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1 **Feeding behaviours during home based treatment of moderate acute** 2 **malnutrition using corn-soy blends or lipid-based nutrient supplements** 3

4 **Abstract**

5 *Feeding behaviours have an important impact on children's nutritional status and are essential to consider*
6 *when implementing nutrition programs. The objective of this study was to explore and compare feeding*
7 *behaviours related to supplementary feeding with corn-soy blends (CSB) and lipid-based nutrient*
8 *supplements (LNS) based on best practice feeding behaviours. The study was conducted as part of a*
9 *randomised controlled trial assessing the effectiveness of new formulations of CSB and LNS, and comprised*
10 *1546 children from 6-23 months. The study included a mixed methods approach using questionnaires, focus*
11 *group discussions and home visits and interviews with a sub-sample of 20 caretakers of trial participants.*

12 *We found that LNS, compared to CSB, were more likely to be mixed into other foods (OR (95% CI) 1.7 (1.3-*
13 *2.2), $p < 0.001$), served with a meal (OR (95% CI) 1.6 (1.1-2.3), $p < 0.018$) or between meals (OR (95% CI) 1.5*
14 *(1.1-1.9), $p < 0.005$) and fed using an encouraging feeding style (mean difference in percentage points (95%*
15 *CI) 23% (6%:40%), $p = 0.01$). CSB were more likely to be fed using a forced feeding style (mean difference in*
16 *percentage points (95% CI) 18% (3 %:33 %), $p = 0.02$) and were often observed to be served unprepared.*

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

21 22 **Keywords**

23 **Malnutrition, feeding behaviours, supplementary feeding, corn-soy blend, lipid-based nutrient supplements**
24
25

26 **Introduction**

27 Acute malnutrition is one of the leading underlying causes of childhood morbidity and mortality in
28 developing countries and affects 52 million children globally (Lenters et al. 2013). A community-based care
29 approach for the management of acute malnutrition has been recommended since 2007 (UNICEF 2007)
30 using lipid-based nutrient supplements (LNS) or enhanced versions of corn-soy blends (CSB) (de Pee and
31 Bloem 2009, Lazzarini, Rubert, and Pani 2013). LNS and CSB are two different diet groups and they differ
32 not only in nutritional composition, but also in terms of texture, usage, preparation and ingestion. LNS have
33 a thick texture, and can be eaten directly from the sachet without preparation, while CSB must be prepared
34 as porridge and is often more liquid. These are factors that may affect feeding behaviours.

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

40 Feeding behaviours are part of a broad spectrum of child care practices critical for good child nutrition
41 (Engle, Bentley, and Pelto 2000) and include dietary, social and psychological practices (Brown 1997).
42 Positive feeding behaviours such as responsiveness during feeding have been demonstrated to enhance
43 children's acceptance of food, increase food intake, and improve nutritional status (Ha et al. 2002, Nti and
44 Lartey 2008). Conversely, lack of parental supervision during meals and irregular meal times have been
45 associated with reduced dietary intake and poor growth (Dettwyler 1986, Flax et al. 2010). Other factors
46 affecting dietary intake include meal frequency, time devoted for feeding and how children are fed in terms
47 of attending to and responding to the child's signals and developmental level (Engle, Bentley, and Pelto
48 2000, Pelto, Levitt, and Thairu 2003, Dearden et al. 2009).

49
50 The aim of our study was to explore and compare feeding behaviours related to supplementary feeding
51 with CSB and LNS and to identify behaviours that may influence the effect of such foods. Our outcomes on
52 feeding behaviours were based on best practice feeding behaviours defined by Pelto et al (2003) and
53 included aspects of *how*, *when* and *where* supplements were fed and *who* was feeding the child.

