60m	13	9.2 (2.6)	7.6-10.8	8	13.3 (5.3)	8.9-17.8	0.0274

* Only patients that completed the rehabilitation phase are included on this table (see results section for explanation)

Figure 1 Selection of patients on the trial

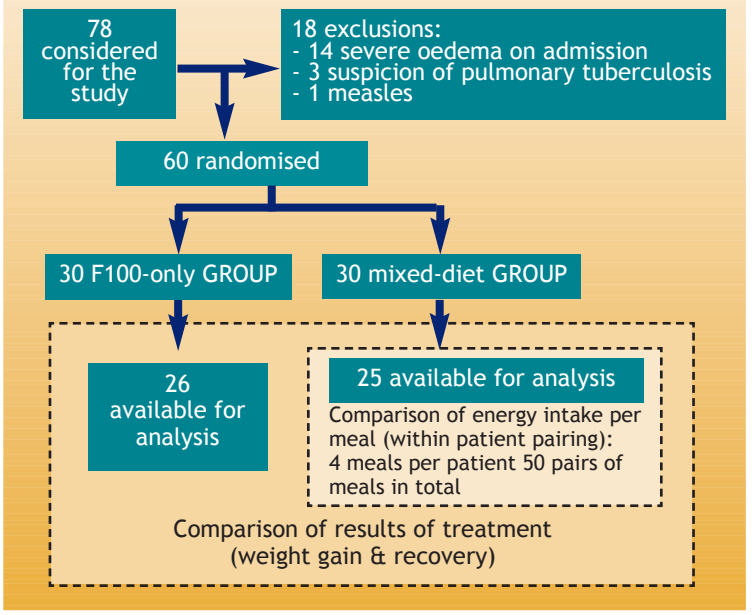
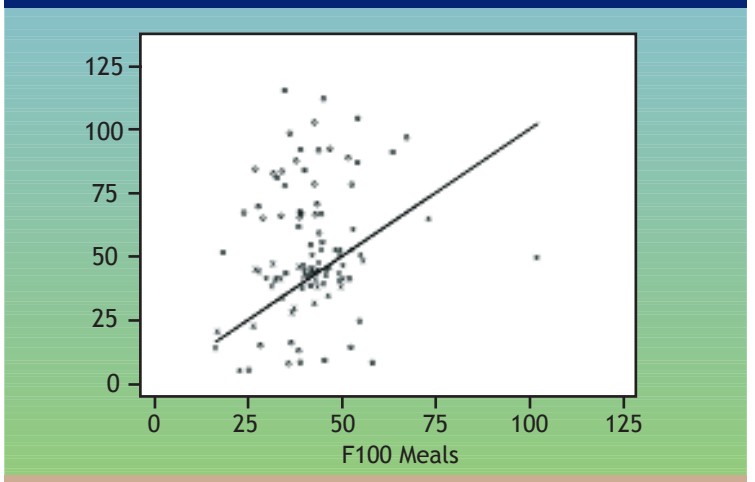


Figure 2 Energy intake (g/kg/meal) in pairs of meals on the mixed-diet (o) and the F100-only group (x)



Note: Each point is defined by the intake in the meal represented in the x-axes (F100) and that of the meal in the y-axes (RUTF or F100). For patients in the F100-only group both meals are F100. For patients in the mixed-diet group, the meal on the x-axes is F100 and the meal on the y-axes is RUTF. The line is the bisect of the graph, NOT a regression line. All units are in kcal/kg/meal. Each child contributes two points to the graph (two pairs of meals measured).

population.

Statistical analysis

The average energy intake of meals in each group was calculated. In the mixed-diet group, each meal was paired with the subsequent meal (first with second, third with fourth), therefore giving two pairs of meals for each patient. The difference in energy intake between each pair of meals of each child and a t-test on that difference were then calculated. In this way, the energy intake of the F100 meal acts as the control for the RUTF meal for each child in the mixed-diet group. We also calculated the average energy intake of patients in the F100-only group, to have a reference point for normal energy intake of F100 under the standard protocol.

