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Investigation of Food Acceptability and Feeding Practices for Lipid Nutrient Supplements and Blended Flours Used to Treat Moderate Malnutrition

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Abstract

Objective—To examine acceptability and feeding practices associated with different supplementary food items and identify practices associated with weight gain.

Methods—Caregivers (n = 409) whose children had been enrolled in a trial comparing a fortified corn-soy blended flour (CSB++), soy ready-to-use supplementary food (RUSF), and soy/whey RUSF answered a questionnaire administered by health workers in their homes.

Results—No significant differences in acceptability of food types were found. CSB++ was more likely than soy RUSF or soy/whey RUSF to be shared (21% vs 3% vs 8%, respectively, $P < .001$). Children who received soy/whey RUSF were more likely to feed themselves than children who received soy RUSF or CSB++ (11% vs 4% vs 3%, respectively, $P < .05$). Refusing food was associated with slower weight gain.

Conclusions and Implications—Despite similar acceptability, feeding practices differed among food types. Increased nonstaple food consumption is associated with weight gain.

Keywords

moderate malnutrition; supplementary feeding; CSB++; ready-to-use food; child

INTRODUCTION

Moderate acute malnutrition (MAM) in children, defined as a weight-for-height Z-score (WHZ) <−2 but ≥−3, remains a worldwide scourge. Affected children experience an increased number of infections, delayed cognitive development, and decreased adult stature and productivity.[1–3] Children with MAM are at 3 times greater risk of death than their well-nourished counterparts.[4]

Two of the most common supplementary food items used to treat MAM are fortified blended flours and ready-to-use supplementary food (RUSF).[5] In addition to cost and availability, these food items differ in taste, texture, preparation, shelf life, and familiarity to

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beneficiary populations. Ready-to-use supplementary food items themselves can differ in taste, texture, and packaging. These qualities can influence the acceptability of the supplement as well as caregiver feeding practices, which in turn may influence individual treatment outcomes and the success of a supplementary feeding program. Identifying and understanding differences in acceptability and feeding practices of supplementary food items are relevant to both clinicians and program managers working to treat MAM.

Studies associating food acceptability and feeding practices with clinical outcomes for acute malnutrition are lacking. The acceptability of fortified blended flours and RUSF have been documented in individual studies,[6–9] but only 1 study has compared them directly and found them equally acceptable.[10] That study also found RUSF less likely than flours to be left over after a meal, and that leftovers were associated with smaller improvements in weight-for-age Z-score.[10]

This study explores the acceptability and feeding practices of supplementary feeding in a previously reported large clinical trial by comparing a fortified blended flour to 2 types of RUSF; it also tests the hypothesis that differences in food acceptability and feeding practices are associated with weight gain in children treated for MAM.[11]

METHODS

Study Participation and Design

Data for this study were collected from October, 2009 to July, 2010 as part of a randomized clinical effectiveness trial comparing 3 supplementary food items in treating children with MAM in southern Malawi.[11] Participants in the study were children who were enrolled in the clinical trial at 1 of 3 government-operated health centers and their primary caregivers. Enrollment criteria for the trial were age between 6 and 59 months, WHZ score <-2 and >-3, absence of bipedal pitting edema, and absence of any history of chronic debilitating congenital or neurologic disease. This study was approved by the University of Malawi, College of Medicine Research and Ethics Committee and the Human Research Protection Office at Washington University.

Procedure

Children with MAM were randomized to receive 1 of 3 different supplementary food types: a fortified corn-soy blended flour (CSB++), soy RUSF, or soy/whey RUSF. CSB++ (produced by Rab Processors, Blantyre, Malawi, under supervision of the World Food Programme) is a corn-soy blended flour fortified with dried skim milk powder, soy oil, sugar, and a micronutrient premix. It was packed in 250 g bags and required cooking by the caregiver to become an edible porridge. Soy RUSF (produced by Project Peanut Butter, Blantyre, Malawi) is a lipid paste containing whole extruded soy flour, peanut paste, sugar, and a micronutrient premix. Soy/whey RUSF, also known as Plumpy'Sup (produced by Nutriset, Malaunay, France), is a lipid paste containing peanut paste, whey powder, cocoa, and isolated soy protein. Both RUSF products were packaged in 92 g foil sachets and did not require preparation before consumption. Nutrient composition of these food types has been detailed elsewhere. [11]

At enrollment, each child received a 14-day supply of supplementary food at a dose of approximately 314 kJ/kg/d (75 kcal/kg/d). Children returned to the health center every 2 weeks for anthropometric evaluation. Participation was complete when the child reached a recovery WHZ >-2, received 12 weeks of supplementary feeding without recovery, developed severe acute malnutrition, died, or dropped out.

