ORIGINAL ARTICLE

Feeding behaviors during home-based treatment of moderate acute malnutrition using corn-soy blends or lipid-based nutrient supplements

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Abstract

Feeding behaviors have an important impact on children's nutritional status and are essential to consider when implementing nutrition programs. The objective of this study was to explore and compare feeding behaviors related to supplementary feeding with corn-soy blends (CSB) and lipid-based nutrient supplements (LNS) based on best practice feeding behaviors. The study was conducted as part of a randomized controlled trial assessing the effectiveness of new formulations of CSB and LNS and comprised 1,546 children from 6 to 23 months. The study included a mixed methods approach using questionnaires, focus group discussions and home visits and interviews with a subsample of 20 caretakers of trial participants.

We found that LNS, compared to CSB, were more likely to be mixed into other foods (OR [95% CI] 1.7 [1.3–2.2], $p = <.001$), served with a meal (OR [95% CI] 1.6 [1.1–2.3], $p = <.018$) or between meals (OR [95% CI] 1.5 [1.1–1.9], $p = <.005$), and fed using an encouraging feeding style (mean difference in percentage points [95% CI] 23% [6%:40%], $p = .01$). CSB were more likely to be fed using a forced feeding style (mean difference in percentage points [95% CI] 18% [3%:33%], $p = .02$) and were often observed to be served unprepared.

The main differences in feeding behaviors between the two diet groups were linked to how and when supplements were served. Educational instructions should therefore be adapted according to the supplement provided; when providing CSB, efforts should be made to promote an encouraging feeding style, and emphasis should be made to ensure preparations are made according to recommendations.

KEYWORDS

corn-soy blend, feeding behaviors, lipid-based nutrient supplements, malnutrition, supplementary feeding

1 | INTRODUCTION

Acute malnutrition is one of the leading underlying causes of childhood morbidity and mortality in developing countries and affects 52 million children globally (Lenters, Wazny, Webb, Ahmed, & Bhutta, 2013). A community-based care approach for the management of acute malnutrition has been recommended since 2007 (UNICEF, 2007) using lipid-based nutrient supplements (LNS) or enhanced versions of corn-soy blends (CSB) (de Pee & Bloem, 2009; Lazzerini, Rubert, & Pani, 2013). LNS and CSB are two different diet groups, and they differ not only in nutritional composition but also in terms of texture, usage,

preparation, and ingestion. LNS have a thick texture and can be eaten directly from the sachet without preparation, while CSB must be prepared as porridge and is often more liquid. These are factors that may affect feeding behaviors.

A community-based care approach with CSB or LNS allows the majority of malnourished children to be treated and cared for at home. Consequently, the role of the caretaker and home environment has become ever more important in the treatment of acute malnutrition (Ashworth, 2006; Gaboulaud et al., 2007) and child care practices in relation to therapeutic, and supplementary feeding must be considered to ensure successful outcomes of nutritional interventions.

Feeding behaviors are part of a broad spectrum of child care practices critical for good child nutrition (Engle, Bentley, & Peltó, 2000) and include dietary, social, and psychological practices (Brown, 1997). Positive feeding behaviors such as responsiveness during feeding have been demonstrated to enhance children's acceptance of food, increase food intake, and improve nutritional status (Ha et al., 2002; Nti & Lartey, 2008). Conversely, lack of parental supervision during meals and irregular meal times has been associated with reduced dietary intake and poor growth (Dettwyler, 1986; Flax et al., 2010). Other factors affecting dietary intake include meal frequency, time devoted for feeding, and how children are fed in terms of attending to and responding to the child's signals and developmental level (Engle et al., 2000; Peltó, Levitt, & Thairu, 2003a, 2003b; Dearden et al., 2009).

The aim of our study was to explore and compare feeding behaviors related to supplementary feeding with CSB and LNS and to identify behaviors that may influence the effect of such foods. Our outcomes on feeding behaviors were based on best practice feeding behaviors defined by Peltó et al. (2003a) and included aspects of *how*, *when*, and *where* supplements were fed and *who* was feeding the child.

2 | METHODS

The study was conducted within a randomized controlled trial (www.controlled-trials.com, ISRCTN42569496) investigating the effectiveness of 12 new formulations of CSB and LNS for the treatment of moderate acute malnutrition (MAM). As reported in previous work (Iuel-Brockdorf et al., 2016), the study included both quantitative and qualitative components: questionnaire-based interviews of all trial participants after 1 month of supplementation as well as individual interviews, focus group discussions (FGDs), and home visits (including structured observations) of a subsample of trial participants. The mixed-method approach was used to obtain comprehensive and nuanced information on feeding behaviors.

