

Unconditional seasonal cash transfer increases intake of high-nutritional-value foods in young Burkinabe children: results of 24-hour dietary recall surveys within the MAM'Out randomized controlled trial

Audrey Tonguet-Papucci, Freddy Hougbe, Lieven Huybregts, Myriam Ait Aissa, Chiara Altare, Patrick Kolsteren, Jean-François Huneau

► **To cite this version:**

Audrey Tonguet-Papucci, Freddy Hougbe, Lieven Huybregts, Myriam Ait Aissa, Chiara Altare, et al.. Unconditional seasonal cash transfer increases intake of high-nutritional-value foods in young Burkinabe children: results of 24-hour dietary recall surveys within the MAM'Out randomized controlled trial . Journal of Nutrition, American Society for Nutrition, 2017, 147 (7), pp.1426-1436. <10.3945/jn.116.244517 >. <hal-01572245>

HAL Id: hal-01572245

<https://hal-agroparistech.archives-ouvertes.fr/hal-01572245>

Submitted on 5 Aug 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 Unconditional seasonal cash transfer increases intake of
2 high-nutritional-value foods in young Burkinabe children:
3 results of 24-hour dietary recall surveys within the
4 MAM'Out randomized controlled trial
5

Audrey Tonguet-Papucci ^{1,2,3}, Freddy Hounbe ^{1,2}, Lieven Huybregts⁴, Myriam Ait-Aissa ¹,
Chiara Altare ¹, Patrick Kolsteren², Jean-François Huneau³

¹ Research and Analyses Unit, Action Contre la Faim, Paris, France

² Department of Food Safety and Food Quality, Ghent University, Ghent, Belgium

³ UMR Physiologie de la Nutrition et du Comportement Alimentaire, AgroParisTech, INRA,
Université Paris-Saclay, 16 rue Claude Bernard, 75005 Paris, France

⁴ Poverty, Health and Nutrition Division, International Food Policy Research Institute,
Washington DC, United States of America

Corresponding author: Audrey Tonguet-Papucci, apapucci@actioncontrelafaim.org

Action Contre la Faim - 14/16 Boulevard Douaumont - CS 80060 - 75854 PARIS CEDEX 17

Phone: +33 6 64 99 92 93

- **List of authors' last names:** Tonguet-Papucci, Hougbe, Huybregts, Ait-Aissa, Altare, Kolsteren, Huneau
- **Word count from abstract to end of references, including tables:** 6950
- **Number of figures:** 1
- **Number of tables:** 6
- **OSM submitted:** none
- **Running title of 50 or fewer characters and spaces:** Unconditional cash transfers and children's diets
- **Source of financial support:** The data presented in this article are part of the MAM'Out study, funded by *Action Contre la Faim*, France and the Center for Disease Control and Prevention, USA. The cash transfer program was made possible thanks to ECHO funds. The MAM'Out project also received financial contributions from ECHO (European Union), USAID (through the Technical Operational Performance Support program, USA) and *Fondation Recherche d'Action Contre la Faim* (France) for research uptake and the dissemination of results.
- **Conflict of interest and funding disclosure:** ATP, FH, CA and MAA are currently employed by *Action Contre la Faim* who implemented the MAM'Out study. LH, PK and JFH do not have any conflict of interest.

6 Abstract

7 **Background:** Cash transfer programs have the potential to improve dietary intake by
8 improving accessibility to food. However, quantitative data on the impact of cash transfer
9 programs on children's energy and nutrient intake is lacking.

10 **Objective:** The aim of this study was to evaluate the effect of seasonal unconditional cash
11 transfer on children's energy, micro and macronutrient and food group intake during the lean
12 season in Burkina Faso.

13 **Methods:** Within the framework of the MAM'Out study, a cluster randomized controlled trial,
14 two 24-h dietary recall surveys were conducted in July and August 2014. Daily energy,
15 macro- and micronutrient intake, breastfeeding practices, as well as food group consumption,
16 were analyzed for 322 children aged 14 to 27 months from the intervention group (benefiting
17 from unconditional cash transfer during the lean season 2013 and 2014) and the control
18 group, using mixed linear/logistic/Poisson regression models or a gamma-generalized linear
19 model with log-link. A dietary diversity score was calculated based on seven food groups.

20 **Results:** Unconditional cash transfers during the lean season improved the diets of rural
21 children through higher consumption of eggs ($11.3 \text{ g} \pm 1.55$ vs $3.25 \text{ g} \pm 0.79$, $p < 0.001$), fat
22 ($20.6 \text{ g} \pm 0.80$ vs $16.5 \text{ g} \pm 0.89$, $p < 0.01$) and vitamin B12 ($0.40 \text{ mg} \pm 0.02$ vs $0.34 \text{ mg} \pm 0.02$,
23 $p < 0.001$) compared to controls, and higher proportions of children eating dairy products (OR:
24 4.14 (1.48, 11.6), $p < 0.05$), flesh food (OR: 2.09 (1.18, 3.70), $p < 0.05$), eggs (OR: 3.61 (1.56,
25 8.37), $p < 0.05$) and iron rich or iron fortified food (OR: 2.23 (1.20, 4.13), $p < 0.05$). No
26 difference was found in energy intake between the two groups. The minimum dietary
27 diversity of two thirds of the children who benefited from cash transfers was adequate
28 compared to that of only one third in the control group ($p < 0.001$).

29 **Conclusion:** Unconditional seasonal cash transfer increases dietary diversity and intake of
30 high nutritional value foods in Burkinabe children aged 14 to 27 months. As such, their use

31 can be recommended in actions addressing children's dietary intake during the lean season.
32 Study registered in ClinicalTrials.gov (NCT01866124).

