Unconditional cash transfers do not prevent children's undernutrition in the Moderate Acute Malnutrition Out (MAM'Out) cluster-randomized controlled trial in rural Burkina Faso

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

Unconditional cash transfers do not prevent children's undernutrition in the Moderate Acute Malnutrition Out (MAM'Out) cluster-randomized controlled trial in rural Burkina Faso

Freddy Houngbe [1,2]☯, Audrey Tonguet-Papucci [1-3]☯, Chiara Altare [1], Myriam Ait-Aissa [1],

Jean-François Huneau [3], Lieven Huybregts [4], Patrick Kolsteren [2]

[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, Paris, France

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

☯ These authors contributed equally to this work.

Corresponding author: Freddy Houngbe, fhoungbe@actioncontrelafaim.org

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

Phone: +1 514 217 0302

- **List of authors' last names**: Houngbe, Tonguet-Papucci, Altare, Ait-Aissa, Huneau, Huybregts, Kolsteren
- **Word count from abstract to end of references, including tables**: 5750
- **Number of figures:** 1
- **Number of tables:** 3
- **OSM submitted:** none
- **Running title of 50 or fewer characters and spaces:** Seasonal unconditional cash transfers and children's nutritional status and morbidity
- **Source of financial support:** The MAM'Out study was funded by *Action Contre la Faim* France and the Center for Disease Control and Prevention, USA. The cash transfer program was funded by ECHO. 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. Lieven Huybregts received funding from the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH), led by the International Food Policy Research Institute.
- **Conflict of interest and funding disclosure:** FH, ATP, CA and MAA are employed by *Action Contre la Faim* France, who implemented the MAM'Out study. JFH, LH and PK do not have any conflict of interest.

Abstract

Background: Limited evidence is available on the impact unconditional cash transfer programs can have on child nutrition, particularly in West Africa where child undernutrition is still a public health challenge.

Objective: This study examined the impact of a multiannual seasonal unconditional cash transfer program to reduce the occurrence of wasting (weight-for-height, mid upper arm circumference), stunting (height-for-age) and morbidity among children under 36 months old in Tapoa Province, Eastern region of Burkina Faso.

Methods: The study was designed as a two-arm cluster randomized controlled trial, with 32 villages randomly assigned to either the intervention or control group. The study population consisted of households classified as poor or very poor according to household economy approach criteria and having at least one child under one-year of age at inclusion. The intervention consisted of seasonal unconditional cash transfers, provided monthly from July to November, over two years (2013 and 2014). A monthly allowance of 10,000 XOF (≈US$17) was given by mobile phone to mothers in participating households. Anthropometric measurements and morbidity were recorded on quarterly basis.

Results: We found no evidence that multiannual seasonal unconditional cash transfers reduced the cumulative incidence of wasting among young children (incidence rate ratio: 0.92, 95% CI: 0.64, 1.32; $p=0.66$). We observed no significant difference ($p>0.05$) in children's anthropometric measurements and stunting at end point, between the two groups. However, children in the intervention group had a lower risk (21%, 95%CI: 3.20, 34.2; $p=0.02$) of self-reported respiratory tract infections compared to children in the control group.

Conclusion: We found that seasonal unconditional cash transfers in the framework of safety nets did not result in a significant decrease in the incidence of child acute malnutrition in Tapoa Province. Cash transfers combined with complementary interventions targeted on child nutrition and health should be further investigated. This trial was registered at clinicaltrials.gov as NCT01866124.

Key words

Seasonal unconditional cash transfers, children, Burkina Faso, nutritional status, morbidity

Introduction

Child undernutrition remains a serious health problem in developing countries, especially in West Africa where it is still a public health challenge [1]. Although encouraging progress has been made in reducing the proportion of hungry people and the number of undernourished people in the past two decades, 31.5 million people in West Africa are still undernourished [2]. West African countries with a sub-Saharan tropical climate have a wet season from June to September and a dry season during the remaining eight months. Trends in children's morbidity and nutritional status vary according to these seasons, with increased rates during the rainy season [3, 4]. Twenty percent of West African children under age 5 are underweight [2] and the prevalence of acute malnutrition is 9%, nearly reaching the public health emergency range [5]. Given that acute malnutrition is associated with increased morbidity and mortality risks [6], effective interventions are urgently needed. The introduction of the community-based management of acute malnutrition (CMAM) model in many Sub-Sahara African countries, including the use of ready-to-use therapeutic foods, made the treatment of acute malnutrition more accessible and convenient to beneficiaries [7]. However, low coverage of scaled-up CMAM programs in a number of countries implies that there remains room for improvement [8]. Complementary strategies aimed at preventing acute malnutrition can therefore play an important role.