54

55 **Methods**

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

63 **Study setting**

64 The study took place in the Province du Passoré in the Northern region of Burkina Faso from September
65 2013 to February 2015. The region is one of the poorest areas in Burkina Faso, with a population of around
66 363.000 inhabitants (Ministère de l'Economie et des Finances, Burkina Faso 2011), mainly of the Mossi
67 ethnic group. Farming is the primary livelihood, and the region is known for both seasonal (corn, millet,
68 sorghum) and off-seasonal (tomatoes, carrots, cabbage, onions) crops. Women are heavily involved in
69 farming activities. A three to five months long *hunger-gap* usually starts from June (Famine Early Warning
70 Systems Network 2014), when the rainy season starts and where food availability is reduced. During this
71 period, women spend much of their day working in the field. The prevalence of MAM and severe acute
72 malnutrition in the area were 9% and 1.4% respectively (Ministère de la Santé, Burkina Faso, Direction de la
73 Nutrition 2013).

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

77 **Participants**

78 During a six months recruitment period, children aged 6-23 months, resident in the catchment area were
79 screened and referred to the sites by community health workers or caretakers would bring them
80 spontaneously. At the sites, they were recruited if they were identified with MAM, defined as MUAC ≥ 115
81 mm and < 125 mm and/or WHZ ≥ -3 and < -2 based on WHO growth reference (WHO | WHO Child Growth
82 Standards, 2006). Only one child per family was included. To prevent mixing or sharing of the supplements,
83 siblings aged 6-23 months with MAM and twins received the same supplement.

84 **Design**

85 Children were randomised to one of six different CSB or six different LNS according to a blocked
86 randomisation list using <http://www.randomization.com>, with varying blocks of 12 or 24 and stratified by

87 site. After one month of supplementation, questionnaire-based interviews were carried out with caretakers
88 and included questions related to feeding behaviours. The questionnaire was developed together with a
89 local research assistant and co-author and piloted prior to the study (Iuel-Brockdorf et al. 2015). Following
90 the pilot study, a few questions were modified slightly.

91 ***Intervention***

92 The supplementary foods included six different CSB and six different LNS, with either dehulled soy (DS) or
93 soy isolate (SI) and with 0%, 20% or 50% of total protein as dry skimmed milk (DSM). The CSB and six LNS
94 could not be distinguished from each other respectively, but CSB vs LNS could not be blinded. All
95 supplements were manufactured by GC Rieber Compact A/S (Bergen, Norway) and had similar
96 micronutrient content provided by a pre-mix of vitamins and minerals designed according to a WHO
97 Technical Note on supplementary foods for the management of MAM (World Health Organization 2012). A
98 daily ration of LNS (92 g) or CSB (120 g) provided 500 kcal per child.

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

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

110 **Home visits, interviews and focus group discussions**

111 ***Participants***

112 For the qualitative component of the study, purposive sampling was used from three of the five research
113 sites (Gonponsom, Latoden, and Bokin) to include a subsample of participants from the main trial. All five
114 sites were very similar in terms of population and the selection of the three sites was therefore based on
115 practicalities and the convenience of the research assistant conducting the home visits. Efforts were made
116 to ensure that a diversity of participants was represented and included breastfed and non-breastfed
117 children and children from the CBS and LNS diet groups. Seasonality was considered to influence feeding

118 behaviours, due to the variations in the workload of the caretakers and food availability. Consequently this
119 part of the study was conducted both during the dry and rainy season.

120 ***Design***

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

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

139 **Data analysis**

140 For outcomes coming from the questionnaires, related to how, when and where the supplements were fed
141 (frequency and mode of consumption and serving), logistic mixed effect models for pairs of categories were
142 used in order to evaluate and quantify the effect of the supplements, while adjusting for age, sex, and
143 season as well as sites (modelled through random effects). To quantify differences between CSB and LNS,
144 odds ratios and differences in proportions, with corresponding 95% confidence intervals (CI), were
145 estimated. Outcomes on observed feeding behaviours from the smaller sub study made during the home
146 visits were simply summarized as raw proportions which were compared between CSB and LNS using chi-
147 square tests.

148 The analysis of the qualitative data was done manually by the first author, using principles of Qualitative
149 Content Analysis (Graneheim and Lundman 2004). First, each interview and FGD was kept intact and read

150 through several times to search for common themes. From the text, condensed meaning units or portions
151 of the text connected to a central meaning were formed and coded for that specific meaning and classified
152 into categories from where themes emerged. Codes and categories could fit into more than one theme.
153 Finally, findings from each of the interviews/FGDs were compared with the aim of exploring similarities,
154 differences and patterns. This characterizes the direction of qualitative content analysis and rests on the
155 underlying assumption that there are many different ways of analysing reality. Consequently, a certain
156 degree of interpretation is involved in the analysis of data (Graneheim and Lundman, 2004). An example of
157 the analytical process can be found in **Table 1**.