33

34 **Key words**

35 24-h dietary recall survey, children, diet, Burkina Faso, nutrient intake, energy, cash transfers

36

37 **Introduction**

38 Although progress has been made in the fight against child undernutrition in recent years, it
39 is still a public health issue worldwide [1]. Nutritional disorders, including wasting, stunting,
40 vitamin A and zinc deficiencies, fetal growth restriction and inadequate breastfeeding are
41 responsible for 45% of all deaths among children under 5 years old, or 3.1 million deaths
42 annually [2]. In Burkina Faso, West Africa, child nutritional status is particularly worrying:
43 32.9% of all children under 5 are stunted, 10.9% wasted and 14% suffered from low birth
44 weight in 2013 [3]. A recent study in rural Burkina Faso using biomarkers also found high
45 deficiency rates for zinc (25.6–73.5%) and moderate deficiency rates for vitamin A (6.0–
46 30.6%), as well as high rates of anemia (29.4–72.3%) among women and preschool children
47 [4].

48 To date, various strategies have been implemented in humanitarian contexts to tackle
49 children's undernutrition, including nutrition specific interventions such as food based
50 strategies [5-8] to address its direct causes, and nutrition sensitive activities to address its
51 underlying determinants [9]. Among nutrition sensitive activities, social safety nets, mainly
52 implemented as cash transfer programs, have been shown to have positive effects on food
53 security [10-12] and on household expenditures on food [13, 14]. However, most studies that
54 have evaluated the impact of cash transfer on child nutritional status used proxies such as
55 dietary diversity scores [12, 15, 16] that do not enable assessment of whether energy and

56 nutrient intake in the child's diet are adequate. There is thus a lack of quantitative data on the
57 effect of cash transfer programs on children's dietary intake.

58 A multiannual seasonal and unconditional cash transfer program was implemented in 2013
59 and 2014 in Tapoa Province, in the Eastern Region of Burkina Faso, in the framework of the
60 MAM'Out study. We designed a cluster randomized controlled trial to evaluate the effect of
61 the program on the prevention of child acute malnutrition [17]. The main objective of this 24-h
62 dietary recall sub-study was to assess the impact of the cash transfer program in the first
63 place on the energy intake of beneficiary children aged between 14 and 27 months during
64 the 2014 annual lean season, corresponding to the period between harvests May to
65 September when people rely on market for their food needs. We further compared the micro-
66 and macronutrient intakes between intervention and control groups.

67

68 **Methods**

69 *The MAM'Out study*

70 The Moderate Acute Malnutrition Out (MAM'Out) study [17] was implemented from June
71 2013 to October 2015 in Tapoa Province, in the Eastern Region of Burkina Faso. The aim
72 was to evaluate whether multiannual seasonal unconditional cash transfers helped prevent
73 acute malnutrition in young children. It was designed as a cluster randomized controlled trial,
74 in which 16 villages received monthly cash payments from July to November in both 2013
75 and 2014, and 16 other villages were used as the control group. The cash (10,000
76 FCFA/month, approx. US\$17) was distributed to mothers via mobile phone, with no
77 conditions or restrictions on use. As cash transfers were unconditional, beneficiaries didn't
78 have to fulfill conditions other than the inclusion criteria in order to receive cash. In June
79 2013, 1,278 children under 1 year of age and living in poor or very poor households
80 according to the Household Economy Approach [18] were included in the study and followed
81 up for up to two years. The study, including the 24-h dietary recall survey, was registered in

82 ClinicalTrials.gov (NCT01866124) on May 7, 2013, and received ethical approval from two
83 separate ethics committees: in April 2013 from the Ethical Committee of the University
84 Hospital of Gent and in May 2013 from the Burkinabe National Ethical Committee.

85 *Study population and sample size*

86 The Eastern Region of Burkina Faso has a Sudan-Sahelian climate, characterized by two
87 distinct seasons: a hot and dry period from October to May and a rainy season from June to
88 September. The 24-h dietary recall was a cross-sectional sub-study nested within the
89 MAM'Out study. Due to limited access in the rainy season, six remote clusters were
90 purposely excluded from this sub-study: three in the control group and three in the
91 intervention group. A subsample of children included in the MAM'Out study was then
92 randomly chosen among the 26 remaining villages to be part of the 24-h dietary recall study.
93 No restriction was put on the children's age or nutritional status. Children in both arms were
94 randomly selected using the computer random number generator in Stata 12.0 (Statacorp,
95 USA). With a Type I error of 5% and a statistical power of 80%, assuming a size effect of 0.4
96 and a design effect of 1.5 [19], with 13 clusters per study arms, 156 children per study arm
97 were required. Allowing for 5-10% non-response we increased the sample size to 166 per
98 study arm.

99 *Data collection*

100 Four teams of two data collectors received one week of training on the multi-pass 24-h
101 dietary recall method [20]. Standardization exercises for food weight measurements and
102 interview techniques were taught and questionnaires pre-tested. All data collectors spoke
103 Gulmancema (the main local language) and two also spoke Pulaar fluently. Two of the data
104 collectors were selected to be supervisors during data collection to check the quality of data
105 collection and coordinate awareness raising activities on the 24-h dietary recall study. These
106 activities took place one or two days prior to data collection and consisted in a visit to the
107 selected household and the presentation of the data collection procedure. The caregiver was

108 also given a standard 24-h recall kit comprising a plate and a bowl to estimate the quantities
109 eaten by the child. Caregivers were asked to set aside a small quantity of the food eaten by
110 the child the day before the visit to facilitate the recall and to take note of the ingredients
111 used to prepare the food.

112 Data were collected during the lean season and the cash transfer period (July and August
113 2014). It consisted of two interactive 24-h dietary recalls and two questionnaires on
114 breastfeeding practices per child on two non-consecutive days. This was meant to reduce
115 bias due to dependency of intake on two consecutive days due to the possible consumption
116 of leftovers. On the day of data collection, data collectors asked the caregiver to describe the
117 food consumed by the child on the previous day. Information was recorded on a classic 24-
118 hour food recall form as proposed by Gibson and Ferguson [20]. To minimize recall bias,
119 interviews were held using a standardized three pass method adapted from Gibson and
120 Ferguson's manual for developing countries [20]. First, the caregiver was asked to recall all
121 the foods the child ate the previous day, including snacks and drinks, from the moment the
122 caregiver woke up the day before until the moment they woke up on the day of the recall
123 interview. The caregivers were then asked to describe the composition of the enlisted
124 composite foods and beverages. The next step was estimating the amounts of foods and
125 beverages consumed using the recall kit. Tanita digital scales, model KD-400 (Tanita
126 Corporation, USA) (precision 1 g) were used to weigh the food. The scales were calibrated
127 daily. In the final step, the data collectors read back all the answers to check no answers had
128 been omitted. Each interview lasted between 45 minutes and one hour.