2.1 | Study setting

The study took place in the Province du Passoré in the Northern region of Burkina Faso from September 2013 to February 2015. The region is one of the poorest areas in Burkina Faso, with a population of around 363,000 inhabitants (Ministère de l'Economie et des Finances, Burkina Faso, 2011), mainly of the Mossi ethnic group. Farming is the primary livelihood, and the region is known for both seasonal (corn, millet, and sorghum) and off-seasonal (tomatoes, carrots, cabbage, and

onions) crops. Women are heavily involved in farming activities. A 3- to 5-months long *hunger-gap* usually starts from June (Famine Early Warning Systems Network, 2014), when the rainy season starts and where food availability is reduced. During this period, women spend much of their day working in the field. The prevalence of MAM and severe acute malnutrition in the area were 9% and 1.4%, respectively (Ministère de la Santé, Burkina Faso, Direction de la Nutrition, 2013).

The study was conducted at five sites (Gomponsom, Latoden, Bagaré, Bokin, and Samba), all established at governmental health centers, where locally recruited staff from the non-governmental organization *Alliance for International Medical Action* (ALIMA, France) carried out all research activities.

2.2 | Participants

During a 6-months recruitment period, children aged 6–23 months, resident in the catchment area, were screened and referred to the sites by community health workers, or caretakers would bring them spontaneously. At the sites, they were recruited if they were identified with MAM, defined as MUAC ≥ 115 mm and < 125 mm and/or WHZ ≥ -3 and < -2 based on WHO growth reference (WHO | WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-height and body mass index-for-age: Methods and development. WHO, 2016). Only one child per family was included. To prevent mixing or sharing of the supplements, siblings aged 6–23 months with MAM and twins received the same supplement.

2.2.1 | Design

Children were randomized to one of the six different CSB or six different LNS according to a blocked randomization list using <http://www.randomization.com>, with varying blocks of 12 or 24 and stratified by site. After 1 month of supplementation, questionnaire-based interviews were carried out with caretakers and included questions related to feeding behaviors. The questionnaire was developed together with a local research assistant and co-author and piloted prior to the study (Iuel-Brockdorf et al., 2015). Following the pilot study, a few questions were modified slightly.

2.2.2 | Intervention

The supplementary foods included six different CSB and six different LNS, with either dehulled soy or soy isolate and with 0%, 20%, or 50% of total protein as dry skimmed milk. The CSB and six LNS could

Key messages

- LNS were more likely to be mixed into other foods and served with a meal or between meals, whereas CSB were more likely to be served as a meal.
- An encouraging and tactile feeding style was more likely with LNS, while CSB were more likely to be fed using a forced feeding style.
- Educational instruction in nutritional programs should be adapted according to the supplement provided to ensure adherence to the treatment and adequate consumption.
- Efforts should be made to prevent CSB to be served unprepared until the consequences of such feeding behavior have been explored further.

not be distinguished from each other, respectively, but CSB versus LNS could not be blinded. All supplements were manufactured by GC Rieber Compact A/S (Bergen, Norway) and had similar micronutrient content provided by a pre-mix of vitamins and minerals designed according to a WHO Technical Note on supplementary foods for the management of MAM (World Health Organization, 2012). A daily ration of LNS (92 g) or CSB (120 g) provided 500 kcal per child.

LNS were packed in 92 grams foil sachets containing a daily ration and did not require any preparation prior to consumption. Caretakers were advised to serve one sachet of LNS in one or more frequent meals throughout the day. CSB were packed in foil bags of 1.7 kg, corresponding to 14 days of daily rations. The CSB required addition of water and cooking to become an edible porridge. Individual dose cups (per meal) were provided to all participants receiving the CSB, and caretakers were instructed how to prepare the porridge with a CSB-water volume ratio of 1:4. They were advised to serve the porridge in three meals per day, giving 40 gram of CSB (167 kcal) per meal. If the child was not able or willing to consume the supplements, caretakers were advised to serve small and more frequent meals or to mix the supplements in the family foods. Forced feeding was strongly discouraged.

All supplements were introduced as a medical treatment to be exclusively consumed by the child included in the study.

2.3 | Home visits, interviews, and focus group discussions

2.3.1 | Participants

For the qualitative component of the study, purposive sampling was used from three of the five research sites (Gonponsom, Latoden, and Bokin) to include a subsample of participants from the main trial. All five sites were very similar in terms of population, and the selection of the three sites was therefore based on practicalities and the convenience of the research assistant conducting the home visits. Efforts were made to ensure that a diversity of participants was represented and included breastfed and non-breastfed children and children from the CBS and LNS diet groups. Seasonality was considered to influence feeding behaviors, due to the variations in the workload of the caretakers and food availability. Consequently, this part of the study was conducted both during the dry and rainy season.