During the last decade, social safety nets and cash based interventions have gained attention in developing countries. Cash transfer programs are increasingly implemented in emergencies [9-12] and in developing contexts [13-15] to alleviate poverty and food insecurity in vulnerable households. Large scale conditional cash-transfer programs first showed their efficacy in Latin America to improve food security [16], health care utilization [17-19], health outcomes [20] and child nutritional status [21, 22]. Less evidence is available regarding unconditional cash transfers (UCTs). Only a few studies showed positive effects on food access and diversity [13, 14], health expenditures [13] and preventive visits to health centers [23]. In the 2013 Lancet Series on Child and Maternal Health, cash transfer programs designed with a nutritional objective were highlighted as having a potential to prevent child undernutrition [24]. However, to date, few rigorous studies have evaluated the impact of UCTs on child nutrition. On the basis of the comprehensive conceptual model of under-nutrition proposed by Black RE et *al*. [25], the "moderate acute malnutrition Out" (MAM'Out) study, implemented in rural Burkina Faso, intended to influence several underlying causes of undernutrition during the lean season when the prevalence of undernutrition is high, by delivering a cost-efficient intervention. The study aimed to assess the impact of cash transfer program in reducing the incidence of acute malnutrition and morbidity, and the prevalence of stunting among children under 36 months old.

Methods

➢ Study design and participants

Burkina Faso is a landlocked country located in the Sahel region in West Africa. A national social protection policy which promotes social transfer mechanisms to the poorest and most vulnerable was adopted in 2012 to enhance population food security [26]. The study was carried out in the North of Tapoa province which is characterized by inappropriate child feeding practices (such as non-exclusive breastfeeding and low diet diversity after one year of age), insufficient access to sanitation and safe water [27, 28].

The study was designed as a two-arm cluster randomized controlled trial, in which 32 villages in three municipalities were randomly assigned to either the intervention or control group. With a type I error of 5%, a statistical power of 90% and a minimum follow-up time of 24 months, assuming a 33% reduction in the cumulative incidence of wasting, a coefficient of variation K of 0.25 and an anticipated 25% drop-out, 16 clusters with 50 children were required in each study group [29]. Randomization of villages to the intervention and control groups was performed during a ceremony, to keep the allocation of cash transparent and fair. Representatives of each of the 32 villages drew blindly from a bag one of the 32 identical papers with “cash” or “no cash” written on it from the bag. Sixteen villages were assigned to the intervention group and 16 others to the control group.

Within villages, household participation in the study was voluntary and based on the following inclusion criteria: household classified as poor or very poor according to household economy approach criteria [30] and having at least one child under 1 year old at inclusion regardless of his/her nutritional status. Study objectives and implementation were explained to both wives and husbands and informed consent obtained from the heads of household by signature or fingerprint.

➢ Intervention

Prior to the MAM’Out study, a needs assessment was conducted in two steps at the end of 2012: an analysis of the causes of undernutrition using nutrition causal analysis (NCA) methodology [31] and formative research related to the cash transfer intervention. Results of the NCA showed that financial insecurity of women, birth spacing and access to potable water were perceived causes of malnutrition [32]. Based on the existing literature and reports from the study area, a theoretical framework of pathways through which cash transfers can impact acute malnutrition was constructed (unpublished paper). The formative research assessed the relevance of a cash based intervention and provided detailed operational guidance on the study area, the target population, the type of cash transfer, the seasonality, the amount of the cash transfer and the delivery mechanism.

The intervention consisted of seasonal UCTs, provided monthly from July to November, over two years (2013 and 2014) [29]. This period partly overlapped with the annual rainy season (May to August) perceived as the “hunger” season because of the cereal shortage observed at household level [4, 33]. As there was no national transfer size defined for cash transfer programs in Burkina Faso, the MAM’Out transfer size was defined during a formative research jointly with Action Contre la Faim operational team in Burkina Faso, based on previous cash transfer experiences in Burkina Faso and in the sub-Sahara African countries.

A monthly allowance of 10,000 XOF (≈US$17) was given by mobile phone (offered by the project) to participating households. Over a year, a total amount of 50,000 XOF (≈US$85) was transferred to each eligible household, representing about 33% of the 2014 annual national poverty line estimated at 153,530 XOF (≈US$260) [34]. The grant value allowed to cover on average the survival gap and 85% of the livelihoods gap for the very poor households, and the entire livelihoods gap of poor households. We specifically designated mothers as primary recipients of the transfer since they are usually in charge of child care [35]. Mothers were told that the cash was given to them to support their child's development and to prevent malnutrition.

A dedicated team supervised and followed up cash transfers activities jointly with the research team. A partnership with a mobile phone company enabled cash distribution via mobile phone. Prior to the intervention, all mothers in the intervention group received an identity card provided by the field teams, a mobile phone and a sim card linked to an electronic account. At the time of distribution, mothers received a text message with a code number notifying them that their account was credited. Mothers were thus invited to visit cash withdrawal points to collect their money. Presentation of the identify card and the code number granted access to the money. Mothers confirmed the cash withdrawal by signing follow-up lists. All study participants in the intervention group received their monthly allowance within a week time. Mothers of children in the control group did not receive a cash grant. Incentives (cooking kit, fabrics, etc.) were given to households in the control group to compensate for the time they spent answering the MAM'Out questionnaires. Next to the approval by the ethical committee of the Ghent University Hospital (Belgium) and the Burkinabe national ethics committee, administrative authorities as well as all heads of villages gave their consent prior to the start of the study. The trial was registered at clinicaltrials.gov as NCT01866124.