129 Recalled composite food and beverage intakes were converted to single ingredients using
130 standardized recipes. A list of the main composite dishes was then extracted from
131 preliminary analysis of the 24-h dietary recall data. For each composite dish, five caregivers
132 living in the study area were asked to prepare the composite food to identify its main
133 ingredients. Raw ingredients, their amounts, the total cooked weight and volume were
134 recorded to compile standardized recipes.

135 As the children randomly selected to participate in the 24-h dietary recall surveys were
136 between 14 and 27 months old, many of them were still breastfed. Hence breastfeeding
137 practices were evaluated in addition to the quantity of food eaten using a detailed
138 questionnaire. The number of times a child was breastfed, the time of the day and the
139 approximate duration of each session were recalled. Data collectors asked the caregiver to
140 recall their previous day, beginning when they woke up the previous day and ending when
141 they woke up on the day of the interview. Each breastfeed was then recorded in a table with
142 its approximate duration (0-10 minutes, 11-20 minutes or 21-30 minutes).

143 The data collected in the 24-h dietary recalls and breastfeeding questionnaires were coded
144 with the unique identification number allocated to each child in the MAM'Out study [17]. None
145 of the paper records included the child's name or address.

146 In addition, data concerning the children's nutritional status and date of birth, level of
147 education of the caregiver and the households' socio-economic status (SES) were imported
148 from the MAM'Out database for the purpose of analysis. For SES, tertiles were created
149 among the poor and very poor households included in the study using principal component
150 analysis (PCA) based on declared assets ownership. Stunting is defined by a height-for-age
151 Z-score inferior to -2 (according to the 2006 WHO growth standards [21]) and wasting as a
152 weight-for-height Z-score inferior to -2 or presence of bilateral pitting edema. These data
153 were collected from June 23 to September 26, 2014, thus including the 24-h dietary recall
154 period.

155 *Data analyses*

156 Data on the 24-h dietary recalls were entered in Lucille®, a computer program conceived by
157 Ghent University, Belgium, and analyzed using Stata 12.0. The food composition table used
158 to describe the quality of the intake was a combination of three sources. The West African
159 food composition table endorsed and developed by the Food and Agriculture Organization
160 and the International Network of Food Data System [22] was used as the primary data

161 source to obtain energy and nutrient concentrations per food. However, a check of the 24-h
162 dietary recall questionnaires revealed that some food products consumed by the children
163 were missing. Information on the missing products was taken from the food composition
164 table for Burkina Faso also used by Arsenault and al. [19]. If no information was available on
165 a given food (e.g. sparrow hawk meat and djonkin juice) in the Burkinabe table, an Internet
166 search was conducted or the information (for Yonhanma flour, Plumpy'nut and
167 Supplementary Plumpy) was taken from the label on the food product. The composition of
168 73% of the ingredients of the consumed food were obtained from the West African food
169 composition table [22], 20% from the Burkina Faso food composition table [19], 3% from
170 Internet and 4% from food product labels.

171 The absorption of certain micronutrients such as iron, calcium and zinc by the human body
172 depends on their chemical forms and on the presence of anti-nutrients that inhibit absorption
173 [20]. To account for differences related to the different food sources, absorbed iron was
174 calculated based on the bioavailability factors of iron and 6% of iron bioavailability was
175 applied to plant food sources and 11% to animal ones [23, 24]. For absorbed calcium, 25%
176 was applied to roots, tubers, legumes and grains, 45% to fruits and vegetables, 32% to all
177 other food groups [24]. As phytate concentrations were not available, it was not possible to
178 calculate the phytate to zinc molar ratio. The absorption level for zinc derived from the 2004
179 working group of the International Zinc Nutrition Consultative Group was used instead. The
180 15% zinc bioavailability is based on a diet based on unrefined cereals [25].

181 Data obtained from the breastfeeding questionnaires were entered in Epidata software and
182 analyzed using Stata 12.0. The mean duration of breastfeeding was calculated by summing
183 the approximate durations of each breastfeeding session over the recalled day: 5 minutes
184 was used if the mother said breastfeeding lasted between 1 and 10 minutes, 15 minutes if
185 the answer was between 11 and 20 minutes, and 25 minutes if the answer was 21-30
186 minutes. The mean number of breastfeeding sessions, the mean duration of a breastfeeding
187 session and the percentage of children still breastfed were also calculated.

188 A dietary diversity score (DDS) was calculated based on seven food groups, namely (1)
189 Grains, roots and tubers; (2) Legumes and nuts; (3) Dairy products; (4) Flesh food; (5) Eggs;
190 (6) Vitamin A rich fruits and vegetables; (7) Other fruits and vegetables [26]. DDS were
191 calculated by summing the number of unique food groups eaten by the child during the 24h
192 dietary recall period. Meal frequency was calculated by summing the number of time each a
193 child ate solid, semi-solid or soft foods (even a snack), during the day. The minimum
194 acceptable diet was defined by the World Health Organization as having a DDS equal to or
195 above 4 and a sufficient meal frequency (e.g. 3 and 4 meals/24 h for breastfed and non-
196 breastfed children, respectively) [26]. The proportion of children consuming iron-rich or iron-
197 fortified food was also calculated including the consumption of flesh food and commercial or
198 homemade fortified foods.