2.3.2 | Design

During the home visits, the subsample of caretakers and their children were observed by a trained female local research assistant during day-time (from 7–8 am to 5–6 pm) for three consecutive days. The observations took place after a minimum of 1 month of supplementation. The assistant followed a structured observation schedule, with questions pertaining to where, when and how the child was fed. One observation schedule was used per meal, and the assistant ticked of the most dominant feeding behaviors during that meal.

Individual interviews to explore how supplements were used within the household were carried out with caretakers during the home visits, while FGDs were carried out at the research sites with a different group of caretakers involved in the main trial but not in home visits. The number of interviews/FGDs was based on the principle of data saturation to ensure that information would be comprehensive and account for deviant cases, to achieve analytical generalization. The interviews and FGDs were carried out in Mooré by two research assistants trained for the purpose by the first author, and a phenomenological approach was applied (Kvale, 1996). The interviews and FGDs lasted between 20 and 45 min and were carried out following a semi-structured interview guide using mainly open-ended questions. To ensure semantic coherence and relevance to the context, the interview guide was carefully discussed and developed with the research assistants prior to the study. All interviews and FGDs were recorded, transcribed, and translated from Mooré to French by the research assistants and from French to English by the first author. The analysis of the data was done by the first author using the English translation.

3 | DATA ANALYSIS

For outcomes coming from the questionnaires, related to how, when and where the supplements were fed (frequency and mode of consumption and serving), logistic mixed effect models for pairs of categories were used in order to evaluate and quantify the effect of the supplements, while adjusting for age, sex, and season as well as sites (modelled through random effects). To quantify differences between CSB and LNS, odds ratios and differences in proportions, with corresponding 95% confidence intervals (CI), were estimated. Outcomes on observed feeding behaviors from the smaller sub-study made

TABLE 1 Examples from the analytical process using principles of qualitative content analysis

Meaning unit	Condensed meaning unit	Code	Category	Theme
<i>No, I usually give him the supplement first, before giving anything else to eat. He loves to eat it plain, without mixing it with other foods</i> 32-year-old mother of 17-month-old child receiving LNS	Child prefers supplement plain, and supplement is served before other foods	Supplement served plain before other foods	Mode of consumption	Feeding behaviors
<i>Me, I prefer to sit down and give it to him gently so that it doesn't get dirty. I saw the neighbor's child eat it all alone, dragging the sachet along the ground, the food all over the ground and then eat it with the dirt. Meanwhile, he was having diarrhea every day: I don't want this to happen to our child, this is why I am careful feeding him myself</i> 24-year-old mother of 20-month-old child receiving LNS	Caretaker feeding the child herself carefully to ensure hygienic precautions and prevent diseases	Caretaker feeding child	Who is feeding the child	Feeding behaviors

during the home visits were simply summarized as raw proportions which were compared between CSB and LNS using chi-square tests.

The analysis of the qualitative data was done manually by the first author, using principles of qualitative content analysis (Graneheim & Lundman, 2004). First, each interview and FGD was kept intact and read through several times to search for common themes. From the text, condensed meaning units or portions of the text connected to a central meaning were formed and coded for that specific meaning and classified into categories from where themes emerged. Codes and categories could fit into more than one theme. Finally, findings from each of the interviews/FGDs were compared with the aim of exploring similarities, differences, and patterns. This characterizes the direction of qualitative content analysis and rests on the underlying assumption that there are many different ways of analyzing reality. Consequently, a certain degree of interpretation is involved in the analysis of data (Graneheim & Lundman, 2004). An example of the analytical process can be found in Table 1.

4 | ETHICAL APPROVAL

As part of the main trial, this study was approved by the Ethical Committee for Health Research in Burkina Faso (2012-8-059), and consultative approval was obtained from the Danish National Committee on Biomedical Research Ethics (1208204). A separate informed consent form was made for the qualitative part of the study.