At each visit, senior research nurses advised caregivers to avoid giving supplementary food to anyone other than the malnourished child. Caregivers for children randomized to an RUSF were also advised to feed the supplementary food directly from the sachet and not to use the RUSF as an ingredient in porridge or other prepared food.

An Acceptability and Use Survey (AUS) questionnaire of 11 closed-ended questions was developed to gather data on the acceptability of the supplementary food items and caregiver feeding practices. The AUS questionnaire was developed by the investigators' team of senior research nurses, who were fluent in the local language and culture. The nurses formulated the wording of the questions after holding focus group discussions with mothers to better understand how they might interpret/understand the questions. After the final version of the AUS was developed, it was piloted among 50 mothers for retest reliability and found to be in >98% concordance for all 11 questions. The AUS included questions about food acceptability, food sharing, and food sharing behaviors. Community health workers at 3 health centers were trained to use the AUS by 1 of the study investigators and instructed to administer the AUS to the primary caregiver within 10 days of the child's enrollment into the trial.

Data Analysis

Baseline enrollment characteristics and treatment outcomes were calculated as mean ± SD for continuous measures and n (%) for categorical measures. Anthropometric indices were based on the World Health Organization's 2006 Child Growth Standards[12] and calculated using Anthro (version 3.1, WHO, Geneva, Switzerland, 2010). The primary clinical outcome of interest was rate of weight gain (g/kg/d) over the first 4 weeks of treatment.

Enrollment characteristics, outcomes, and answers to the AUS were compared among treatment groups using chi-square analysis for discrete variables and ANOVA for continuous variables (Open Source Epidemiologic Statistics for Public Health, version 2.3.1, OpenEpi, Cambridge, MA, 2010). Dietary diversity was scored by summing the total number of staple servings per day, total number of nonstaple servings per day (vegetable or fruit, beans, meat, snacks, and other), and total number of animal source food servings per day using caretakers' responses to a dietary survey.

Multivariate linear regression modeling using SPSS Statistics (version 19.0, IBM, Somers, NY, 2010) was used to examine whether variables derived from the AUS were independently associated with weight gain. Explanatory variables were selected with backward elimination. The final model controlled for the type of supplementary food, age, sex, enrollment mid-upper arm circumference, enrollment WHZ, whether the child was breastfeeding or not, whether the child's mother was alive, and days of fever and diarrhea prior to enrollment.

RESULTS

Caregivers (n = 409) were contacted by community health workers and agreed to answer the AUS (Table 1). Consistent with findings in the clinical effectiveness trial, there were no significant differences in clinical outcomes among the 3 intervention groups.[11]

As shown in Table 2, there were no significant differences in the acceptability of the 3 food items. In total, 27% of caregivers reported that their child “always” or “sometimes” refused to eat the supplementary food. CSB++ was more likely to be shared with other children than were the RUSF (21% for CSB++ vs 3% for soy RUSF and 8% for soy/whey RUSF, $P < .001$). Children who received soy/whey RUSF were more likely to feed themselves compared to children who received soy RUSF or CSB++ (11% vs 4% and 3%, respectively, $P = .01$).

Multivariate linear regression modeling was used to determine which AUS responses were associated with greater weight gain. Variables included were caregiver hand washing, difficulty consuming full ration, refusal to eat supplementary food, acknowledgment of sharing food or leftovers, the frequency of meat consumption, and the frequency of nonstaple food consumption (model coefficient of determination = 0.36). Increased servings of nonstaple food items were associated with improved weight gain ($\beta = 0.23$, $P < .05$), whereas refusal to eat supplementary food was inversely correlated with weight gain ($\beta = -1.10$, $P < .001$). In addition, greater weight gain was associated with the child's mother being alive and the child having had recent episodes of diarrhea just prior to treatment.