The same procedures were carried out with the quantities of water taken during and after the meal. In addition, we calculated the weight gain for all patients, from minimal to maximum weight, and compared the mixed-diet and F100-only groups with an unmatched t-test.

Results

Seventy-eight non-breast fed children, aged between 12 and 59 months, were considered for inclusion in the study. Figure 1 summarises the selection of patients for the trial and the two analyses performed on them. Eighteen patients were excluded for medical reasons, 10 boys and 8 girls, with an average age of 29.5 months (sd. 1.8). Table 1 presents a baseline description of the characteristics of the children on the day of admission. Data was available for energy intake analysis of 26 children in the F100-only group and 25 children in the mixed-diet group. Energy intake was not measured in four other children in the F100-only group due to loss to follow up, while four in the mixed-diet group completed treatment before the day of measurement of energy intake and one defaulted from the centre.

Energy intake: comparison of meals in the mixed-diet group.

The mean weight-for-height Z score (sd) of the children on the day of the measurement of energy intake (day 6 of rehabilitation phase), was –2.9 (0.55) in the F100-only group and –2.9 (0.67) for the mixed-diet group. Average weight that day for the F100 group was 7.6 kg (1.56) and in the mixed-diet group 7.2 kg (1.36).

Table 2 presents the energy intake and water intake up until 45 minutes after the meal of children in the mixed-diet group. Among these children, the mean energy intake in the RUTF meals was significantly higher than from the F100 meals ($p < 0.0001$). The mean difference in energy intake between F100 and RUTF meals was 21.7 kcal/kg/meal (sd, 32.6. 95% CI 12.47, 31.0). As a reference, the average energy intake in the F100 meals in the F100-only group was 39.89 kcal/kg/meal (n = 104 meals; sd, 12.25).

The order in which the meals were given did not affect the preference for one product or the other (data not shown). The age of the child did not affect the average energy intake either. Among children aged 12- 24 months the difference in energy intake between meals is smaller than in older children, this difference is still in the same range as the average and significant (data not shown).

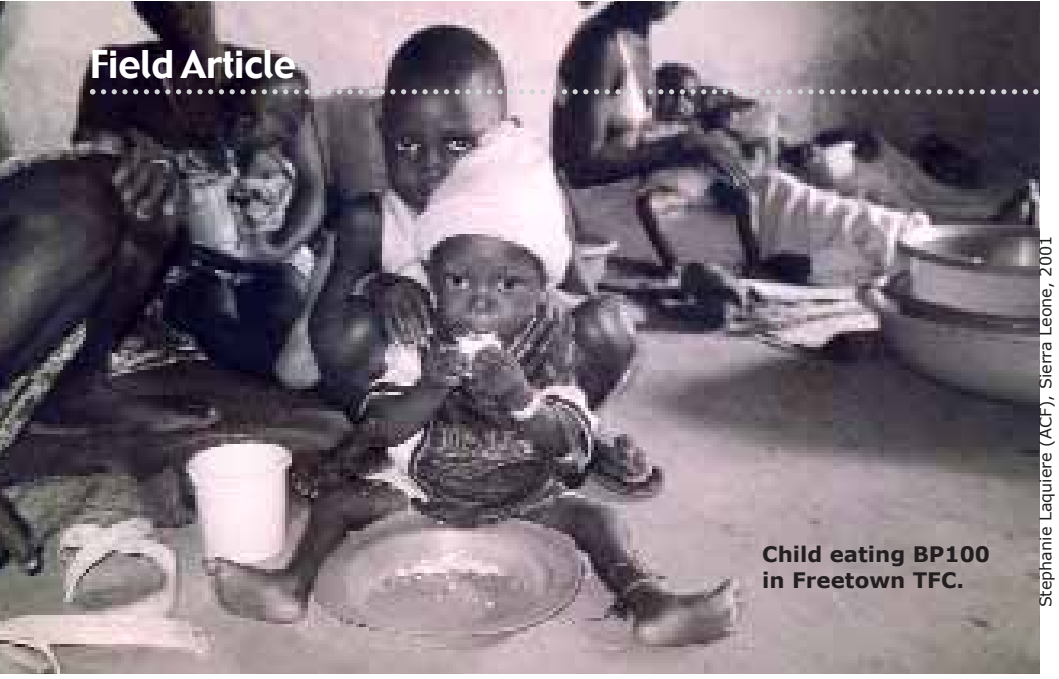
Water intake: comparison of meals in the Mixed-diet group.