➢ Measurements

Trained fieldworkers performed quarterly home visits to collect data. A pretested questionnaire was used to collect socioeconomic (education, occupation and asset ownership) and demographic data on a half-yearly basis, whereas anthropometrics and morbidity (diarrhea, fever and respiratory tract infections) data were collected on a quarterly basis. All anthropometric measurements were taken in duplicate by team members. The average of the two values was used for analysis. A diarrheal episode was defined as having at least three loose stools within a day. Tactile assessment technique was used to identify fever. Respiratory tract infection episode was defined as persistent cough and/or fast or difficult breathing. Morbidity episodes were recalled by mothers over the last seven days. Child age at recruitment was estimated from a birth certificate or using a locally adapted special events calendar. The protocol provides more details on measurement tools and standardization procedures used to ensure good quality of data [29]. Baseline data were collected one month earlier in the intervention group than in the control group, to enable cash transfer to start in due time. Follow up visits were performed at the same time in the two groups. Data collection lasted 29 months (June 2013 to October 2015).

Weight-for-height Z-score (WHZ), height-for-age Z-score (HAZ) and weight-for-age Z-score (WAZ) were calculated according to 2006 WHO growth standards to conform with the Burkinabe national protocols for the management of acute malnutrition. Wasting was defined as WHZ <-2 or presence of bilateral pitting edema, stunting as HAZ <-2 and underweight as WAZ <-2 [36]. All children identified as wasted were referred to the nearest health centers for adequate nutritional care as per national protocol. If a child was absent from home, another home visit was planned within the round of data collection to ensure complete measurements of the child. In case of a child's death, a verbal autopsy was adapted from WHO standards [37, 38].

In the first round, data were collected on paper forms and entered in double using EpiData version 3.1 (EpiData Association) by two groups of data clerks. From the fifth round on, we switched to computer assisted personal interviews with tablets using open data kit application (Core ODK, UW-CSE) to allow real time follow-up of collected data. The lot quality assurance sampling method was applied on a monthly basis to ensure both good quality data collection and data entry.

Statistical analysis

Our primary outcome was the cumulative incidence of wasting. Secondary outcomes included the mean WHZ change over time, the mean HAZ change over time, the mean mid-upper arm circumference (MUAC) change over time, the prevalence of stunting at end point, and the cumulative incidence of morbidity episodes [29]. Z-scores were calculated using the *zscore06* command in Stata 14.2 [39].

We described baseline characteristics using proportions, means and standards deviations. A household socioeconomic status (SES) proxy was created using a principal component analysis (PCA) based on declared asset ownership recorded as a binary variable (possessed or not) and collected throughout the intervention. A PCA was applied to 20 asset indicator variables, which showed a relevant contribution (>10% of the variability of the component) to the combined SES score factor. The first principal component (explaining 18% of the variation in the dataset) with the highest eigenvalue (3.61) was categorized into tertiles (low, middle and high) and used as proxy indicator for the household socioeconomic status [40].

All analyses were conducted on intention-to-treat basis and children were analyzed as from the initial group assignment. We used 2-sided tests for all analyses with statistical significance set at 5%.

The intervention effect on continuous growth outcomes (weight, length, WHZ, HAZ, WAZ and MUAC) was analyzed using linear mixed-effect models with cluster, household and children as random effects. Because of the time difference at baseline, the month of data collection was used to harmonize the unit of time for the follow-up measurements between the two groups. A likelihood ratio test was used to test if the addition of the month of data collection (as random slope) and the addition of a quadratic term of the month of data collection (fixed effect) improved the model fit.

We examined the intervention effect on the incidence of wasting and self-reported morbidity outcomes (diarrhea, fever and respiratory tract infections) using a multilevel mixed-effects Poisson regression model adjusted for clustering by village, household and child. For binary morbidity outcomes, we used a robust estimation of standard errors to relax the assumption for a Poisson distribution [41]. We adjusted these models for the number of recalls that were recorded. We analyzed the effect of the intervention on the prevalence of stunting at endpoint using mixed-effects logistic regression model with cluster and household as random effects. Fixed effects included in all of the models were child's sex, child's age, SES at baseline and the outcome at inclusion.

Finally, we used Kenward-Roger adjustment for continuous outcomes and bootstrap methods for binary outcomes, to provide reasonable estimates that account for the relatively small number of clusters [42]

Results

A total of 1,278 children from the 32 selected villages were enrolled in the study in May 2013, after their parents gave their informed consent at home. During the course of the study, 99 children of which 57.6% in the intervention group, dropped out from the study for different reasons, mainly related to child death or leaving the study area (**Figure 1**).