Further exploratory bivariate analyses revealed certain variables to be associated with refusal to eat the supplementary food. Compared to children who did not ever refuse, children who sometimes or always refused were younger (15.3 months vs 20.4 months, $P < .001$) and had higher rates of gastrointestinal symptoms at the time of the AUS (59% vs 44% for diarrhea, $P = .01$, and 33% vs 20% for vomiting, $P < .009$). Certain answers to the AUS were also associated with refusal. Caregivers who reported that their child sometimes or always refused supplementary food were more likely to also report that the supplementary food item (if it was an RUSF) was added to porridge (51% vs 21%, $P < .001$) and that the supplementary food was shared with other children (18% vs 7%, $P = .003$). Refusal of supplementary food was associated with lower recovery rate from MAM; 82% of children whose caregivers reported refusal recovered, compared to 91% of children whose caregivers did not ($P = .02$).

DISCUSSION

Among children with MAM in a supplementary feeding trial, CSB++ was more likely than either RUSF to be shared with other children. Greater consumption of nonstaple food items was associated with greater weight gain, whereas occasional or consistent refusal of supplementary food was associated with lesser weight gain.

The finding that children were more likely to feed themselves soy/whey RUSF suggests that despite the many similarities in ingredients, nutrient composition, and packaging, subtle differences between the 2 RUSF products may affect feeding behavior. The RUSF products in this study differ in flavor and texture. Cocoa is a flavoring agent in soy/whey RUSF, but not in soy RUSF. Soy/whey RUSF may therefore be independently sought by the child because of its pleasant taste. Soy/whey RUSF also has a thicker consistency and a more homogenous texture that enables the food to be extrusion cooked from an open sachet, much like piped frosting or toothpaste, whereas soy RUSF is more fluid. The thicker consistency of the soy/whey RUSF is likely to be associated with less spillage during consumption, and mothers may therefore encourage their children to feed themselves more often. Independent feeding of the supplementary food is likely to be a benefit, in that it may allow the child to consume more supplementary food in circumstances in which caretaker supervision is limited.

In the regression analysis, self-feeding behavior was not significantly predictive of weight gain. The proportion of children who are reported to feed themselves supplementary food (6%) is somewhat lower than the 11% previously observed.[10] The discrepancy may be explained by different definitions of self-feeding. In Flax's study, self-feeding was defined as feeding oneself at least part of the time; in contrast, the questionnaire used in this study asked caregivers to identify the person who usually feeds the child.

It is widely assumed that supplementary food, when distributed as take-home rations, will be shared with other members of the household. The World Food Programme recommends

doubling the supplementary feeding ration from 500 kcal per child per day at an on-site feeding program to 1,000 kcal per day for a take-home feeding program to account for sharing at home.[13] In this study, supplementary food was dosed by weight, and no adjustment for presumed sharing was made.

Caregivers (12%) reported sharing or trading supplementary food that remained uneaten after feeding, and that CSB++ was more likely to be shared than either type of RUSF. These results are consistent with the previous observations of sharing in 10% of recipient households and the finding that a fortified blended flour is more likely than RUSF to be left over at the end of a meal.[10] This finding might be because fortified blended flours, after being prepared into a warm porridge, are relatively more inconvenient to preserve if the child fails to finish his or her portion; as a result, leftovers tend to be shared. This problem is avoided with RUSF, because they do not require preparation and because the foil sachet packaging enables easier storage. However, the clinical importance of this finding is unclear because no correlation was found in the study between sharing behavior and weight gain and because outcomes among all 3 intervention groups were similar.

Children who consumed more nonstaple food items (vegetables or fruit, beans, meat, or snacks) experienced greater weight gain. The importance of dietary diversity to nutritional status has been well documented in Kenya,[14] Mali,[15] Burkina Faso,[16] Bangladesh,[17] China,[18] and elsewhere. This study suggests that dietary diversity may also help moderately wasted children recover from an episode of acute malnutrition.

Caregivers, regardless of which supplementary food they were given, were equally likely to report that their child had refused to eat the supplementary food at some point during the first 2 weeks, suggesting that there were no differences in palatability or acceptability of the different supplementary food items. However, the overall proportion with which caregivers reported child refusal (27%) was somewhat higher than expected, given that prior studies had shown excellent acceptability of both RUSF and fortified blended flours.[6–8] This finding may be explained in part by this study's reliance on caregiver report and not direct observation, so no distinction could be made between a report of refusal that reflected the child's anorexia, or active caregiver feeding behavior exceeding the child's normal appetite, or both.