199 The 2005 estimated energy requirement (EER) by age group and sex published by the
200 Institute of Medicine [27] were used to identify outliers for energy intakes. An arbitrary over-
201 reporting threshold was established when the mean energy intake of a child was more than
202 twice the EER for his/her sex and age group. In the same way, underreporting was
203 considered when the mean energy intake was less than 30% of the EER for the child's age
204 group and sex. A total of eight children were excluded from the study: three for over-reporting
205 in the control group, four for over-reporting in the cash group and one for under-reporting in
206 the control group. Two children aged more than 27 months old were also excluded from the
207 study because they were outliers in age. Data were analyzed with and without exclusion of
208 these 10 children and the overall results did not differ.

209 The primary outcome of the study was child energy intake. Usual intake distributions of
210 nutrients and energy were generated using the Multiple Source Method (MSM) [28] based on
211 the two dietary recalls collected per child. No covariate was added to the model. The usual
212 intake distributions obtained were subsequently used to calculate means and standard
213 deviations to describe the children's intakes. Differences in energy and nutrient intakes
214 between the intervention and the control groups were analyzed using linear mixed models

215 including *village* as random effect to account for clustered observations. Fixed effects
216 included in the models were the child's age at recall, child's sex, mother's literacy rate and
217 household's socio-economic status. When the distribution was not bell shaped, variables
218 were first log-transformed and then analyzed. Mixed-effects Poisson regression models were
219 used to analyze differences in the dietary diversity score and the number of meals per day.
220 Random and fixed effects were the same as the ones described above. Differences in the
221 quantities of each food group consumed by children in the intervention and control groups
222 were analyzed using a gamma generalized linear model (GLM) with log link [29] adjusted for
223 *village* as random effect and adjusted for all the above mentioned co-variates. This model
224 was chosen to take into account the high frequencies of non-consumption among the data,
225 resulting in many zeros in the dataset. All the tests were two-sided and a statistical
226 significance level of 5% was used for all analyses.

227

228 **Results**

229 *General characteristics*

230 The data available for analysis included two dietary recalls from 322 children aged 14 to 27
231 months (**figure 1**). All children sampled were surveyed. The child characteristics (**table 1**)
232 were balanced between children in the intervention and control group for age and
233 breastfeeding practices. Children were on average 20.5 ± 0.16 months old and 72% were still
234 partially breastfed. The mean duration of breastfeeding per day was 52.3 ± 2.18 minutes and
235 each breastfeeding session lasted 6.86 ± 0.28 minutes. The intra-class correlation between
236 the two recalls for the duration of each breastfeeding session was 0.80 (95% CI: 0.76, 0.84)
237 ($p < 0.0001$), for the total duration of breastfeeding per day 0.80 (95% CI: 0.76, 0.84)
238 ($p < 0.0001$) and for the mean number of breastfeeding session per day 0.56 (95% CI: 0.48,
239 0.65) ($p < 0.0001$). Child nutritional status was also balanced between the intervention and
240 control group with the exception of the mean weight-for-height Z-score, which was slightly

241 lower in the control group than in the intervention group (-0.89 ± 0.07 vs. -0.77 ± 0.07). The
242 socio-economic status also slightly differed between households benefiting from cash
243 transfers and control households, with more intervention households being classified as
244 having a medium socio-economic status (40.9 % vs 32.9 %).

245 *Indicators for food diversity and infant and young child feeding practices*

246 After the cash transfer, the 24-h dietary recall surveys identified that a bigger proportion of
247 children in the intervention group ate milk and dairy products (25.0 % vs 7.41%; $p=0.007$),
248 flesh food (26.3% vs 14.8%; $p=0.01$) and eggs (31.3% vs 11.1%; $p=0.003$) compared to
249 children in the control group (**Table 2**). In terms of quantities, children in the intervention
250 group ate on average more eggs ($p<0.001$) than children in the control group (**Table 3**).

251 There was a trend towards a higher mean diet diversity score for the children in the
252 intervention group (4.02 ± 0.06) compared to that of the children in the control group ($3.61 \pm$
253 0.05) ($p=0.07$) (**Table 4**). Approximately two thirds of the children in the intervention group
254 had adequate minimum dietary diversity compared with one third in the control group
255 ($p<0.001$). We did not observe a difference in the frequency of meals between the groups
256 and almost all children in both groups had an adequate minimum meal frequency. The
257 percentage of children who consumed iron-rich or iron-fortified food was also higher in the
258 intervention group (35.6%) than in the control group (21.1%) ($p<0.05$).

259 *Energy and nutrient intakes*

260 We didn't find any significant difference in mean energy intake from complementary food
261 (defined as all solid, semi-solid and soft foods given to the children in addition to
262 breastfeeding) between the intervention and the control groups (**Table 5**). However, we
263 measured that children in the intervention group ate more fat ($p<0.01$) than children in the
264 control group and had a tendency of consuming more protein ($p=0.06$). Considering the
265 contribution of macronutrients to energy intake, children who benefited from cash transfers

266 consumed more energy from fats ($p<0.01$) and less from carbohydrates ($p<0.01$) than
267 children in the control group.

268 Children in the intervention group had a statistically significant higher vitamin B12 ($p<0.001$),
269 riboflavin ($p<0.05$) and vitamin E ($p<0.05$) intake than children in the control group (**Table 6**).

270

271 Discussion

272 Our study aimed to assess the effects of seasonal unconditional cash transfers on energy,
273 micro- and macronutrient intake of young Burkinabe children using the strong design of a
274 randomized controlled trial. The results of the 24-h dietary recall surveys showed that cash
275 transfer during the lean season improved the diet of 14 to 27-month old children. We
276 observed positive effects on the quantity of eggs consumed as well as on the percentage of
277 children consuming meat, eggs and dairy products.

278 Our results of the impact of an unconditional cash transfer on children's dietary diversity and
279 frequency of food group consumption are in line with those of two other studies that
280 investigated the effect of unconditional cash transfers on children's diet. The Malawi Social
281 Cash Transfer Scheme led to a more diverse diet in beneficiary households with more
282 people eating meat, fish and dairy products compared to households in the control group
283 [15]. In Kenya, Haushofer and al. found that households benefiting from unconditional cash
284 transfers ate meat and fish more frequently than households in the control group [30].