5 | RESULTS

5.1 | Characteristics of trial participants

Out of the 1,609 children included for the main trial, 1,546 children, who had completed 1 month of supplementation, were included for the final analysis of this study. Out of the 63 children not included, 21 children were lost to follow-up, 31 children had developed severe acute malnutrition during the first month of supplementation and were therefore receiving other treatment, while eight children had received replacement supplements (Plumpy Supp) due to a positive salmonella test of the supplement that was allocated to them. Finally, two children died, and the caretaker of one child withdrew consent. The mean (SD) age was 13.3 (4.8) months, and 94.6% ($n = 1460$) of the children were breastfed at the time of inclusion, while 93.0% ($n = 1431$) were breastfeeding after 1 month of supplementation. The ethnic origin of the participants was Mossi for 94.0% ($n = 1452$) of participants. The majority, 58.7% ($n = 907$), were Muslim, 24.0% ($n = 371$) were Catholic, 6.2% ($n = 95$) were Protestant, and 11.1% ($n = 169$) had traditional beliefs. Randomization generally resulted in baseline balance between the main diet groups (Table 2) as well as the 12 individual groups (data not shown, but reported previously (Iuel-Brockdorf et al., 2016), except that proportion of males ranged from 41.8 to 51.5%.

5.2 | Characteristics of participants from the home visits/interviews, and FGDs

Ten of the children in the home visit and interview subsample received CSB and ten received LNS. Their demographic data and

TABLE 2 Baseline characteristics of trial participants ($n = 1,546$)

Supplements	CSB ($n = 766$)	LNS ($n = 780$)
Age (months), mean ($\pm$ SD)	13.1 (4.7)	13.4 (4.9)
Boys, % (n)	44.3 (339)	45.8 (357)
Weight for height z-score, mean ($\pm$ SD)	-2.2 (0.5)	-2.2 (0.5)
Mid upper arm circumference (mm), mean ($\pm$ SD)	122.6 (4.0)	122.7 (3.8)
Breastfed, % (n)	94.4 (722)	94.7 (738)
Age of caretaker (years), ($\pm$ SD)	27.1 (6.3)	27.4 (6.3)
Mother absent % (n)	2.0 (15)	1 (8)
Educational level of mother % (n)		
No education	84.4 (646)	87.3 (680)
Primary	10.7 (82)	7.8 (61)
Secondary	4.6 (35)	4.5 (35)
>Secondary	0.1 (1)	0
Unknown	0.1 (1)	0.4 (3)
Household members, mean ($\pm$ SD)	13.2 (8.4)	13.1 (8.3)
Season at time of inclusion % (n)		
Dry season	65.8 (504)	66.4 (518)
Rainy season	34.2(262)	33.6 (262)
Ethnicity of mother % (n)		
Mossi	93.2 (713)	94.9 (739)
Fulani	2.9 (22)	1.7 (13)
Dafing/Other	3.9 (30)	3.4 (27)
Religion of mother % (n)		
Catholic	26.7 (204)	21.4 (167)
Protestant	5.1 (39)	7.2 (56)
Muslim	58.2 (445)	59.3 (462)
Traditional beliefs/other	10.0 (77)	12.1 (94)

LNS = lipid-based nutrient supplements; CSB = corn-soy blends.

nutritional status were similar to the full cohort, although there was a higher representation of boys (65%, $n = 13$). Also, children receiving CSB were older (mean [SD] 14.3 months [4.3]) than children receiving LNS (mean [SD] 12.3 months [6.3]). Eighteen of the children were living with both mother and father, while one lived with only the mother and one with the grandmother. Eighteen of the children were breastfed, equally divided between the two groups. The mean duration (SD) of supplementation at the time of the home visits was 6.8 (2.7) weeks for children receiving CSB and 6.2 (1.8) weeks for children receiving LNS. The mean duration (SD) of the home visits was 9.4 (0.8) hours and 9.5 (0.6) hours for children receiving CSB and LNS, respectively, and 95 meals were observed (CSB 46, LNS 49). Half of the home visits were conducted during the rainy season (50%, $n = 30$).

Twenty individual interviews and nine FGDs were carried out. The FGDs were divided in the following way to ensure that the different feeding behaviors related to the different supplements could be discussed: four FGDs with caretakers of children receiving CSB, four FGDs with caretakers of children receiving LNS, and one mixed FGD with caretakers of children receiving either CSB or LNS. Fifty-one female caretakers participated in the FGDs, and the mean (SD) age was 30 years (7.2).

TABLE 3 Estimated associations between reported feeding behaviors and practices when using CSB or LNS (Questionnaires after one month of supplementation, 1546 participants)

Product		CSB	LNS	OR (95% CI) ^a	P-value
Mode of consumption % (n) CSB versus LNS	Alone	78.4 (600)	71.5 (555)		
	Mixed with other foods	21.6 (165)	28.5 (221)	1.7 (1.3–2.2)	<.001
Mode of serving % (n)	With a meal	16.7 (127)	20.6 (158)	1.6 (1.1–2.3)	.018
	Between meals (as a snack)	40.9 (312)	45.8 (351)	1.5 (1.1–1.9)	.005
	As a meal ^b	42.4 (323)	33.6 (258)	0.6 (0.5–0.8)	<.001

LNSs = lipid-based nutrient supplements; CSBs = corn-soy blends; OR = odds ratios; CI = confidence interval.

