# 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

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## Abstract

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

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

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

**Results**: Unconditional cash transfers during the lean season improved the diets of rural children through higher consumption of eggs (11.3 g ± 1.55 vs 3.25 g ± 0.79, $p<0.001$), fat (20.6 g ± 0.80 vs 16.5 g ± 0.89, $p<0.01$) and vitamin B12 (0.40 mg ± 0.02 vs 0.34 mg ± 0.02, $p<0.001$) compared to controls, and higher proportions of children eating dairy products (OR: 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, 8.37), $p<0.05$) and iron rich or iron fortified food (OR: 2.23 (1.20, 4.13), $p<0.05$). No difference was found in energy intake between the two groups. The minimum dietary diversity of two thirds of the children who benefited from cash transfers was adequate compared to that of only one third in the control group ($p<0.001$).

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

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

## Key words

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

## Introduction

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

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

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

## Methods

*The MAM'Out study*

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

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

*Study population and sample size*

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

*Data collection*

Four teams of two data collectors received one week of training on the multi-pass 24-h dietary recall method [20]. Standardization exercises for food weight measurements and interview techniques were taught and questionnaires pre-tested. All data collectors spoke Gulmancema (the main local language) and two also spoke Pulaar fluently. Two of the data collectors were selected to be supervisors during data collection to check the quality of data collection and coordinate awareness raising activities on the 24-h dietary recall study. These activities took place one or two days prior to data collection and consisted in a visit to the selected household and the presentation of the data collection procedure. The caregiver was also given a standard 24-h recall kit comprising a plate and a bowl to estimate the quantities eaten by the child. Caregivers were asked to set aside a small quantity of the food eaten by the child the day before the visit to facilitate the recall and to take note of the ingredients used to prepare the food.

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

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

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

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

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

*Data analyses*

Data on the 24-h dietary recalls were entered in Lucille®, a computer program conceived by Ghent University, Belgium, and analyzed using Stata 12.0. The food composition table used to describe the quality of the intake was a combination of three sources. The West African food composition table endorsed and developed by the Food and Agriculture Organization and the International Network of Food Data System [22] was used as the primary data source to obtain energy and nutrient concentrations per food. However, a check of the 24-h dietary recall questionnaires revealed that some food products consumed by the children were missing. Information on the missing products was taken from the food composition table for Burkina Faso also used by Arsenault and al. [19]. If no information was available on a given food (e.g. sparrow hawk meat and djonkin juice) in the Burkinabe table, an Internet search was conducted or the information (for Yonhanma flour, Plumpy'nut and Supplementary Plumpy) was taken from the label on the food product. The composition of 73% of the ingredients of the consumed food were obtained from the West African food composition table [22], 20% from the Burkina Faso food composition table [19], 3% from Internet and 4% from food product labels.

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

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

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

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

The primary outcome of the study was child energy intake. Usual intake distributions of nutrients and energy were generated using the Multiple Source Method (MSM) [28] based on the two dietary recalls collected per child. No covariate was added to the model. The usual intake distributions obtained were subsequently used to calculate means and standard deviations to describe the children's intakes. Differences in energy and nutrient intakes between the intervention and the control groups were analyzed using linear mixed models including *village* as random effect to account for clustered observations. Fixed effects included in the models were the child's age at recall, child's sex, mother's literacy rate and household's socio-economic status. When the distribution was not bell shaped, variables were first log-transformed and then analyzed. Mixed-effects Poisson regression models were used to analyze differences in the dietary diversity score and the number of meals per day. Random and fixed effects were the same as the ones described above. Differences in the quantities of each food group consumed by children in the intervention and control groups were analyzed using a gamma generalized linear model (GLM) with log link [29] adjusted for *village* as random effect and adjusted for all the above mentioned co-variates. This model was chosen to take into account the high frequencies of non-consumption among the data, resulting in many zeros in the dataset. All the tests were two-sided and a statistical significance level of 5% was used for all analyses.

## Results

*General characteristics*

The data available for analysis included two dietary recalls from 322 children aged 14 to 27 months (**figure 1**). All children sampled were surveyed. The child characteristics (**table 1**) were balanced between children in the intervention and control group for age and breastfeeding practices. Children were on average 20.5 ± 0.16 months old and 72% were still partially breastfed. The mean duration of breastfeeding per day was 52.3 ± 2.18 minutes and each breastfeeding session lasted 6.86 ± 0.28 minutes. The intra-class correlation between the two recalls for the duration of each breastfeeding session was 0.80 (95% CI: 0.76, 0.84) ($p<0.0001$), for the total duration of breastfeeding per day 0.80 (95% CI: 0.76, 0.84) ($p<0.0001$) and for the mean number of breastfeeding session per day 0.56 (95% CI: 0.48, 0.65) ($p<0.0001$). Child nutritional status was also balanced between the intervention and control group with the exception of the mean weight-for-height Z-score, which was slightly lower in the control group than in the intervention group (-0.89 ± 0.07 vs. -0.77 ± 0.07). The socio-economic status also slightly differed between households benefiting from cash transfers and control households, with more intervention households being classified as having a medium socio-economic status (40.9 % vs 32.9 %).