285 Approximately two thirds of the children in the intervention group benefited from adequate
286 minimum dietary diversity compared to only one third in the control group. This is a
287 significant improvement over the figures cited in the most recent demographic and health
288 survey conducted in Burkina Faso, which reported that only 6.2% of children aged 6-23
289 months living in the Eastern Region consumed at least four food groups [31]. It is however
290 noteworthy to mention that 13.4% of the children in our study are 24 months old or above,
291 and that we surveyed children from 2 municipalities out of 27 of the Eastern Region.

292 We did not observe a difference in mean energy intake between children in the intervention
293 group and in the control group. However, the source of energy differed between the two
294 groups: energy originated mainly from fat in children in the intervention group and to a lesser
295 extent from carbohydrates as compared to children in the control group. Nevertheless,
296 relative fat intake remained to the lower end of the recommended complementary food fat
297 intake values (between 21% to 43% of the energy intake in case of medium level of energy
298 intake from breastmilk [32]).

299 Children in the present study had a mean complementary food density of 0.77 kcal/g and ate
300 an average of 4.8 meals per day. According to Dewey and Brown [32] children aged 12 to 23
301 months with a low level of energy intake from breastmilk should eat a minimum of 5 meals
302 per day if the complementary food density is 0.6 kcal/g, and 3.7 meals per day if the density
303 reaches 0.8 kcal/g. This number is based on the definition of meal frequency including both
304 meals and snacks, as defined by the World Health Organization [26]. Therefore, our results
305 show that the complementary food density was adequate during the lean season and
306 corresponded to international recommendations. This result was quite unexpected during the
307 lean season, given the high carbohydrate and low fat content of the complementary food the
308 children received. This outcome is partly due to the number of meals or snacks each child
309 consumed each day. In our study, the meal frequency of 99% of all children was adequate,
310 compared to that of only 39% of all children aged 6-23 months and living in the Eastern
311 Region of Burkina Faso [31]. One possible explanation could be linked to the age of the
312 children we surveyed, who are in average 20.5 months old, with 13% of the children above
313 24 months old.

314 Vitamin B12, riboflavin and vitamin E intakes were significantly higher in children in the
315 intervention group. This is encouraging given the important role of vitamins B12 and E in
316 immune system [33]. The higher intake of vitamin B12 may be the consequence of the larger
317 quantity of eggs eaten by children in the intervention group. However, despite the larger

318 quantities of iron-rich food consumed, we found no difference in iron intake between the two
319 groups.

320 Several strengths can be highlighted for this study. The 24-h dietary recalls were
321 implemented in the framework of a cluster randomized controlled trial and took advantage of
322 its strong design. All the basic characteristics of the intervention and control groups, including
323 height-for-height Z-score, were comparable, except for the slightly lower mean weight-for-
324 height Z-score of children in the control group. However, as adjusting the analyses for the
325 nutritional status and breastfeeding practices, which may both have changed as a result of
326 the cash transfer program, holds a risk of bias, we did not adjust the analyses for these two
327 factors. The one week training the data collectors underwent on the 24-h food recall
328 methodology allowed for the standardization and pretesting of the method of data collection.
329 In addition, the two month period of data collection was supervised: every week, two of the
330 children visited by each data collector were visited a second time by the supervisor to check
331 on the data collected. A number of study limitations also need to be addressed. First, we
332 were unable to adjust analyses for data collectors, due to an error during data entry.
333 Collector bias was nevertheless limited by the fact that two different data collectors
334 systematically conducted the two recalls in the same household. Secondly, the six clusters
335 excluded from data collection due to difficult access may have had higher prevalence of
336 acute malnutrition, compared to those included. The effect of the intervention might also
337 have been lower in these villages due to limited access to market. Thirdly, two thirds of the
338 children in the study were still breastfed at the time of the evaluation. To our knowledge, no
339 precise technique to evaluate the quantity of milk consumed by children is currently available
340 beyond weighing the baby before and after breastfeeding or giving isotopic labeled water to
341 mothers. In the MAM'Out study area, it was not possible to use either of these techniques
342 due to operational constraints. We tried to overcome this problem by designing a detailed
343 questionnaire on breastfeeding practices to estimate the number of times a child was
344 breastfed during the day and the corresponding duration, but this was still not sufficient to

345 estimate energy intake from breastmilk. One possible solution would have been to
346 hypothesize average breast milk intake as has been done in previous studies [34]. However,
347 this is still an estimation and does not measure the breastmilk intake precisely. Since the
348 same estimation method was used in both groups, we assume that the measurement error
349 was similar for the two groups. Fourthly, we did not adjust our analyses for multiple
350 hypothesis testing. Although this is still an ongoing debate [35], concerns may be raised
351 about the need to reevaluate the p-value used for the significance of results, which may
352 decrease the number of significant differences we found between groups. However, the
353 results presented here tend to go in the same direction (with higher number of children
354 consuming animal products in the intervention group, more eggs intake in term of quantities
355 and more B12 intake), which strengthen confidence in them [35]. Finally, no measurement of
356 body composition or biomarkers before and after the intervention was performed. As such, it
357 is hard to see the direct health benefits of the intervention. However, our results demonstrate
358 first of all that unrestricted and unconditional cash was used for food purposes and allow
359 improving children's diet quality. Yet, the amount distributed may have been too low with
360 respect to the family size in order to have a positive effect on child's health via an improved
361 diet quality.

362

363 **Conclusion**

364 Unconditional cash transfers during the lean season did not lead to a higher energy intake,
365 but improved the intake of mainly animal source foods amongst 14 to 27-month old
366 Burkinabe children living in rural areas. Two thirds of the children who benefited from cash
367 transfers also had an adequate minimum dietary diversity score compared to only one third
368 in the control group. Our results support the implementation of unconditional seasonal cash
369 transfer programs to improve children's diet and nutritional intake during the lean season. We
370 therefore recommend their use in actions addressing children's dietary intake during this
371 difficult period.