A total of 1,250 children aged 0 to 15 months from 1,162 households (630 children in the intervention group and 620 children in the control group) provided at least two measurements and were accounted for in the analyses. This sample size was equivalent to the necessary size required to ensure enough statistical power. Overall, baseline characteristics were balanced between the intervention and the control groups (**Table 1**). Children in the intervention group were more likely to be one month younger and wasted. About 31.7% of all children were less than 6 months old and 8% were aged 12 months or older at study inclusion.

Children contributed to 15,394 and 14,458 months of follow-up in the intervention and control groups respectively (**Table 2**). Non-response rate was rather similar (2.17% vs. 2.21%; p=0.93) in the intervention and the control group respectively. We observed no difference in the mean change in WHZ in the intervention and the control groups over the 24 months of follow-up. We found no difference in the incidence of wasting episodes in the intervention and the control groups (incidence rate ratio: 0.92, 95% CI: 0.64, 1.32; p=0.66). Similar results were obtained when we broke down the analysis for moderate and severe wasting, and also by sex (data not shown). The longitudinal analysis of child's MUAC showed similar results as for WHZ with absence of difference in the mean MUAC change over time (-0.02 mm/month; 95% CI: -0.08, 0.02; p=0.33). The mean change in HAZ was similar (p=0.78) in the control and the intervention groups over the 24 months of follow up. The odds of stunting at the end of the intervention in the two groups (OR: 0.73, 95%CI: 0.47, 1.14; p=0.17) was comparable.

Children in the intervention group had a lower risk (21%, 95%CI: 3.20, 34.2; p=0.02) of self-reported respiratory tract infections compared to children in the control group (**Table 3**). No difference in other self-reported morbidity outcomes was observed between the study groups. Death incidence rate is similar in the two groups (incidence rate ratio: 0.97, 95% CI: 0.92, 1.02; p=0.308) (data not shown).

Discussion

This study assessed the effectiveness of multiannual seasonal UCTs to prevent acute malnutrition in young children in Tapoa province, Eastern region of Burkina Faso. We were unable to demonstrate a significant reduction in the incidence of wasting children belonging to households that received the seasonal cash transfers as compared to control children. In addition, we did not find any intervention effect on child linear growth, resulting in similar odds of stunting at the end of the intervention. However, distributing cash reduced the incidence of self-reported episodes of respiratory tract infections.

The absence of evidence on the impact of the intervention on children's anthropometrics is consistent with results reported in the few available impact studies of UCTs. Previous randomized controlled intervention studies of UCTs in Zambia, Kenya and Burkina Faso have recently (after the inception of the MAM'Out study) reported the absence of significant improvements on wasting, stunting and mean HAZ of children under five years of age [43-46].

Different reasons could explain the absence of evidence about the MAM'Out intervention effect on child anthropometrics. First, the money received by the participating mothers was not (only) used for the child's needs. Although during cash distributions and home visits, program staff emphasized that the money should be used for the targeted child, there was no mechanism or conditions imposed to guarantee the exclusive use of the money for the targeted child. Qualitative and study expenditure data collected during the MAM'Out intervention revealed that the two first investment domains for the cash received were food and health, not only for the child, but for the whole family. Women reported using approximately one quarter of the monthly allowance to buy food for the child while the main part was used to increase the household food stock (unpublished data). This situation may have been worsened by the stressful “hunger” season during which additional household budget is required to counter the dwindling granary supplies and to cover expenses related to the seasonal increase in disease [4]. Presumably, the cash transfer benefited all household members which, as consequence, might have diluted the cash related impact on child nutrition and health outcomes. The total value of the cash transfer may not have been enough to cater for both the child's specific needs and the households' needs altogether. On the other hand, the intervention related improvement might have been insufficient to translate into a sustained improvement in their nutritional status. A quantitative 24-hour dietary recall carried out during the UCT study reported better dietary quality in children belonging to the intervention group as compared to the control group. More specifically, intervention children consumed animal source foods more frequently and demonstrated higher intakes in vitamin B12 and E. However, no difference in energy and protein intake between the intervention and the control groups was observed (unpublished data). The positive intervention effect on diet quality might have been too small (both in the percentage of children and nutrient quantity) to affect child anthropometry. Furthermore, the high number of cumulative morbidity episodes emphasizes the high frequency of illness (table 3). The cyclic interaction between undernutrition and infections is widely recognized [1, 47, 48]. Previous studies showed that diarrheal illnesses can prevent weight gain as well as height gain, with the greatest effects when illnesses are recurrent [49]. Infections can further reduce food intake and increase energy and nutrient needs to fight infection, maintaining tissue repair and constraining body resources to be used for basic maintenance [50, 51]. The cumulative growth faltering may have hampered the improvement in the children's nutritional status in both groups. Finally, seasonal UCT may not have been a sufficient intervention to prevent child acute malnutrition. Future studies on the prevention of child malnutrition should evaluate UCT interventions combined with other child nutrition sensitive interventions. One possible complementary intervention could be the behavior change communication (BCC) for better nutrition and health, which fosters behavior change at the individual household and community levels through behavior change trainings, monitoring and evaluation and a sustainability component [52]. The effectiveness of a similar approach (combining cash transfers with nutrition BCC) for the prevention of undernutrition is currently being assessed by the transfer modality research initiative (TMRI) in Bangladesh (ClinicalTrials.gov, identifier: NCT02237144).