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

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

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

*Energy and nutrient intakes*

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

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

## Discussion

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

Our results of the impact of an unconditional cash transfer on children's dietary diversity and frequency of food group consumption are in line with those of two other studies that investigated the effect of unconditional cash transfers on children's diet. The Malawi Social Cash Transfer Scheme led to a more diverse diet in beneficiary households with more people eating meat, fish and dairy products compared to households in the control group [15]. In Kenya, Haushofer and al. found that households benefiting from unconditional cash transfers ate meat and fish more frequently than households in the control group [30]. Approximately two thirds of the children in the intervention group benefited from adequate minimum dietary diversity compared to only one third in the control group. This is a significant improvement over the figures cited in the most recent demographic and health survey conducted in Burkina Faso, which reported that only 6.2% of children aged 6-23 months living in the Eastern Region consumed at least four food groups [31]. It is however noteworthy to mention that 13.4% of the children in our study are 24 months old or above, and that we surveyed children from 2 municipalities out of 27 of the Eastern Region.

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

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

Vitamin B12, riboflavin and vitamin E intakes were significantly higher in children in the intervention group. This is encouraging given the important role of vitamins B12 and E in immune system [33]. The higher intake of vitamin B12 may be the consequence of the larger quantity of eggs eaten by children in the intervention group. However, despite the larger quantities of iron-rich food consumed, we found no difference in iron intake between the two groups.

Several strengths can be highlighted for this study. The 24-h dietary recalls were implemented in the framework of a cluster randomized controlled trial and took advantage of its strong design. All the basic characteristics of the intervention and control groups, including height-for-height Z-score, were comparable, except for the slightly lower mean weight-for-height Z-score of children in the control group. However, as adjusting the analyses for the nutritional status and breastfeeding practices, which may both have changed as a result of the cash transfer program, holds a risk of bias, we did not adjust the analyses for these two factors. The one week training the data collectors underwent on the 24-h food recall methodology allowed for the standardization and pretesting of the method of data collection. In addition, the two month period of data collection was supervised: every week, two of the children visited by each data collector were visited a second time by the supervisor to check on the data collected. A number of study limitations also need to be addressed. First, we were unable to adjust analyses for data collectors, due to an error during data entry. Collector bias was nevertheless limited by the fact that two different data collectors systematically conducted the two recalls in the same household. Secondly, the six clusters excluded from data collection due to difficult access may have had higher prevalence of acute malnutrition, compared to those included. The effect of the intervention might also have been lower in these villages due to limited access to market. Thirdly, two thirds of the children in the study were still breastfed at the time of the evaluation. To our knowledge, no precise technique to evaluate the quantity of milk consumed by children is currently available beyond weighing the baby before and after breastfeeding or giving isotopic labeled water to mothers. In the MAM'Out study area, it was not possible to use either of these techniques due to operational constraints. We tried to overcome this problem by designing a detailed questionnaire on breastfeeding practices to estimate the number of times a child was breastfed during the day and the corresponding duration, but this was still not sufficient to estimate energy intake from breastmilk. One possible solution would have been to hypothesize average breast milk intake as has been done in previous studies [34]. However, this is still an estimation and does not measure the breastmilk intake precisely. Since the same estimation method was used in both groups, we assume that the measurement error was similar for the two groups. Fourthly, we did not adjust our analyses for multiple hypothesis testing. Although this is still an ongoing debate [35], concerns may be raised about the need to reevaluate the p-value used for the significance of results, which may decrease the number of significant differences we found between groups. However, the results presented here tend to go in the same direction (with higher number of children consuming animal products in the intervention group, more eggs intake in term of quantities and more B12 intake), which strengthen confidence in them [35]. Finally, no measurement of body composition or biomarkers before and after the intervention was performed. As such, it is hard to see the direct health benefits of the intervention. However, our results demonstrate first of all that unrestricted and unconditional cash was used for food purposes and allow improving children’s diet quality. Yet, the amount distributed may have been too low with respect to the family size in order to have a positive effect on child’s health via an improved diet quality.

## Conclusion

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

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

## References

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

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

30. Haushofer J, Shapiro J: **Policy brief: Impacts of unconditional cash transfers.** *Massachusetts Institute of Technology* 2013.

31. INSD MD, Macro I: **Enquête démographique et de santé et à indicateurs multiples (EDSBF-MICS IV), Rapport préliminaire, Burkina Faso, 2010.** *Ouagadougou: INSD* 2011, **40**.

32. Dewey KG, Brown KH: **Update on technical issues concerning complementary feeding of young children in developing countries and implications for intervention programs.** *Food and nutrition bulletin* 2003, **24:**5-28.

33. Kau AL, Ahern PP, Griffin NW, Goodman AL, Gordon JI: **Human nutrition, the gut microbiome, and immune system: envisioning the future.** *Nature* 2011, **474:**327-336.

34. Wondafrash M, Huybregts L, Lachat C, Bouckaert KP, Kolsteren P: **Dietary diversity predicts dietary quality regardless of season in 6-12-month-old infants in south-west Ethiopia.** *Public health nutrition* 2016**:**1-10.

35. Streiner DL: **Best (but oft-forgotten) practices: the multiple problems of multiplicity-whether and how to correct for many statistical tests.** *The American journal of clinical nutrition* 2015, **102:**721-728.

## 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] |
|---|---|---|---|
| *Minerals* | | | |
| 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 |
| *Vitamins* | | | |
| 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