372

Acknowledgement

373 ATP, LH, MAA, PK and JFH designed the research; FH conducted the research; ATP
 374 performed statistical analysis; ATP, FH, LH, CA, JFH and PK wrote the paper; ATP had
 375 primary responsibility for final content. All the authors read and approved the final
 376 manuscript.

377

References

- 378 1. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, Ezzati M, Grantham-
 379 McGregor S, Katz J, Martorell R, et al: **Maternal and child undernutrition and overweight in**
 380 **low-income and middle-income countries.** *Lancet* 2013, **382**:427-451.
- 381 2. **Global Health Observatory (GHO) data. MDG 1: Eradicate extreme poverty and hunger**
 382 3. **The state of the World's Children 2015 Country Statistical tables - Burkina Faso**
- 383 4. Martin-Prevel Y, Allemand P, Nikiema L, Ayassou KA, Ouedraogo HG, Moursi M, De Moura FF:
 384 **Biological Status and Dietary Intakes of Iron, Zinc and Vitamin A among Women and**
 385 **Preschool Children in Rural Burkina Faso.** *PloS one* 2016, **11**:e0146810.
- 386 5. Huybregts L, Hougbe F, Salpeteur C, Brown R, Roberfroid D, Ait-Aissa M, Kolsteren P: **The**
 387 **effect of adding ready-to-use supplementary food to a general food distribution on child**
 388 **nutritional status and morbidity: a cluster-randomized controlled trial.** *PLoS medicine* 2012,
 389 **9**:e1001313.
- 390 6. Sayyad-Neerkorn J, Langendorf C, Roederer T, Doyon S, Mamaty AA, Woi-Messe L, Manzo
 391 ML, Harouna S, de Pee S, Grais RF: **Preventive Effects of Long-Term Supplementation with 2**
 392 **Nutritious Food Supplements in Young Children in Niger.** *The Journal of nutrition* 2015,
 393 **145**:2596-2603.
- 394 7. Tomedi A, Rohan-Minjares F, McCalmont K, Ashton R, Opiyo R, Mwanthi M: **Feasibility and**
 395 **effectiveness of supplementation with locally available foods in prevention of child**
 396 **malnutrition in Kenya.** *Public health nutrition* 2012, **15**:749-756.
- 397 8. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, Webb P, Lartey A, Black RE:
 398 **Evidence-based interventions for improvement of maternal and child nutrition: what can**
 399 **be done and at what cost?** *Lancet* 2013, **382**:452-477.
- 400 9. Ruel MT, Alderman H: **Nutrition-sensitive interventions and programmes: how can they**
 401 **help to accelerate progress in improving maternal and child nutrition?** *Lancet* 2013,
 402 **382**:536-551.
- 403 10. Fiszbein A, Schady NR, Ferreira FH: *Conditional cash transfers: reducing present and future*
 404 *poverty.* World Bank Publications; 2009.
- 405 11. Vincent K, Cull T: **Impacts of social cash transfers: case study evidence from across southern**
 406 **Africa.** *Instituto de Estudos Sociais e Económicos* 2009.
- 407 12. Fenn B, Noura G, Sibson V, Dolan C, Shoham J: **The role of unconditional cash transfers**
 408 **during a nutritional emergency in Maradi region, Niger: a pre-post intervention**
 409 **observational study.** *Public health nutrition* 2014:1-9.

- 410 13. The Kenya CT-OVC Evaluation Team: **The impact of the Kenya Cash Transfer Program for**
 411 **Orphans and Vulnerable Children on household spending.** *Journal of Development*
 412 *Effectiveness* 2012, **4**:9-37.
- 413 14. Alderman H: **Can transfer programs be made more nutrition sensitive?** Available at SSRN
 414 2423776 2014.
- 415 15. Miller CM, Tsoka M, Reichert K: **The impact of the Social Cash Transfer Scheme on food**
 416 **security in Malawi.** *Food Policy* 2011, **36**:230-238.
- 417 16. Baye K, Retta N, Abuye C: **Comparison of the effects of conditional food and cash transfers**
 418 **of the Ethiopian Productive Safety Net Program on household food security and dietary**
 419 **diversity in the face of rising food prices: ways forward for a more nutrition-sensitive**
 420 **program.** *Food and nutrition bulletin* 2014, **35**:289-295.
- 421 17. Tonguet-Papucci A, Huybregts L, Ait Aissa M, Huneau JF, Kolsteren P: **The MAM'Out project:**
 422 **a randomized controlled trial to assess multiannual and seasonal cash transfers for the**
 423 **prevention of acute malnutrition in children under 36 months in Burkina Faso.** *BMC public*
 424 *health* 2015, **15**:762.
- 425 18. Boudreau T, Lawrence M, Holzmann P, O'Donnell M, Adams L, Holt J, Hammond L, Duffield A:
 426 **The practitioners' guide to the household economy approach.** *Food Economy Group,*
 427 *Johannesburg* 2008.
- 428 19. Arsenault JE, Nikiema L, Allemand P, Ayassou KA, Lanou H, Moursi M, De Moura FF, Martin-
 429 Prevel Y: **Seasonal differences in food and nutrient intakes among young children and their**
 430 **mothers in rural Burkina Faso.** *Journal of nutritional science* 2014, **3**:e55.
- 431 20. Gibson RS, Ferguson EL: **An interactive 24-hour recall for assessing the adequacy of iron and**
 432 **zinc intakes in developing countries.** *Washington DC and Cali: International Food Policy*
 433 *Research Institute (IFPRI) and International Center for Tropical Agriculture (CIAT)* 2008.
- 434 21. World Health Organization: **WHO Child Growth Standards. Length/height-for-age, weight-**
 435 **for-age, weight-for-length, weight-for-height and body mass index-for-age. Methods and**
 436 **development.** 2006.
- 437 22. Stadlmayr B, Charrondiere U, Enujiugha V, Bayili R, Fagbohoun E, Samb B, Addy P, Barikmo I,
 438 Ouattara F, Oshaug A: **West African food composition table.** *Rome: Food and Agriculture*
 439 *Organization of the United Nations* 2012.
- 440 23. Kennedy GL, Pedro MR, Seghieri C, Nantel G, Brouwer I: **Dietary diversity score is a useful**
 441 **indicator of micronutrient intake in non-breast-feeding Filipino children.** *The Journal of*
 442 *nutrition* 2007, **137**:472-477.
- 443 24. Kennedy G, Nantel G: **Basic guidelines for validation of a simple dietary diversity score as an**
 444 **indicator of dietary nutrient adequacy for non-breastfeeding children 2-6 years.** *Rome: FAO*
 445 2006.
- 446 25. Brown KH, Rivera JA, Bhutta Z, Gibson RS, King JC, Lonnerdal B, Ruel MT, Sandtrom B,
 447 Wasantwisut E, Hotz C: **International Zinc Nutrition Consultative Group (IZiNCG) technical**
 448 **document #1. Assessment of the risk of zinc deficiency in populations and options for its**
 449 **control.** *Food and nutrition bulletin* 2004, **25**:S99-203.
- 450 26. World Health Organization U, USAID, AED, UCDAVIS, IFPRI: **Indicators for assessing infant**
 451 **and young child feeding practices: part 1: definitions: conclusions of a consensus meeting**
 452 **held 6-8 November 2007 in Washington DC, USA.** 2008.
- 453 27. Institute of Medicine of the National Academies: *Dietary References Intake for Energy,*
 454 *Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids.* The National
 455 Academy Press; 2005.
- 456 28. Harttig U, Haubrock J, Knüppel S, Boeing H: **The MSM program: web-based statistics**
 457 **package for estimating usual dietary intake using the Multiple Source Method.** *European*
 458 *journal of clinical nutrition* 2011, **65**:S87-S91.
- 459 29. Nichols A: **Regression for nonnegative skewed dependent variables.** In *BOS10 Stata*
 460 *Conference.* Stata Users Group; 2010: 15-16.

