The importance of nutrition education in achieving food security and adequate nutrition of the poor: Experimental evidence from rural Bangladesh

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Abstract

Nutrition-sensitive social protection that enhances household resources and nutrition knowledge can be an important avenue of addressing food security and nutrition concerns of the poor. This paper studies a cluster randomized intervention of cash and food transfers, with or without nutrition behavioral change communication (BCC), on food security and nutrition outcomes in rural Bangladesh. We find that addition of the BCC to transfers led to the greatest impact on the quantity and quality of food consumed by household members, especially women and children. Addition of BCC also had the greatest impact in reducing the incidence and intensity of deprivations measured using a nutrition-sensitive multidimensional poverty index. Evidence suggests this occurs through the BCC inducing increased consumption of flesh food, egg, dairy, fruits, and vegetables and through investments in housing, sanitation, and assets.

JEL Classifications – D04, I38, O12

Keywords – cash transfers, food transfers, behavioral change communication, social protection, food security, women's empowerment, living standards, multidimensional poverty, rural Bangladesh

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1. Introduction

The primary objective of this paper is to examine the impact of a cluster randomized social protection intervention of cash and food transfers - with or without complementary nutrition behavioral change communication (BCC) - to poor women in rural Bangladesh on household food security, and women and child nutritional outcomes. The main departure of this paper is to study not only the modality of cash and food transfers, but also whether combining complementary nutrition BCC with transfers yield any additional benefit to the poor. We also construct a nutrition-sensitive multidimensional poverty index, combining indicators of food security and nutrition, to analyze the program's impact on the incidence (headcount) of multidimensional poverty as well as the intensity (depth) of deprivations experienced by the multidimensionally poor. In recent decades, although Bangladesh has attained admirable progress in food security and nutrition at the aggregate level, it is among a list of 11 countries (out of 80) where nutrition inequalities are rising between the rich and the poor (Bredenkamp et al., 2014). This provides an appropriate context to evaluate whether addressing the economic constraint of the poor is enough to achieve food security and adequate nutrition, or whether there is a need to provide knowledge on dietary intake and infant and young child feeding (IYCF) practices, brought about by carefully constructed BCC.

The evidence of impact of transfer programs on food security and nutrition around the world is mixed. A global review done in 2014 by Andrews et al. (2014), found that out of 142 studies around the world, only 41 showed impacts on health and nutrition outcomes. Likewise, Bastagli et al. (2016) reviewed 12 studies on the impacts of cash transfers on dietary diversity and find positive impacts from seven studies with none in the other five studies. On the issue of child health outcomes, while Duflo (2000) find an unconditional cash transfer (UCT) program in South Africa to have improved anthropometric outcomes for girls but not boys, Paxson and Schady (2010) does not find an impact of transfers on cognitive, behavioral, and physical outcomes for children from a UCT in Ecuador. On the other hand, conditional cash transfer (CCT) programs conditioned on health have improved child nutritional status for a select group of children – younger children from rural areas – in Colombia (Attanasio et al., 2005), improved child nutritional status in Nicaragua (Maluccio and Flores, 2005), but had no impacts in Brazil (Morris et al., 2004) and Honduras (Hoddinott, 2010). Similarly, Gentilini (2016) comparing 11 impact evaluations of transfer programs in 10 developing countries reveal mixed results of effectiveness of cash against food transfers. For example, while in most cases, cash transfers were more effective in increasing food consumption, food transfers had a larger impact on calorie intake with mixed results for measures of diet diversity.

A feature of many of the above transfer programs in developing regions are an inclusion of nutrition training or counseling with transfers. This hinges on the assumption that increasing resources to reduce the economic vulnerability of poor households may not be enough to ease the burden of undernourishment, rather such transfers should be bundled with nutrition education so that households have sufficient income as well as the knowledge to purchase adequate and diverse foods (Black et al., 2013; Ruel and Alderman, 2013). However, such conditions are often "soft" (e.g., warnings or small penalties are applied instead of withholding the full transfer), making the difference between CCTs and UCTs less stark for e.g. in Sub-Saharan Africa (Garcia and Moore, 2012). Similarly, in Ecuador, Paxson and Schady (2010) found that only 28% of participants in an UCT program thought conditions applied.