The water intake during the meals is higher with F100 than with BP100 (table 2). The mean difference in total water intake up until 45 minutes after the meal (including water used for diluting the milk) is 22.8 ml (sd 19.8; 95% CI 17.8, 27.8; $p< 0.0001$). Again, the order of the meals or the age-group of the child did not affect this difference. Total water intake in the F100-only group was 42.4 ml (sd 12.6). Water intake in the F100-only group was not significantly different from water intake in the F100 meals of the mixed-diet group (mean difference, 0.87 ml; se 2.3; t-test p 0.37).

Comparison of the mixed-diet group and the F100-only group.

Table 3 presents the results of treatment in terms of weight gain, comparing children in the F100-only and the mixed-diet groups, and showing the effect of age on the response to treatment. Presence of oedema on admission or gender did not affect the rate of weight change in either of the two groups.

The duration of the Rehabilitation phase until discharge was similar for patients completing treatment in the mixed-diet and the F100-only



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groups. In the F100-only group, rehabilitation took an average 24.8 days (sd 10.3; 95% CI 20.5, 29.2) and in the mixed-diet group, 24.7 days (8.8; 20.4, 28.9) (t-test for the difference, p = 0.9493).

Eighty percent of patients had enough weight gain to recover completely. Among those that didn't recover, nine cases defaulted from the centre. Seven of the nine children that defaulted did so despite a positive weight gain (i.e. above 5g/kg/day on average). Defaulting rates were similar in both groups (4 children in the control group and 5 in the study group). Defaulting rates in TFCs are often high, particularly during planting and harvest seasons in rural populations. The mortality rate among the patients in the TFC of the study is below mortality rates expected in TFC programmes according to all guidelines.

Discussion

In this study, children showed a preference for the biscuit form of RUTF without reducing intake of the milk product (F100). The high energy intakes obtained in the mixed-diet group translate into average weight gains above those obtained with F100 alone in the F100-only group (which are, themselves, above the minimum weight gain expected in this phase of treatment). These results are in accordance with a similar study on Plumpy'nut implemented by ACF (ref 1).

A limitation of the study was that it was impossible to measure the total energy intake for a full 24 hours. Using the information from the meals measured, and extrapolating to the whole day, the total daily energy is estimated at 289.3 kcal/kg in the F100-only group and 353.1 kcal/kg in the mixed-diet group. These levels are well above the needs of patients during the rehabilitation phase.

The range of energy intakes with RTUF is much wider than that of F100 (figure 2). While this applies mainly to the highest intakes of the product, it should be taken into account. One of the advantages of F100 may be the relative stability of the quantities that the children take in any given meal. This range of intake of RUTF, also observed with other RUTFs in the field (ACF), may be related to the characteristics of the child (age, physical status, presence of fever or other), or to the product itself, but this could not be analysed with the small sample in our study.

Experience of peanut based RUTF in the field (ACF) shows that patients with fever or those who are weaker (like the older or sick children) tend to prefer a liquid (F100) to a solid or paste meal. This phenomenon needs to be taken into account in selecting patients for treatment at home, to ensure that all the children sent home for rehabilitation are in good enough health to ensure appropriate intakes of the RUTF. Surveillance and information systems should be in place in all home-based programmes to ensure prompt reaction if the energy intake of the child is not sufficient. This, in turn, should help to refine the criteria for the selection of children who can be treated at home.