- 461 30. Haushofer J, Shapiro J: **Policy brief: Impacts of unconditional cash transfers.** *Massachusetts*
462 *Institute of Technology* 2013.
- 463 31. INSD MD, Macro I: **Enquête démographique et de santé et à indicateurs multiples (EDSBF-**
464 **MICS IV), Rapport préliminaire, Burkina Faso, 2010.** *Ouagadougou: INSD* 2011, **40.**
- 465 32. Dewey KG, Brown KH: **Update on technical issues concerning complementary feeding of**
466 **young children in developing countries and implications for intervention programs.** *Food*
467 *and nutrition bulletin* 2003, **24**:5-28.
- 468 33. Kau AL, Ahern PP, Griffin NW, Goodman AL, Gordon JI: **Human nutrition, the gut**
469 **microbiome, and immune system: envisioning the future.** *Nature* 2011, **474**:327-336.
- 470 34. Wondafrash M, Huybregts L, Lachat C, Bouckaert KP, Kolsteren P: **Dietary diversity predicts**
471 **dietary quality regardless of season in 6-12-month-old infants in south-west Ethiopia.**
472 *Public health nutrition* 2016:1-10.
- 473 35. Streiner DL: **Best (but oft-forgotten) practices: the multiple problems of multiplicity-**
474 **whether and how to correct for many statistical tests.** *The American journal of clinical*
475 *nutrition* 2015, **102**:721-728.
- 476

Tables

Table 1: General characteristics of Burkinabe children of 14 – 27 months of age

	Control (n=162)	Intervention (n=160)
Clusters, n	13	13
Children's age, mo	20.6 ± 0.22	20.4 ± 0.23
Male children, n (%)	79 (48.8)	91 (56.9)
Children still breastfed, %	74.1	70.6
Breastfeeding sessions, n /d	7.88 ± 0.15	7.73 ± 0.18
Duration of one breastfeed session, min	7.14 ± 0.30	6.32 ± 0.29
Total duration of breastfeeding, min/d	55.8 ± 3.05	48.7 ± 3.10
Child weight-for-height z-score ^a	-0.89 ± 0.07	-0.77 ± 0.07
Child height-for-age z-score ^a	-1.96 ± 0.09	-1.97 ± 0.08
Wasted children, % ^a	9.88	8.23
Stunted children, % ^a	46.9	48.7
Literate mothers, % ^c	24.7	20.1
Households socio-economic status: low / medium / high, % ^b	35.4 / 32.9 / 31.7	30.8 / 40.9 / 28.3

Values presented in this table are means (± SD when applicable) and percentages.

^a Nutritional status data were available for 162 children in the control group and for 158 in the intervention group

^b Socio-economic data were available for 161 children in the control group and 159 in the intervention group. Tertiles were created among the poor and very poor households included in the study using principal component analysis (PCA) based on declared assets ownership.

^c Education data were available for 162 children in the control group and 159 in the intervention group

Table 2: Proportions of 14-27 months old Burkinabe children consuming each of the seven food groups during the last 24 hours

	Control arm	Intervention arm	Odd ratios (95% CI) ^d	P-value
Grains, roots and tubers (%)	100 ± 0.00	99.4 ± 0.63	NA	NA
Legumes and nuts (%)	66.0 ± 3.73	72.5 ± 3.54	1.40 (0.57, 3.43)	0.47
Milk and dairy products (not including breastfeeding) (%)	7.41 ± 2.06	25.0 ± 3.43	4.14 (1.48, 11.6)	0.007
Flesh food (meat, fish, poultry) (%)	14.8 ± 2.80	26.3 ± 3.49	2.09 (1.18, 3.70)	0.01
Eggs (%)	11.1 ± 2.48	31.3 ± 3.68	3.61 (1.56, 8.37)	0.003
Vitamin A rich fruits and vegetables (%)	98.8 ± 0.87	96.3 ± 1.51	0.36 (0.07, 1.83)	0.22
Other fruits and vegetables (%)	1.23 ± 0.87	2.50 ± 1.24	2.32 (0.38, 14.1)	0.36

Values presented in this table are proportions (± SD).