Multiannual seasonal UCTs that targeted mothers in vulnerable households in Tapoa province significantly reduced episodes of respiratory tract infection in the seven days before the interview, as reported by mothers. As methods vary among studies, we found it difficult to compare our findings with the relatively small body of literature on UCTs. Most studies reported an effect of UCTs on overall children's well-being and health outcomes, but few looked at the child morbidity indicators as defined by our study. After 24 months of implementation, the Zambian child grant program reported the intervention group of children had a 4.9 percentage points lower diarrheal prevalence compared to the control group, but did not find any intervention effect on cough [53]. After two years of cash transfers in an orphans and vulnerable children's program in Kenya, the evaluation team reported no intervention effect on morbidity indicators (diarrhea, fever and cough) among children under 5 years old who sought care when sick compared to children belonging to a control group [54]. A randomized controlled trial in Malawi did find that children 6-17 years (therefore older than ours) included in a cash transfer program were less likely to be sick (with respiratory infections, malaria and abdominal pain as the most common reported illnesses), but does not provide insights on the pathways [23]. Although there was an apparent reduction in child's respiratory tract infections episodes in our study, it is difficult to support our findings with previous evidence. Therefore, the impact pathway for such an effect remains to be elucidated.

Our study has some limitations that need to be addressed. First, the sample size attained was smaller than foreseen, mainly due to logistical constraints (security, accessibility). Lost to follow-up was however lower than expected and the proportion of missing data was small thanks to the extra time invested in additional home visits when the participant was absent. In addition, adjustment for important prognostic covariates pre-specified in the protocol likely outweighed the loss of power due to the reduction in the sample size [55]. Secondly, child morbidity was recalled by mothers, which could have resulted in under or over-estimation. Finally, concerns about contamination between individuals are often present when it comes to the distribution of cash or food supplements. We chose a prospective interventional study with randomization at village level to limit these biases. However, we could not blind the study participants and the fieldworkers with respect to the intervention assignment because of the nature of the intervention (cash).

Conclusion

We did not find evidence of the effectiveness of multiannual seasonal unconditional cash transfers in preventing acute malnutrition in young children in Tapoa province. However, they resulted in a reduction in respiratory tract infection episodes. A cash-based program combined with a child nutrition and health behavior change communication component is a good compromise that requires further investigation.

Acknowledgments

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

Abbreviations: ACF-France, Action Contre la Faim-France; BCC, behavior change communication; CMAM, Community-based management of acute malnutrition; HAZ, height-for-age Z-score, MUAC, mid-upper arm circumference; NCA, Nutrition Causal Analysis; OR, odds ratio; PCA, Principal component analysis; SES, socioeconomic status; TMRI, transfer modality research initiative; UCT, unconditional cash transfers; WAZ, weight-for-age Z-score; WHO, World Health Organization; WHZ, weight-for-height Z-score; XOF, West African CFA (Financial Community of Africa) franc.

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. Food and Agriculture Organization: **Regional Overview of Food Insecurity Africa: African Food Security Prospects Brighter Than Ever.** 2015.
3. de Pee S, Grais R, Fenn B, Brown R, Briend A, Frize J, Shoham J, Kiess L: **Prevention of acute malnutrition: Distribution of special nutritious foods and cash, and addressing underlying causes-what to recommend when, where, for whom, and how.** *Food and Nutrition Bulletin* 2015, **36:**S24-S29.
4. Vaitla B, Devereux S, Swan SH: **Seasonal Hunger: A Neglected Problem with Proven Solutions.** *Plos Medicine* 2009, **6**.
5. UNICEF, WHO, WorldBankGroup: **Levels and trends in child malnutrition - Key findings of the 2015**
6. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J, Study MCU: **Maternal and child undernutrition 1 - Maternal and child undernutrition: global and regional exposures and health consequences.** *Lancet* 2008, **371:**243-260.
7. World Health Organization: **Guideline: Updates on the Management of Severe Acute Malnutrition in Infants and Children.** *WHO Library Cataloguing-in-Publication Data* 2013.
8. Rogers E, Myatt M, Woodhead S, Guerrero S, Alvarez JL: **Coverage of community-based management of severe acute malnutrition programmes in twenty-one countries, 2012-2013.** *PLoS One* 2015, **10:**e0128666.
9. Bailey S, Hedlund K: **The impcat of cash transfers on nutrition in emergency and transitional contexts: A review of evidence.** *HPG Synthesis paper London: Overseas Development Institute* 2012.

10. Langendorf C, Roederer T, de Pee S, Brown D, Doyon S, Mamaty AA, Toure LW, Manzo ML, Grais RF: **Preventing acute malnutrition among young children in crises: a prospective intervention study in Niger.** *PLoS Med* 2014, **11:**e1001714.