^aAdjusted for age, sex, and season as well as sites (modelled through random effects).

^bNo other foods served at the same time.

5.3 | Results from questionnaire-based interviews

Caretakers reported feeding LNS less frequently than CSB (2.6 [95% CI 2.5–2.7] vs 3.0 [95% CI 2.9–3.0] times per day, $p < .001$). Supplements were mainly reported to be served between meals (as a snack) or as a meal (no other foods served at the same time). The mode of serving differed significantly between LNS and CSB ($p = .002$): LNS were more likely to be served with a meal or between meals compared to CSB, but less likely to be served as a meal (Table 3). Both types of supplements were mainly reported to be consumed alone and not mixed into other foods, but LNSs were more likely to be mixed into other foods compared to CSB (Table 3).

5.4 | Results from structured observations during home visits

Ninety-five meals were observed during the home visits of 20 children; 48% ($n = 46$) meals with CSB and 52% ($n = 49$) meals with LNS. The mean (95% CI) duration of the meals was 10.6 min (8.3–12.9) for CSB and 10.4 min (8.2–12.6) for LNS, excluding time for preparation (of CSB) and hygienic precautions. The observed frequency of feeding

was 1.6 times/day (1.2–2.1) for CSB and 1.5 times/day (1.1–1.9) for LNS.

Other similarities in feeding behaviors identified during the home visits were that both diet groups were mainly fed by the caretaker and were consumed between meals and served alone, not mixed into other foods. In 13.3% ($n = 6$) of the meals with CSB, flours were served unprepared where the child would eat the flours by hand by themselves, like cookie-crumbs (Table 4).

The main differences were found within the feeding environment, feeding style, and utensils used for feeding: more meals with CSB were served, while the child was alone, away from other children, compared to meals with LNS (CSB 86%, LNS 67%, difference [95% CI] 19% [2%:36%], $p = .03$). Furthermore, the mean proportion of meals fed using an encouraging feeding style, defined as “feeding with positive verbal encouragement, without verbal and physical coercion” (Pelto et al., 2003a, 2003b) was higher in the LNS group (CSB 63%, LNS 87%, difference [95% CI] 23% [6%:40%], $p = .01$), while the proportion of meals served using a forced feeding style, described as caretakers repeatedly trying to push the food into the mouth of the child if he or she was refusing to eat, was higher in the CSB group (CSB 26%, LNS 8%, difference [95% CI] 18% [3%:33%], $p = .02$). Finally, more meals with CSB were served using a spoon compared to LNS meals

TABLE 4 Observed feeding behaviors during 95 meals of 20 children

		CSB (n = 46)	LNS (n = 49)	Difference in proportions % (95% CI)	P-value
Supplement served, % (n)	Mixed with other foods	15 (7)	18 (9)	–3 (–18:12)	.69
	Alone	85 (39)	81 (40)	4 (–11:19)	
Supplement consumed, % (n)	As a meal	44 (20)	46 (22)	–2 (–22:18)	.81
	Between meals (as snack)	57 (26)	54 (26)	3 (–17:23)	
Meals fed by, % (n)	Caretaker all of the time	76 (35)	80 (39)	–4 (–20:12)	.68
	Caretaker some of the time	2 (1)	2 (1)	0 (–16:16)	>.999
	Eats alone all of the time	17 (8)	14 (7)	3 (–11:17)	.69
	Eats alone some of the time	4 (2)	2 (1)	2 (5:9)	.57
Positioning of child % (n)	Sitting on the ground	15 (7)	23 (11)	–8 (–24:8)	.32
	Walking, standing	7 (3)	12 (6)	–5 (–17:5)	.31
	With caretaker (on lap, in the arms of)	78 (36)	65 (32)	13 (–4:31)	.16
Feeding environment, % (n)	Child eating with other children	14 (6)	33 (16)	–19 (–36:–2)	.03
	Child eating alone	86 (37)	67 (33)	19 (2:36)	
Caregiver behaviors % (n)	Encouraging feeding	63 (29)	86 (42)	–23 (–40:–6)	.01
	Forced feeding	2 (12)	8 (4)	–6 (–14:2)	.02
	Indifferent/laissez-faire feeding	13 (6)	6 (2)	7 (–5:19)	.24
	Restrictive feeding	9 (4)	2 (1)	7 (–2:16)	.13
Utensils used for feeding, % (n)	Spoon	91 (42)	16 (8)	75 (62:88)	<.001
	Hands of caretaker	9 (4)	59 (29)	–50 (–66:34)	
	LNS sachet	–	25 (12)	–	

LNS = lipid-based nutrient supplements; CSBs = corn-soy blends; CI = confidence interval.