^d Analyzed using a mixed logistic regression model with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate

Table 3: Mean daily intake of seven food groups of 14-27 months old Burkinabe children

	Control arm	Intervention arm	P-value ^e
Grains, roots and tubers (g/d)	158.6 ± 5.26	163.5 ± 5.53	0.49
Legumes and nuts (g/d)	12.6 ± 1.37	14.7 ± 1.35	0.28
Milk and dairy products (not including breastfeeding) (g/d)	18.7 ± 7.49	46.3 ± 9.37	0.33
Flesh food (meat, fish, poultry) (g/d)	2.02 ± 0.54	4.00 ± 0.79	0.12
Eggs (g/d)	3.25 ± 0.79	11.3 ± 1.55	<0.001
Vitamin A rich fruits and vegetables (g/d)	38.4 ± 2.68	33.6 ± 2.17	0.29
Other fruits and vegetables (g/d)	0.44 ± 0.42	0.33 ± 0.25	NA ^f

Values presented in this table are means (± SD).

^e Analyzed using a gamma generalized linear model with log link, with *village* as random effect and adjusted for child's sex, age, household's SES and mother literacy rate

^f Non Applicable. Only 6 consumers in total

Table 4: Infants' and young children's feeding indicators for 14-27 months old Burkinabe children

	Control arm	Intervention arm	Odds ratio (95% CI)	P-value
Dietary diversity score (7 food groups) ^g	3.61 ± 0.05	4.01 ± 0.06	NA	0.07
Children with adequate minimum dietary diversity, n (%) ^h	64 (39.5)	105 (65.6)	2.95 (1.86, 4.68)	<0.001
Mean number of meals / day for breastfed children ^g	4.76 ± 0.06	4.92 ± 0.06	NA	0.66
Mean number of meals / day for non-breastfed children ^g	4.72 ± 0.10	4.95 ± 0.09	NA	0.65
Children with adequate minimum meal frequency, n (%) ^h	160 (98.8)	159 (99.4)	1.72 (0.12, 25.5)	0.69
Children with minimum acceptable diet, n (%) ^h	64 (39.5)	105 (65.6)	2.95 (1.86, 4.68)	<0.001
Children consuming iron rich or iron fortified food, n (%) ^h	33 (20.4)	58 (36.3)	2.23 (1.20, 4.13)	0.01

Values presented in this table are means (± SD) or number of children (and the corresponding percentages).

^g Analyzed using a mixed Poisson regression model with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate

^h Analyzed using a mixed logistic model with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate

Table 5: Energy and macronutrient intake from complementary foods of 14-27 months old Burkinabe children

	Control Arm	Intervention Arm	P-value
Energy (kcal / day) ⁱ	915 ± 24.1	962 ± 23.6	0.20
Energy (kJ / day) ⁱ	3828 ± 101.0	4026 ± 98.7	0.20
Complementary food energy density (kcal/g) ⁱ	0.78 ± 0.15	0.79 ± 0.14	0.57
Fat (g/day) ⁱ	16.5 ± 0.89	20.6 ± 0.80	0.001
Carbohydrates (g/day) ⁱ	169 ± 4.33	169 ± 5.01	0.59
Protein (g/day) ⁱ	20.1 ± 0.60	21.7 ± 0.55	0.06
Fiber (g/day) ⁱ	13.5 ± 0.45	12.2 ± 0.39	0.10
Fat (% of total energy) ⁱ	15.7 ± 0.60	19.7 ± 0.71	0.004
Carbohydrates (% of total energy) ^j	74.5 ± 0.72	69.8 ± 0.89	0.006
Protein (% of total energy) ⁱ	8.87 ± 0.16	9.29 ± 0.23	0.34

Values presented in this table are means (± SD).

ⁱ Analyzed using a mixed linear model (after log transformation) with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate

^j Analyzed using a mixed linear model with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate

Table 6: Micronutrient intake from complementary foods of 14-27 months old Burkinabe children

	Control arm	Intervention arm	P-value ^k
<i>Minerals</i>			
Ca (mg/d)	248.7 ± 10.9	263.0 ± 9.60	0.31
Available Ca (mg/d)	86.8 ± 3.26	89.6 ± 2.83	0.45
Fe (mg/d)	19.7 ± 0.79	19.4 ± 0.64	0.79
Available Fe (mg/d)	0.47 ± 0.02	0.52 ± 0.02	0.46
Mg (mg/d)	165.9 ± 5.86	153.5 ± 4.90	0.28
Zn (mg/d)	4.31 ± 0.16	4.51 ± 0.15	0.33
Available Zn (mg/d)	0.65 ± 0.02	0.68 ± 0.02	0.33
<i>Vitamins</i>			
Vitamin A (µg/d)	96.3 ± 5.55	111.7 ± 5.51	0.13
Vitamin C (mg/d)	219.4 ± 8.75	215.2 ± 11.3	0.23
Vitamin E (mg/d)	4.50 ± 0.33	5.55 ± 0.31	0.01
Thiamin B1 (mg/d)	0.34 ± 0.01	0.36 ± 0.01	0.25
Riboflavin (mg/d)	0.34 ± 0.02	0.40 ± 0.02	0.04
Nicotinic acid (mg/d)	3.38 ± 0.10	3.31 ± 0.10	0.82
Vitamin B6 (mg/d)	0.42 ± 0.01	0.40 ± 0.01	0.74
Folic acid (µg/d)	60.7 ± 2.18	66.4 ± 2.17	0.19
Vitamin B12 (µg/d)	0.21 ± 0.04	0.52 ± 0.06	<0.001

Values presented in this table are means (± SD).

^k Analyzed using a mixed linear model (after log transformation) with *village* as random effect and adjusted for child's sex, age, household's SES and mother's literacy rate