11. Polastro R, Khalif A, Mohamed, Van-Eyben M, Ninaber, Posada S, Salah A, S, Mohamoud, Steen N, Toft E: **IASC Evaluation of the Humanitarian Response in South Central Somalia (2005-2010).** 2011.

12. Sibson VL, Grijalva-Eternod CS, Bourahla L, Haghparast-Bidgoli H, Morrison J, Puett C, Trenouth L, Seal A: **The REFANI-N study protocol: a cluster-randomised controlled trial of the effectiveness and cost-effectiveness of early initiation and longer duration of emergency/seasonal unconditional cash transfers for the prevention of acute malnutrition among children, 6-59 months, in Tahoua, Niger.** *Bmc Public Health* 2015, **15**.

13. Alviar C, Davis B, Handa S, Hurrell A, Hussein A, Musembi D, Ochieng S, Palermo T, Pearson R, Pellerano L, et al: **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. 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.

15. Ng M, Misra A, Diwan V, Agnani M, Levin-Rector A, De Costa A: **An assessment of the impact of the JSY cash transfer program on maternal mortality reduction in Madhya Pradesh, India.** *Global Health Action* 2014, **7**.

16. Lignani JD, Sichieri R, Burlandy L, Salles-Costa R: **Changes in food consumption among the Programa Bolsa Familia participant families in Brazil.** *Public Health Nutrition* 2011, **14:**785-792.

17. Attanasio OP, Gomez L, Carlos, Heredia P, Vera-Hernandez M: **The short-term impact of a conditional cash subsidy on child health and nutrition in Colombia.** *The Institute of Fiscal Studies Report summary* 2005, **3:**15.

18. Shei A, Costa F, Reis MG, Ko AI: **The impact of Brazil's Bolsa Familia conditional cash transfer program on children's health care utilization and health outcomes.** *Bmc International Health and Human Rights* 2014, **14**.

19. Sosa-Rubi SG, Walker D, Servan E, Bautista-Arredondo S: **Learning effect of a conditional cash transfer programme on poor rural women's selection of delivery care in Mexico.** *Health Policy and Planning* 2011, **26:**496-507.

20. Barber SL, Gertler PJ: **The impact of Mexico's conditional cash transfer programme, Oportunidades, on birthweight.** *Tropical Medicine & International Health* 2008, **13:**1405-1414.

21. Fernald LCH, Gertler PJ, Neufeld LM: **Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades.** *Lancet* 2008, **371:**828-837.

22. Leroy JL, Ruel M, Verhofstadt E: **The impact of conditional cash transfer programmes on child nutrition: a review of evidence using a programme theory framework.** *Journal of Development Effectiveness* 2009, **1:**103-129.

23. Luseno WK, Singh K, Handa S, Suchindran C: **A multilevel analysis of the effect of Malawi's Social Cash Transfer Pilot Scheme on school-age children's health.** *Health Policy and Planning* 2014, **29:**421-432.

24. Ruel MT, Alderman H, Grp MCNS: **Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?** *Lancet* 2013, **382:**536-551.

25. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J, Maternal, Child Undernutrition Study G: **Maternal and child undernutrition: global and regional exposures and health consequences.** *Lancet* 2008, **371:**243-260.

26. PNPS: **Politique Nationale de Protection Sociale 2013-2022.** *Gouvernement du Burkina Faso* 2012.

27. Boucher-Castel L, Chalimbaud J: **Rapport de synthèse NCA-Tapoa, Burkina Faso.** *Action Contre la Faim, Paris, France* 2013.

28. Action Contre la Faim: **Programme "Wash-in-Nut" : intégration d'un paquet minimum EAH dans les programmes de traitement de la sous-nutrition.** *Burkina Faso* 2013.

29. 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.

30. Bargo M, Dahani M, Gandema A, Hien S, Konate P, S., Ouedraogo D: **Analyse de l'économie des ménages : Burkina Faso Zone Sud-Est céréales, élevage, forêt et faune Province de la Tapoa : novembre-décembre 2011.** *Burkina Faso* 2011.

31. Chalimbaud J, Coates J, Collaiezzi B: **Link NCA-A Particpatory and Response Oriented Method for Conducting a Nutritional Causal Analysis.** *Action Contre la Faim, Paris, France* 2015.

32. Boucher-Castel L, Chalimbaud J: **Rapport de synthèse NCA-Tapoa, Burkina Faso.** In *Action Contre la Faim*. pp. 116. Paris, France2013:116.

33. Savy M, Martin-Prevel Y, Traissac P, Eymard-Duvernay S, Delpeuch F: **Dietary diversity scores and nutritional status of women change during the seasonal food shortage in rural Burkina Faso.** *J Nutr* 2006, **136:**2625-2632.

34. Institut National de la Statistique et de la Démographie: **Enquête Multisectorielle Continue (EMC) 2014 Profil de Pauvreté et d'Inégalités.** *Ministère de l'Economie et des Finances, Burkina Faso* 2015.

35. Duflo E: **Grandmothers and granddaughters: Old-age pensions and intrahousehold allocation in South Africa.** *World Bank Economic Review* 2003, **17:**1-25.