(CSB 91%, LNS 16%, difference [95% CI] 75% [62%:88%], $p = <.001$) (Table 4).

5.5 | Findings from individual interviews and FGDs

LNS were reported to be eaten either one or several times per day, while CSB were said to be consumed three times per day as recommended.

Often, when I get up in the morning, I give him some [of LNS] to eat, and then he finishes the rest in the afternoon (30-year-old caretaker of 19-month-old boy)

He finishes the [LNS] supplement in one meal as he has been told to do (32-year-old caretaker of 17-month-old boy)

When they wake up in the morning, we prepare the CSB porridge for them, and then after the porridge, they eat the tô [local dish, a bitter pulp made from crushed, cooked millet, sorghum or corn and consumed with a vegetables sauce]. At noon we prepare the [CSB] porridge for them and the tô as well and in the evening they eat the tô and the [CSB] porridge before going to sleep. (FGD Gonponsom)

When asked if there were occasions where caretakers would not feed their children the supplements, most of them said that they would feed the supplements at all times. Only during illness such as diarrhea, some said that they would withhold or reduce the frequency of supplementary feeding, due to the child refusing to eat.

No, it [LNS] is medicine; there are no circumstances that could keep me from giving medicine to my child (32-year-old caretaker of 17-month-old boy)

If children had difficulties consuming the supplements, some of the caretakers of children receiving LNS said that they placed the supplements on the breast to encourage the child to eat while breastfeeding or mixed it into the family foods. Some of the caretakers of children receiving CSB said that they forced the child to drink the CSB porridge if they refused.

As my child does not like to eat it [LNS], I prefer to use the finger, because with the sachet, I would not manage to get him to eat it. But I prefer to put it on the tip of my breasts, so that he can breastfeed and eat at the same time (20-year-old caretaker of 8-month-old boy)

Sometimes I force her if she categorically refuses to drink it [CSB] (25-year-old caretaker of 11-month-old girl)

Some caretakers of children receiving LNS said that the children often preferred eating the supplements by themselves, while others said that they fed their children by hands as it allowed them to better

dose the quantity and made the child consider the supplement as food instead of medicine.

They are still young, so if I use a spoon, I could put a big quantity in their mouths, which could be difficult for them to swallow. But if I use my hand, I can put the right amount of food in their mouths (27-year-old caretaker of 7-month-old boy)

If I give it to him with a spoon, he will think that it is medicine. He refuses to eat it from the sachet, so I give it to him with my hand (34-year-old caretaker of 7-month-old boy)

Many caretakers of children receiving CSB said that their children preferred eating the flours raw. This way, the child would take or be given a handful of the CSB and snack on the flours like cookie crumbs. Additionally, some caretakers said that they prepared the CSB flours with less water, into what they called "couscous" (high viscosity porridge), if the child was refusing to eat.

If I give it to him as porridge, I have to force the child to drink it, and often I stuff it in him and he vomits immediately afterwards. But he can eat two measures of flour plain in one single meal (FGD Gonponsom)

My child was also refusing the porridge, so he was eating it like couscous and sometimes he just ate the flour. (FGD Latoden)

Caretakers also described giving the supplements before breastfeeding or family foods, to ensure that the child still had an appetite. Some reported to withhold other foods to ensure consumption of the supplement.

If you give it [CSB] to him after the meal, he will not take anything, so I give the porridge to him before giving him other meals (29-year-old caretaker of 16-month-old boy)

Yes, but when he refuses I don't give him anything to eat for a long period of time, and then I give him the supplement [LNS], and often he manages to eat very well. (30-year-old caretaker of 19-month-old boy)

Some caretakers said that they preferred to feed the child themselves, to ensure that hygienic precautions were respected and to increase consumption. Others reported that they were feeding the child to prevent the other children in the household from taking the supplement. Likewise, this was a reason for feeding the child isolated from the others.

We don't want to give it [LNS] to the child in front of everyone. Not because we are ashamed, but because we don't want the other children to see it and start crying and asking for some. So we have to take him aside and feed him and once he is full, you can go out to the other (FGD Bokin)

When you are preparing the [CSB] porridge for your child, other children want the porridge, if they are present. Therefore, you can go into your house and give the porridge to the child there. The others will not know it so they will not come, but if you give it out in the open, the small children will ask for some and some may cry and want you to give it to them. (FGD Gonponsom)

6 | DISCUSSION

The aim of this study was to explore and compare feeding behaviors related to supplementary feeding with CSB, and we found that the main differences between the two diet groups were linked to how and when supplements were served.