Water intake during the RUTF meals was well below that in the F100 meals. In part this is due to the fact that F100 is diluted with water and the child takes it in a passive way. As our patients in the mixed-diet group were receiving alternate meals of the two products, they could compensate for the low water intakes of the RUTFs meals with the water taken with the milk. No conclusive statements on the water intake of the RUTF, if it was taken alone, can be made from these data. A study is needed of a diet based solely on RUTF (in a TFC or in a home-based protocol) to assess the risk of inadequate water intake. Both peanut based RUTF and RUTF biscuits contain no water and should always be provided with water in order to ensure absorption and avoid dehydration.

Children on the mixed diet of RUTF and F100 do gain weight faster than those on the standard diet. However, the rate of weight gain is sufficient for a proper recovery in both groups, and the mix of F100 and RUTF in the same diet is not intended for operational practice. Use of RUTFs in younger children (in particular below 12 months) needs further study before field implementation.

This study shows that solid RUTF is well accepted and can be used in the rehabilitation of severe malnutrition in the TFC and at home. There should be further studies of the use of RUTF-only diets in home based treatment, including measurements of energy and water intakes. However, suitability of RUTF is only one of the many factors that may affect the success or failure of a home based programme for the treatment of severe malnutrition in emergency situations[5].

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[5] For a list of other factors, see Daudet A, Navarro-Colorado, C. Socio-anthropological aspects of home recovery from severe malnutrition. Field Exchange 2004; issue 21, p24

ARTSEN ZONDER GRENZEN

by Jeremy Shoham

My interview with Saskia van der Kam from MSF Holland didn't start well. I turned up at the offices I had been visiting in Amsterdam for over 10 years only to find it wasn't there. It took a while to convince myself that it really wasn't there and that MSF had in fact moved since my last visit. After some judicious use of the mobile phone and a couple of calls back to the office I managed to find out the new address. Saskia, who I have known for years, met me at reception to tell me that they had in fact moved offices over a year ago. I made a mental note to read my emails properly in future.

Saskia joined MSF H in 1994 as assistant to Kurt Ritmeijer who was the nutritionist at the time. Prior to this she had been working for the MoH in Burkina Fasso seconded by WHO. She began working for MSF Holland on an hourly basis doing a range of work from analysing surveys to preparing briefing papers. She was effectively on call. During Kurt's tenure as nutritionist there was a lot of internal discussion over whether MSF should remain a predominantly medical agency or broaden activities to include linkages between health and nutrition. Fortunately, Kurt's view that 'sick people needed food to get better' prevailed. When Kurt became the health advisor it was natural for Saskia to replace him as the nutritionist. For a period, Saskia was joined by another nutritionist - Austin Davis, who later went on to become Director of MSF Holland.

Saskia explained that MSF H and MSF Belgium were set up as 'an independent clone' of MSF France in 1984. Their first mission was a joint MSF H and MSF B programme in Chad. This was followed by an independent MSF H programme in Darfur. MSF Holland nutrition activities basically started in the form of nurses obtaining as much food as they could and handing this out at feeding centres to starving children. More formal selective feeding programmes were implemented in Khartoum in 1988 for the IDP camps. The first really professional and protocolised selective feeding programmes were probably implemented in Somalia in the late 1980s and early 1990s.

Saskia identified a number of key learning points in MSF's nutrition programming history. The large number of severely malnourished adults during the Somalia civil war (1991/2) were a real shock to the agency and forced them to think through a new set of nutritional protocols for adults. A year later in Liberia and Sierra Leone MSF H were forced to implement large SFPs and TFPs in open situations. These programmes "really honed MSF staff professional and management skills". The 1998 famine in southern Sudan led to the realisation that perhaps MSF were too focused on individuals at the cost of the family and that MSF needed to consider "larger amounts of food aid programming", i.e. blanket SFPs and GFDs. The experience taught them that waiting for advocacy to work may not always be a good strategy, i.e. WFP may not come up with the food in time. Saskia also remembered Wau in southern Sudan in 1998 as the occasion when MSF had to come to grips with extensive adult malnutrition. The technical expertise of Andre Briend, Mike Golden and Steve Collins were instrumental in dealing with the problem. During the Afghanistan crisis, MSF learned that nutrition surveys based on MUAC measurements cannot be used as an advocacy tool