36. Ministère de la Santé: **Plan de Passage à l'Echelle de la Promotion des Pratiques Optimales d'Alimentation du Nourrisson et du jeune Enfant au Burkina Faso (2013-2025).** *Burkina Faso* 2014.

37. Coldham C, Ross D, Quigley M, Segura Z, Chandramohan D: **Prospective validation of a standardized questionnaire for estimating childhood mortality and morbidity due to pneumonia and diarrhoea.** *Tropical Medicine & International Health* 2000, **5:**134-144.

38. Mobley CC, Boerma JT, Titus S, Lohrke B, Shangula K, Black RE: **Validation study of a verbal autopsy method for causes of childhood mortality in Namibia.** *Journal of Tropical Pediatrics* 1996, **42:**365-369.

39. Leroy J: **ZSCORE06: Stata module to calculate anthropometric z-scores using the 2006 WHO child growth standards.** *Available at* http://econpapersrepecorg/software/bocbocode/s457279htm *Accessced July 28, 2016*.

40. Vyas S, Kumaranayake L: **Constructing socio-economic status indices: how to use principal components analysis.** *Health Policy Plan* 2006, **21:**459-468.

41. Cummings P: **Methods for estimating adjusted risk ratios.** *Stata Journal* 2009, **9:**175-196.

42. McNeish DM, Stapleton LM: **The Effect of Small Sample Size on Two-Level Model Estimates: A Review and Illustration.** *Educational Psychology Review* 2016, **28:**295-314.

43. Akresh R, de W, D, Kazianga H: **Evidence from a Randomized Evaluation of the Household Welfare Impacts of Conditional and Unconditional Cash Transfers Given to Mothers or Fathers.** *The world Bank, Policy Research Working Paper 7730* 2016.

44. Pega F, Liu SY, Walter S, Lhachimi SK: **Unconditional cash transfers for assistance in humanitarian disasters: effect on use of health services and health outcomes in low- and middle-income countries.** *Cochrane Database of Systematic Reviews* 2015.

45. Seidenfeld D, Handa S, Tembo G, Michelo S, Harland C, Prencipe L: **The Impact of an Unconditional Cash Transfer on Food Security and Nutrition: The Zambia Child Grant Programme.** *IDS Special Collection* 2014.

46. Haushofer J, Shapiro J: **Policy Brief: Impacts of Unconditional Cash Transfers.** 2013.

47. Macallan D: **Malnutrition and infection.** *Medicine* 2005, **33**.

48. Tomkins A, Watson F: **Malnutrition and Infection - A Review - Nutrition Policy Discussion Paper No.5.** *United Nations, ACC/SCN* 1993.

49. Guerrant RL, Schorling JB, Mcauliffe JF, Desouza MA: **Diarrhea as a Cause and an Effect of Malnutrition - Diarrhea Prevents Catch-up Growth and Malnutrition Increases Diarrhea Frequency and Duration.** *American Journal of Tropical Medicine and Hygiene* 1992, **47:**28-35.

50. Schaible UE, Kaufmann SHE: **Malnutrition and infection: Complex mechanisms and global impacts.** *Plos Medicine* 2007, **4:**806-812.

51. Sridhar D: **Linkages between Nutrition, Ill-Health and Education: Background paper prepared for the Education for All Global Monitoring Report 2009, Overcoming Inequality: why governance matters.** *UNESCO* 2008.

52. USAID: **Behavior change interventions and child nutritional status : Evidence from the promotion of improved complementary feeding practices Literature review.** 2011.

53. American Institutes for Research: **Zambia's Child Grant Program: 24-Month Impact Report.** *Washington, DC* 2013.

54. Ward P, Hurell A, Visram A, Riemenschneider N, Pellerano L, O'Brien C, MacAuslan I, Willis J: **Cash transfer programme for orphans and vulnerable children (CT-OVC), Kenya operational and impact evaluation, 2007–2009 - Final report.** *Oxford, Policy Management* 2010.

55. Kahan BC, Jairath V, Dore CJ, Morris TP: **The risks and rewards of covariate adjustment in randomized trials: an assessment of 12 outcomes from 8 studies.** *Trials* 2014, **15**.

Tables

Table 1: Baseline characteristics of children enrolled in the MAM'Out study

Characteristics	Control arm (620)	Intervention arm (630)
Children's age in months, mean ± SD	7.79 ± 2.93	6.83 ± 3.29
Children's age category, frequency (percent)		
Children aged < 6 months	161 (26.0)	236 (37.5)
Children aged 6 – 11 months	396 (63.8)	358 (56.8)
Children aged 12 – 15 months	63 (10.2)	36 (5.7)
Children's gender categories, frequency (percent)		
Male children	313 (50.5)	349 (55.4)
Female children	307 (49.5)	281 (44.6)
Children's anthropometric measurements, mean ± SD		
Children's weight, kg	6.7 ± 1.12	6.3 ± 1.22
Children's height, cm	65.8 ± 4.25	64.4 ± 5.10
Children's MUAC, mm[a]	133.1 ± 11.7	131.3 ± 12.8
Children's weight-for-height z-score	-1.07 ± 1.12	-1.24 ± 1.23
Children's height-for-age z-score	-1.33 ± 1.24	-1.18 ± 1.44
Children's wasting forms, frequency (percent)		
Wasted children with weight-for-height z-score < -2	119 (19.2)	164 (26.0)
Severely wasted children with weight-for-height z-score < -3	22 (3.55)	44 (7.00)
Wasted children with mid upper arm circumference < 125 mm	82 (18.2)	115 (29.2)
Severely wasted children with mid upper arm	19 (4.23)	39 (9.92)