158 **Ethical approval**

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

163 **Results**

164 **Characteristics of trial participants**

165 Out of 1609 children included for the main trial, 1546 children, who had completed one month of
166 supplementation, were included for the final analysis of this study. Out of the 63 children not included, 21
167 children were lost to follow-up, 31 children had developed severe acute malnutrition during the first month
168 of supplementation and were therefore receiving other treatment, while eight children had received
169 replacement supplements (Plumpy Supp) due to a positive salmonella test of the supplement that was
170 allocated to them. Finally, two children died and the caretaker of one child withdrew consent. The mean
171 (SD) age was 13.3 (4.8) months and 94.6% (n=1460) of the children were breastfed at the time of inclusion,
172 while 93.0% (n=1431) were breastfeeding after one month of supplementation. The ethnic origin of the
173 participants was Mossi for 94.0% (n=1452) of participants. The majority, 58.7% (n=907), were Muslim,
174 24.0% (n=371) were Catholic, 6.2 % (n=95) were Protestant, and 11.1% (n=169) had traditional beliefs.
175 Randomization generally resulted in baseline balance between the main diet groups (Table 2) as well as the
176 12 individual groups (data not shown, but reported previously (Luel-Brockdorf et al. 2016)), except that
177 proportion of males ranged from 41.8 to 51.5%.

178

179 **Characteristics of participants from the home visits/interviews and FGDs**

180 Ten of the children in the home visit and interview subsample received CSB and ten received LNS. Their
181 demographic data and nutritional status were similar to the full cohort, although there was a higher
182 representation of boys (65%, n=13). Also, children receiving CSB were older (mean (SD) 14.3 months (4.3))
183 than children receiving LNS(mean (SD) 12.3 months (6.3)). Eighteen of the children were living with both
184 mother and father, while one lived with only the mother and one with the grandmother. Eighteen of the
185 children were breastfed, equally divided between the two groups. The mean duration (SD) of
186 supplementation at the time of the home visits were 6.8 (2.7) weeks for children receiving CSB and 6.2 (1.8)
187 weeks for children receiving LNS. The mean duration (SD) of the home visits was 9.4 (0.8) hours and 9.5
188 (0.6) hours for children receiving CSB and LNS respectively and a total of 95 meals were observed (CSB 46,
189 LNS 49). Half of the home visits were conducted during the rainy season (50%, n=30).

190 Twenty individual interviews and nine FGDs were carried out The FGDs were divided in the following way to
191 ensure that the different feeding behaviours related to the different supplements could be discussed: four
192 FGDs with caretakers of children receiving r CSB, four FGDs with caretakers of children receiving LNS and
193 one mixed FGD with caretakers of children receiving either CSB or LNS. A total of 51 female caretakers
194 participated in the FGDs and the mean (SD) age was 30 years (7.2).

195 **Results from questionnaire-based interviews**

196 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
197 per day, p<0.001). Supplements were mainly reported to be served between meals (as a snack) or as a meal
198 (no other foods served at the same time). The mode of serving differed significantly between LNS and CSB
199 (p=0.002): LNS were more likely to be served with a meal or between meals compared to CSB, but less
200 likely to be served as a meal (**Table 3**). Both types of supplements were mainly reported to be consumed
201 alone and not mixed into other foods, but LNS were more likely to be mixed into other foods compared to
202 CSB (**Table 3**).

203 **Results from structured observations during home visits**

204 A total of 95 meals were observed during the home visits of 20 children; 48% (n=46) meals with CSB and
205 52% (n= 49) meals with LNS. The mean (95% CI) duration of the meals was 10.6 minutes (8.3-12.9) for CSB
206 and 10.4 minutes (8.2-12.6) for LNS, excluding time for preparation (of CSB) and hygienic precautions. The
207 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.