6.1.1 | Mode of serving

To our knowledge, only one study has previously compared feeding behaviors in supplementary feeding with CSB and LNS, where the main differences found were that CSB were more likely to be served as a meal (Flax et al., 2010). Similar findings in terms of mode of serving were seen in our study, where LNS were less likely to be served as a meal.

LNS were mixed with other foods to enhance the taste of family foods or to stimulate consumption. The latter is consistent with an earlier study where child refusal of supplementary foods encouraged caretakers to add them into family foods (Wang et al., 2013) and may be more easy with LNS, due to the texture of the supplement. Surprisingly, we found that CSB occasionally were both reported and observed to be consumed un-prepared as many children preferred to snack on the flours. The recommended cooking time of 5–10 min for CSB (World Food Program, 2010) is essential to ensure digestibility and nutrient availability, and this may be affected if CSB are consumed unprepared. The consequences of this practice should therefore be further explored, understood, and addressed. Unfortunately, our study did not capture to what extent CSB was prepared correctly, when mixed with water (e.g., the right ratio of blend to water).

6.1.2 | Who were feeding the supplement

We found that caretakers fed the child themselves during the majority of meals of both diet groups, mainly to prevent sharing, to ensure hygienic precautions, or to increase consumption. LNS were preferred to be fed by hand as it allowed for caretakers to better dose the quantity, and many children also preferred consuming LNS by themselves. Additionally, it was reported that LNS were sometimes placed on the breast of the caretaker to encourage the child to eat. These tactile feeding behaviors support some of the best practice feeding behaviors defined by Pelto et al. (2003), where feeding should be adapted to the psychomotor abilities of the child, be carried out with age and culturally appropriate utensils and ensure a balance between providing assistance and encouraging self-feeding. The thick texture of the LNS may facilitate these

feeding behaviors, while this could be more challenging with the more liquid texture of the CSB porridge.

6.1.3 | How and where supplements were fed

Best practice feeding behaviors also include feeding responsively and in an encouraging and sensitive manner and creating a protected and comfortable feeding environment (Engle et al., 2000; Pelto et al., 2003a). Responsive feeding has previously been associated with positively deviant children (Ha et al., 2002; Nti & Lartey, 2008). In our study, we found that an encouraging feeding style was more frequently applied in meals with LNS, while forced feeding was more frequent in meals with CSB, although this behavior was discouraged. A reason for this difference could be that CSB porridge looks more like a traditional food that caretakers may be used to force-feed, whereas with LNS, caretakers can easily remember they are feeding something different and special with special instructions not to use force. The aspect of LNS being perceived as different from other foods was also emphasized by the fact that LNS were often referred to as medicine. This characteristic has been discussed further in previous papers (Iuel-Brockdorf et al., 2015, 2016). We also found that children were often isolated from other children during feeding of the supplements, regardless of the diet group. Isolation of the child during feeding was mainly done to prevent sharing and thereby contributed to the creation of a protected feeding environment. However, isolating the child from other children during feeding could potentially have a social impact in terms of stigma, as it could exclude the child from being part of the social situation which a meal may represent. The consequences of this could be explored further. Nevertheless, caretakers said that they would feed both diet groups at all times, when asked if there were occasions where they would not feed their children the supplements. This indicates that there was no stigma associated with feeding the supplements.

6.1.4 | When were supplements consumed

We found that supplements were often served early in the morning, because they had high priority in the daily diet of the child and to prevent sharing with other children. Both diet groups were reported to be served prior to breastfeeding or family foods, to ensure that the child still had appetite. Some even said that they were withholding family foods for this reason. This, in addition to the fact that the supplements were frequently observed and reported to be served as a meal, could potentially lead to supplements replacing family foods or breastmilk, thereby decreasing the total daily energy consumption of the child. On the contrary, if supplements are served as a snack, the child may be more likely to consume more family foods/breastmilk. However, previous studies have not found an impact of CSB and LNS or the order of which these foods are provided, on breastmilk intake or general food consumption neither in healthy infants (Owino et al., 2007; Galpin et al., 2007) nor in malnourished children (Cohuet et al., 2012).