circumference < 115 mm		
Children's stunting forms, frequency (percent)		
Stunted children with height-for-age < -2	169 (27.2)	175 (27.7)
Severely stunted children with height-for-age z-score < -3	56 (9.03)	64 (10.1)
Households' socio-economic status categories, frequency (percent) [b]		
Low category	248 (40.1)	288 (45.7)
Middle category	205 (33.1)	224 (35.6)
High category	166 (26.8)	118 (18.7)

Data are frequency (percent) or mean ± SD

[a] Mid upper arm circumference was measured in children ≥ 6months old

[b] Socio-economic status data was not completed for one child in the control group

Table 2: Effect of multiannual seasonal UCTs on children's anthropometric measurements and their nutritional status

Outcome	Control arm (n=620)	Intervention arm (n=630)	p-Value
Children's wasting			
End point mean weight-for-height z-score, mean ± SD	-0.61 ± 0.93	-0.56 ± 0.95	
Intervention effect (95% CI) on weight-for-height z-score, z-score/month [a]	Reference	-0.003 (-0.008 ; 0.0003)	0.07
Cumulative episodes of weight-for-height z-score < -2	542	537	
Number of observed child-months	14,458	15,394	
Number of episodes per child-month (95%CI) [b]	0.045 (0.036 ; 0.057)	0.039 (0.031 ; 0.051)	
Incidence rate ratio (95% CI) [c]	Reference	0.92 (0.64 ; 1.32)	0.66
Children's stunting			
End point mean height-for-age z-score, mean ± SD	-1.99 ± 1.04	-1.96 ± 1.03	
Intervention effect (95% CI) on height-for-age z-score, z-score/month [a]	Reference	-0.0005 (-0.004 ; 0.003)	0.78
Odds ratio of the end point stunting (95% CI) [d]	Reference	0.73 (0.47 ; 1.14)	0.17
Mid upper arm circumference			
End point mean mid upper arm circumference in mm, mean ± SD	144.2 ± 10.3	144.3 ± 11.0	
Intervention effect (95% CI) on mid upper	Reference	-0.02 (-0.08 ; 0.02)	0.33

arm circumference, mm/month [a]			

[a] Analyzed using a linear mixed model with cluster, household and children as random effects, adjusted for child's age at baseline, child's sex, socio-economic status at inclusion and the baseline value of the outcome under analysis.

[b] Confidence intervals were estimated from a mixed Poisson model with random effects cluster, household and child.

[c] Analyzed using a mixed Poisson regression model with cluster, household and children as random effects, adjusted for child's age at baseline, child's sex, socio-economic status at inclusion and weight-for-height z-score baseline value.

[d] Analyzed using a mixed logistic model with cluster and household as random effects, adjusted for child's age at baseline, child's sex, socio-economic status at inclusion and baseline value

Table 3: Effect of multiannual seasonal UCTs on children's self-reported morbidity

Outcome	Control arm (n=620)	Intervention arm (n=630)	p-Value
Number of child-months recalled [a]	1261	1266	
Diarrhea			
Number of diarrhea episodes	1049	1083	
Number of diarrhea episodes per child-month (95% CI) [b]	0.83 (0.80 ; 0.85)	0.85 (0.82 ; 0.88)	
Incidence rate ratio (95% CI) [c]	Reference	1.00 (0.97 ; 1.03)	0.89
Fever			
Number of fever episodes	2574	2302	
Number of fever episodes per child-month (95% CI) [b]	2.03 (1.99 ; 2.08)	1.81 (1.78 ; 1.85)	
Incidence rate ratio (95% CI) [c]	Reference	0.98 (0.96 ; 1.03)	0.31
Respiratory tract infections			
Number of respiratory tract infections episodes	1198	1106	
Number of respiratory tract infections episodes per child-month (95% CI) [b]	0.95 (0.92 ; 0.97)	0.87 (0.84 ; 0.89)	
Incidence rate ratio (95% CI) [c]	Reference	0.79 (0.78 ; 0.81)	0.000

[a] Calculated by number of recalls x recall duration

[b] Confidence intervals are estimated from a mixed Poisson model with cluster, household and child random effects.

[c] Analyzed using a mixed Poisson regression model with cluster, household and child as random effects, adjusted for child's age at baseline, child's sex, socio-economic status at inclusion and morbidity status at baseline.