208 Other similarities in feeding behaviours identified during the home visits were that both diet groups were
209 mainly fed by the caretaker and were consumed between meals and served alone, not mixed into other

210 foods. In 13.3% (n=6) of the meals with CSB, flours were served unprepared where the child would eat the
211 flours by hand by themselves, like cookie-crumbles (**Table 4**).

212 The main differences were found within the feeding environment, feeding style and utensils used for
213 feeding: more meals with CSB were served while the child was alone, away from other children, compared
214 to meals with LNS (CSB 86%, LNS 67%, difference (95% CI) 19% (2%: 36%), p=0.03). Furthermore, the mean
215 proportion of meals fed using an encouraging feeding style, defined as “*feeding with positive verbal*
216 *encouragement, without verbal and physical coercion*” (Gretel H Pelto, Levitt, and Thairu 2003) was higher
217 in the LNS group (CSB 63%, LNS 87%, difference (95% CI) 23% (6%:40%), p=0.01), while the proportion of
218 meals served using a forced feeding style, described as caretakers repeatedly trying to push the food into
219 the mouth of the child if he/she was refusing to eat, was higher in the CSB group (CSB 26%, LNS 8%,
220 difference (95% CI) 18% (3 %:33 %), p=0.02). Finally, more meals with CSB were served using a spoon
221 compared to LNS meals (CSB 91 %, LNS 16%, difference (95% CI) 75% (62%:88%), p= <0.001) (**Table 4**)

222 **Findings from individual interviews and FGDs**

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

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

227
228 *He finishes the [LNS] supplement in one meal as he has been told to do*
229 *(32-year old caretaker of 17-months old boy)*

230
231 *When they wake up in the morning, we prepare the CSB porridge for them, and then after the*
232 *porridge, they eat the tô [local dish, a bitter pulp made from crushed, cooked millet,*
233 *sorghum or corn and consumed with a vegetables sauce]. At noon we prepare the [CSB]*
234 *porridge for them and the tô as well and in the evening they eat the tô and the [CSB] porridge*
235 *before going to sleep.* (FGD Gonponsom)

236

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

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

243

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

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

251 *Sometimes I force her if she categorically refuses to drink it [CSB]*
252 (25-year old caretaker of 11-months old girl)
253

254 Some caretakers of children receiving LNS said that the children often preferred eating the supplements by
255 themselves, while others said that they fed their children by hand as it allowed them to better dose the
256 quantity and made the child consider the supplement as food instead of medicine.

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

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

262 Many caretakers of children receiving CSB said that their children preferred eating the flours raw. This way,
263 the child would take or be given a handful of the CSB and snack on the flours like cookie crumbs.

264 Additionally, some caretakers said that they prepared the CSB flours with less water, into what they called
265 “couscous” (high viscosity porridge), if the child was refusing to eat.

266 *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*
267 *he vomits immediately afterwards. But he can eat two measures of flour plain in one single*
268 *meal* (FGD Gonponsom)

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

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

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

276 *Yes, but when he refuses I don't give him anything to eat for a long period of time, and then I*
277 *give him the supplement [LNS], and often he manages to eat very well.*
278 (30-year old caretaker of 19-months old boy)

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

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

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

292

293 **Discussion**

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

297 ***Mode of serving***

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

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

311 ***Who were feeding the supplement***

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

322 ***How and where supplements were fed***

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

342 ***When were supplements consumed***

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

353 Finally, our results show a discrepancy between reported and observed findings such as how many times
354 per day supplements were fed as caretakers reported to feed the supplements more frequently than what
355 was observed. Similar discrepancy in terms of adherence to supplements has been reported previously
356 (Abbeddou et al. 2014, Flax et al. 2010, Ashorn et al. 2015) and may be due to participants engaging in
357 social desirability or difficulties adhering to the recommended frequency of feeding, which may influence
358 the total energy intake of the child.

359 ***Strengths and limitations***

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

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

375 recommended feeding behaviours was poorer during observations compared to the feeding behaviours
376 reported.