Refusal of supplementary food during the first 2 weeks of treatment was inversely related to weight gain and recovery from MAM. Compared to children who did not ever refuse, children who refused were younger, on average 15 months compared to 20 months for children who never refused, and had higher rates of gastrointestinal symptoms at the time of the AUS. These findings are consistent with previous studies, which found that rates of anorexia peaked between 12 and 17 months of age,[19] that gastrointestinal illness is associated with reduced caloric intake,[20] and that reduced caloric intake during gastrointestinal illness is attributable to anorexia. [21–23] As might be expected, report of child refusal was associated with higher frequency of leftovers and sharing. For those children in RUSF treatment groups, caregivers who reported child food refusal were more likely to report that they used RUSF as an ingredient in porridge. This result suggests that caregivers, upon finding that their child refused to consume RUSF directly, might have attempted to encourage consumption of the supplementary food by incorporating it as an ingredient in a more familiar porridge preparation. This theory is supported by a previous study, which demonstrated the importance of porridge in childhood feeding in Malawi, finding that it is often the first food introduced to infants after breast milk and that it is the only food mothers report preparing especially for their infants.[24]

The questionnaire about supplementary food usage was not formally validated with observation of feeding behavior, which is the primary and major limitation of the study. Prior work by other researchers in Malawi showed that food usage information collected by self-reported questionnaires is indeed similar to that observed by neutral observers.[25,26] Quantitative correlation between observation and mothers' response was poor in this previous work. Thus the frequencies with which mothers in this study reported a particular behavior should be regarded as uncertain. Flax's work also showed that mothers report higher levels of dietary compliance than are actually observed. Thus it is likely that the actual frequency of sharing in this study was greater than reported. However, because of the strong statistical association between use of CSB++ and ration sharing ($P < .001$), the authors speculate that the fortified-blended flour was more frequently shared.

The community health workers who administered the survey command a degree of respect in their communities as a function of their position and education. As a consequence, respondents may have been compelled to answer certain questions differently than if they had been approached by a more neutral interviewer. For example, it seems unlikely that 90% of caregivers “always” washed their hands prior to feeding the child supplementary food, as was reported in the survey; a similar study observed that only 49% of caregivers washed their hands before feeding.[10] The questions in the survey about sharing or mixing RUSF with porridge were also likely to be affected by response bias, since the intervention included an educational component that discouraged sharing or mixing. Therefore, sharing and mixing behaviors are likely to be underreported in the survey. The generalizability of these findings may be limited by the fact that Malawians are familiar with blended flours as a traditional complementary food for young children.[26] Furthermore, these data were collected in rural Africa and should not be extrapolated to other settings, such as urban areas or other continents.

IMPLICATIONS FOR RESEARCH AND PRACTICE

There were no differences in feeding behavior found among treatment groups, with the exception of self-feeding, which was more likely to occur with soy/whey RUSF, and sharing, which was more likely to occur with CSB++. Neither behavior was predictive of outcome. Two factors associated with outcome were identified: greater dietary diversity, which was correlated with a faster rate of weight gain; and refusal of supplementary food, which was correlated with a slower rate of weight gain. The findings of this present study suggest that even if their nutrient compositions may be similar, not all RUSF products are equal, and differences in taste or texture may affect feeding behavior. Although CSB++ was shared more frequently than the RUSF products, the impact of ration sharing in supplementary feeding programs may not affect nutritional outcomes. Further research is needed to explore what might be done to improve outcomes for children who are reported to occasionally or consistently refuse supplementary food. The clinical implication of sharing and self-feeding behaviors in other settings also warrants further exploration.