Finally, our results show a discrepancy between reported and observed number of times per day supplements were fed as caretakers reported to feed the supplements more frequently than what was observed. Similar discrepancy in terms of adherence to supplements

has been reported previously (Abbeddou et al., 2014; Flax et al., 2010; Ashorn et al., 2015) and may be due to participants engaging in social desirability or difficulties adhering to the recommended frequency of feeding, which may influence the total energy intake of the child.

6.1.5 | Strengths and limitations

We believe that the combination of quantitative and qualitative data used for the purpose of this study provides a unique detailed and nuanced picture of feeding behaviors related to supplementary foods in this context. We have not only been able to explore *how*, *when*, and *where* supplementary foods are fed and *who* is feeding the child but also *why* feeding behaviors are practiced as they are in this context.

We acknowledge that the study had certain limitations: The analysis of qualitative data usually involves some degree of interpretation, while the translation from Mooré to French to English may have involved some loss of meaning. Moreover, no back translation was carried out. However, the translations and interpretations were carefully and continuously discussed with the two research assistants, who were fluent in Mooré and conducted the interviews. Another limitation is that the duration of the home visits were limited to daytime and information on feeding behaviors in the morning, and evening hours is therefore lacking. Participants may also have been affected by the presence of the research assistant during the home visits and therefore demonstrating behaviors not reflecting usual practice. To account for this, observations were carried out for three consecutive days, allowing for participants to get used to being observed. The discrepancies between the reported and observed number of times per day supplements were fed, could suggest that the behaviors observed were not influenced by the presence of the research assistant, as adherence to recommended frequency of feeding was poorer during observations compared to the feeding behaviors reported.

7 | CONCLUSION

Feeding behaviors in relation to supplementary feeding are important to consider in order to ensure the successful outcomes of nutritional interventions. Our results show that the main differences in feeding behaviors between the two diet groups are linked to how and when supplements were served; LNS were more likely to be mixed into other foods and fed using an encouraging feeding style and applying more tactile feeding behaviors. CSB were more likely to be served as a meal and fed using a forced feeding style. We therefore recommend that, when providing CSB in nutritional programs, efforts should be made to promote an encouraging feeding style. Furthermore, emphasis should be made to ensure that CSB is prepared according to recommendations, until the consequences of consuming CSB unprepared has been evaluated. In conclusion, we strongly recommend that educational instructions in nutritional programs are adapted according to the supplement provided to ensure adherence to the treatment.

Text Box 1. Educational messages about the use of the supplements

General

- The supplement is a treatment to treat malnutrition and should therefore not be shared.
- For breastfed children, breastfeeding should be continued on demand. Children <12 months should be breastfed prior to supplementation.
- The supplement should not replace local foods but be given in addition to them.

Hygiene

- Wash the child and caretakers hands with soap before preparing foods and eating.
- Feed the child using clean hands, clean utensils and clean cups.
- Store the foods in a clean, cool, dry and safe place and keep it covered.

Feeding behaviors

- Be patient and actively encourage child to eat.
- Don't force child to eat.

Health

- In case of diarrhea, continue feeding. Provide extra food and water.

CSB

- The porridge should be given three times/day.
- Use clean water for the preparation of the porridge.
- Four cups of water for one cup of flour. Water can be reduced or increased depending on desired thickness of porridge.
- Once water is boiling, add the flour and boil for a minimum of 5 min and a maximum of 10 min.
- Let the porridge cool off for a few minutes before giving it to the child.
- Use a separate plate to feed the child to make sure he or she eats all the food given and that it is not shared with others.
- Porridge should be eaten immediately after being prepared. Uneaten porridge must not be saved for later.
- The porridge may not be shared with other children or adults.

LNS

- One sachet/child/day – this can be divided in several meals.
- Before opening the sachet, squeeze the content around and ensure that it is mixed well.
- Before opening the sachet, wash it with water and soap.
- The supplement does not require any preparation but can be given straight from the sachet or on a finger or a spoon.
- If the child cannot finish the supplement in one take, close the sachet carefully and keep it stored in a clean, dry, and cool place. Then try again later.
- If the supplement is not eaten by the end of the day, do not save it for the next day.
- Offer plenty of clean water to drink while eating the supplement.
- The supplement must not be shared with other children or adults.

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CONFLICTS OF INTEREST

None declared. Neither the funders nor the manufacturer of the experimental food supplements had any role in the design, implementation, analysis or reporting of the results from this study.

CONTRIBUTIONS

A-S I-B, TAD, PA, SF, and KFM performed the conception and design of the study. CR, A-S I-B, and AO performed the analysis and interpretation of data. A-S I-B and AO performed the acquisition of data and analysis and interpretation of data, and all authors contribute to the drafting and reviewing of manuscript.

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