377 **Conclusion**

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

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Key Messages

390 *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.*

391 *An encouraging and tactile feeding style was more likely with LNS, while CSB were more likely to be
392 fed using a forced feeding style*

393 *Educational instruction in nutritional programs should be adapted according to the supplement
394 provided to ensure adherence to the treatment and adequate consumption*

395 *Efforts should be made to prevent CSB to be served unprepared until the consequences of such
feeding behaviour have been explored further.*

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398 **Conflict of interest**

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

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Tables

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

<p>General</p> <ul style="list-style-type: none"> • 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. 	
<p>Hygiene</p> <ul style="list-style-type: none"> • 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 	
<p>Feeding behaviors</p> <ul style="list-style-type: none"> • Be patient and actively encourage child to eat. • Don't force child to eat. 	
<p>Health</p> <ul style="list-style-type: none"> • In case of diarrhoea, continue feeding. Provide extra food and water. 	
CSB	LNS
<ul style="list-style-type: none"> • The porridge should be given 3 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 minutes and a maximum of 10 min. • Let the porridge cool of 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 	<ul style="list-style-type: none"> • 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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Table 1. Examples from the analytical process using principles of qualitative content analysis

Meaning Unit	Condensed meaning unit	Code	Category	Theme
<p><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></p> <p>32-year old mother of 17-months old child receiving LNS</p>	<p>Child prefers supplement plain, and supplement is served before other foods</p>	<p>Supplement served plain before other foods</p>	<p>Mode of consumption</p>	<p>Feeding behaviors</p>
<p><i>Me, I prefer to sit down and give it to him gently so that it doesn't get dirty. I saw the neighbour'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 diarrhoea every day: I don't want this to happen to our child, this is why I am careful feeding him myself</i></p> <p>24-year old mother of 20-months old child receiving LNS</p>	<p>Caretaker feeding the child herself carefully to ensure hygienic precautions and prevent diseases</p>	<p>Caretaker feeding child</p>	<p>Who is feeding the child</p>	<p>Feeding behaviors</p>

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) (+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 (+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)

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) ¹	P-value
Mode of consumption % (n) CSB vs LNS	Alone	78.4 (600)	71.5 (555)		
	Mixed with other foods	21.6 (165)	28.5 (221)	1.7 (1.3-2.2)	<0.001
Mode of serving % (n)	With a meal	16.7 (127)	20.6 (158)	1.6 (1.1 - 2.3)	0.018
	Between meals (as a snack)	40.9 (312)	45.8 (351)	1.5 (1.1-1.9)	0.005
	As a meal ²	42.4 (323)	33.6 (258)	0.6 (0.5-0.8)	<0.001

¹ adjusted for age, sex, and season as well as sites (modelled through random effects).

² no other foods served at the same time

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)	0.69
	alone	85 (39)	81 (40)	4 (-11 : 19)	
Supplement consumed, % (n)	as a meal	44 (20)	46 (22)	-2 (-22 : 18)	0.81
	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)	0.68
	caretaker some of the time	2 (1)	2 (1)	0 (-16 : 16)	>0.999
	eats alone all of the time	17 (8)	14 (7)	3(-11 : 17)	0.69
	eats alone some of the time	4 (2)	2 (1)	2 (5 : 9)	0.57
Positioning of child % (n)	Sitting on the ground	15 (7)	23 (11)	-8 (-24 : 8)	0.32
	Walking, standing	7 (3)	12 (6)	-5 (-17 : 5)	0.31
	With caretaker (on lap, in the arms of)	78 (36)	65 (32)	13 (-4 : 31)	0.16
Feeding environment, % (n)	child eating with other children	14 (6)	33 (16)	-19 (-36 : -2)	0.03
	child eating alone	86 (37)	67 (33)	19 (2 : 36)	
Caregiver behaviors % (n)	encouraging feeding	63 (29)	86 (42)	-23 (-40 : -6)	0.01
	forced feeding	2 (12)	8 (4)	-6 (-14 : 2)	0.02
	indifferent/laissez-faire feeding	13 (6)	6 (2)	7 (-5 : 19)	0.24
	restrictive feeding	9 (4)	2 (1)	7 (-2 : 16)	0.13
Utensils used for feeding, % (n)	spoon	91 (42)	16 (8)	75 (62 : 88)	<0.001
	hands of caretaker	9 (4)	59 (29)	-50 (-66:34)	
	LNS sachet	-	25 (12)	-	