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Table 1

Baseline Characteristics and Clinical Outcomes of Malawian Children Enrolled in the Study by Treatment Group (n = 409)[a]

	CSB++ (n = 120)		Soy RUSF (n = 148)		Soy/Whey RUSF (n = 141)	
	n	Mean (SD) or %	n	Mean (SD) or %	n	Mean (SD) or %
Male	50	41.7	50	33.8	44	31.2
Mother not alive	2	1.7	0	0	2	1.4
Mother known to be HIV+	10	8.3	4	2.7	7	5.0
Still breastfeeding	85	70.8	100	67.6	101	71.6
Twin	3	2.5	4	2.7	3	2.1
Had vomiting in past 2 wk	29	24	31	20.9	36	25.5
Had diarrhea in past 2 wk	51	42.5	73	49.3	73	51.8
Age, mo		19.8 (10.6)		19.2 (11.5)		18.2 (10.5)
Weight-for-height z-score		−2.2 (0.4)		−2.2 (0.4)		−2.3 (0.3)
Height-for-age z-score		−2.8 (1.4)		−2.7 (1.2)		−2.5 (1.3)
Mid-upper-arm circumference, cm		12.1 (1.3)		−12.1 (1.3)		−12.1 (0.8)
Clinical outcome						
Recovered from MAM	108	90.0	130	87.8	125	88.7
Developed severe acute malnutrition[b]	10	8.3	16	10.8	12	8.5
Remained moderately malnourished after 12 wk	1	0.8	1	0.7	3	2.1
Default	1	0.8	0	0	0	0
Death	0	0	1	0.7	1	0.7
Weight gain, g/kg/d[c]		3.0 (3.2)		2.6 (3.1)		3.1 (2.9)
Weight gain over first mo, g/kg/d		3.5 (2.8)		3.3 (2.3)		3.6 (2.5)
Time to recovery, d		26 (20)		23 (15)		24 (16)

CSB++ indicates a fortified corn-soy blended flour; MAM, moderate acute malnutrition; RUSF, ready-to-use supplementary food.

[a] $P > .05$ for all comparisons;

[b] Severe wasting (weight-for-height z-score <−3) or bilateral pitting edema;

[c] This data is only reported on children who recovered from MAM.

Table 2

Acceptability and Use of Supplementary Food of Malawian Children by Intervention Group (n = 409)

	CSB++ (n = 120)		Soy RUSF (n = 148)		Soy/Whey RUSF (n = 141)		
	n	Mean (SD) or %	n	Mean (SD) or %	n	Mean (SD) or %	*P*[a]
Time from enrollment to survey administration, d		8.8 (3.3)		9.2 (2.5)		8.7 (2.3)	.25
Child had difficulty consuming daily allotment	13	11	16	11	15	11	.99
Frequency that child refused to eat supplemental food:							
Always	2	2	4	3	7	5	–
Sometimes	27	23	39	26	33	23	.74
Never	90	75	100	68	100	71	.41
No data	1	1	5	3	1	1	–
Frequency that caregiver washed hands prior to feeding child:							
Always	110	92	131	89	129	91	.60
Sometimes	7	6	13	9	11	8	.66
Never	0	0	0	0	0	0	–
No data	3	3	4	3	1	1	–
Number of persons for whom the caregiver prepared meals		4.9 (1.9)		4.6 (2.4)		5.0 (2.1)	.26
Supplemental food was added to porridge	–		45	30	41	29	.81
Person feeding the child:							
Mother	110	92	132	89	120	85	.24
Child (self)	4	3	6	4	16	11	.01
Other	6	5	10	7	5	4	.46
Frequency that supplemental food remained uneaten after feeding:							
Always	8	7	16	11	12	9	.49
Sometimes	68	57	79	53	75	53	.82
Never	43	36	51	34	45	32	.79
No data	1	1	2	1	9	6	–
Use of supplemental food not consumed by child:							
Traded	0	0	1	1	1	1	–
Shared with children	25	21	5	3	11	8	< .001
Shared with adults	2	2	2	1	2	1	–

	CSB++ (n = 120)		Soy RUSF (n = 148)		Soy/Whey RUSF (n = 141)		
	n	Mean (SD) or %	n	Mean (SD) or %	n	Mean (SD) or %	P^a
Child food consumption, servings/d:							
Staple food items		3 (2.3)		3 (3.4)		3 (2.3)	.81
Nonstaple food items		0 (0.2)		1 (0.2)		0 (0.2)	.30
Meat		0 (0.0)		0 (0.0)		0 (0.0)	.40

CSB++ indicates a fortified corn-soy blended flour; RUSF, ready-to-use supplementary food.

[a] *P* for difference between 3 groups, assessed using ANOVA for continuous variables and using chi-square test for categorical variables.

Note: Dashes indicate that no P values could be computed due to small numbers of patients.