In this paper, we contribute to the literature in several ways. First, using an experimental setting, the paper generates evidence on the impact of two competing modality of transfer cash and food – with and without nutrition BCC – on household food security, and women and child

nutritional outcomes[2]. The form of transfer modality is one of the most debated topics in the social protection literature. Relative merits of cash transfers are embedded in the neo-classical consumer theory where cash transfers give households the means to make choices (Southworth, 1945) and maximize their utility given their preferences, available resources, and the alternatives they face. Furthermore, relative advantages exist for cash transfers in terms of timeliness of delivery and cost savings (Gentilini, 2016). On the other hand, in-kind[3] transfers are often used in a paternalistic view to influence recipient's behavior to achieve some desirable outcome (Cunha, 2014), to aid in targeting (Moffitt, 1983), to supply goods that are not obtainable locally (Aker, 2017). In Bangladesh, there are over 100 social protection programs providing cash and in-kind transfers with the government allocating around US$7.69 billion[4] (13.81% of total budget) for the fiscal year 2018-19. It is thus important to evaluate which modality of transfer works best for the poor.

Second, so far in most studies on the modality of social protection transfer, transfers are usually bundled with complementary nutrition training with no explicit attempt in isolating the additional impacts of bundling transfers with trainings (Fiszbein et al., 2009), which highlights the need for rigorous evidence in this regard (Hidrobo et al., 2014). The conditionality and implementation of training are also relaxed as stated before. Furthermore, an evaluation of the effectiveness of cash and food-based interventions of four national social protection programs in rural Bangladesh by Ahmed et al. (2009), while found evidence of positive impact on income and food security, found no evidence of impact on child nutritional outcomes. This points to the importance of examining whether the addition of a well-designed and properly implemented complementary nutrition training is important in achieving the desired food security and nutritional outcomes.

Third, a salient feature in the impact evaluation literature of transfer programs is the use of unidimensional indicators to assess the average impact of transfers over the sample, where the indicators reflect the various objectives of the study. However, it is useful for policymakers to evaluate whether each household have benefited from more than one improvement using a summary index. This is especially important when addressing the issue of food security and nutrition of households since the nature of the problem is multidimensional with synergies that exist between the underlying aspects. For example, there may be negative intra-household externalities where deprivation of one aspect – poor maternal health and nutrition, and infant and child feeding practices (IYCF) – will affect the children in the household in terms of their health and nutrition outcome. Indices thus summarize heterogenous information into a single metric and enable straight comparisons across groups. Furthermore, by summarizing information, it avoids the statistical issue of multiple hypothesis testing as well as selective reporting of results (Masset and Garcia-Hombrados, 2021). Therefore, we combine the different indicators of food security and nutrition to form a nutrition-sensitive multidimensional poverty index (N-MPI) following Alkire et al. (2015) and analyze the program's impact on the incidence (headcount) and intensity (depth) of multidimensional poverty.

We find that the addition of the nutrition BCC with transfers led to the greatest impact on indicators of food security and nutrition after two years of program implementation. Specifically, cash or food transfer combined with BCC has a statistically significant impact on reducing households with hunger, low diet diversity and low adult equivalized calorie intake along with

[2] Companion papers using the same program and data looked into economic wellbeing of beneficiary households in terms of consumption and assets (Ahmed et al., 2019b), child wellbeing (Ahmed et al., 2019a), infant and young child nutrition knowledge of mothers (Hoddinott et al., 2018b), and use of multiple-micronutrient powders and iron supplements in children (Hoddinott et al., 2018a).

[3] In-kind transfers include a vast array of items such as shelter, agricultural inputs, subsidized healthcare, and food. In this paper, we only consider a subset of in-kind transfer i.e. food. We use "in-kind" and "food" interchangeably.

[4] Exchange rate of 1 USD = 83.44 BDT from www.oanda.com on 15 April 2019.

reducing households with inadequate diet diversity of women and children. In addition to these indictors, food combined with transfers has an impact on reducing households with low asset base, while cash combined with BCC additionally having impact on reducing household with poor housing condition and sanitation. The impact of transfers combined with BCC on diet diversity came through an increase in the consumption of flesh food, eggs, and dairy. The impact coming through the BCC arm is also statistically significantly different than impact from other modalities (cash only, food only, and half-cash-half-food). Furthermore, transfers combined with BCC also had the greatest impact on the incidence and intensity of deprivations measured using a nutrition-sensitive multidimensional poverty index irrespective of the multidimensional poverty cutoff and weights.

The rest of the paper is structured as follows: Section 2 introduces the program and study design, presents the data and descriptive analysis; Section 3 describes the outcome indicators; Section 4 discuss the empirical methods used to evaluate the impact of the different transfer modalities; Section 5 presents the impact estimates; Section 6 conducts robustness and extended analysis; and Section 7 concludes.

2. The intervention design and data

2.1 Transfer Modality Research Initiative (TMRI)

To elicit the impact of different modalities of social protection transfer on food security and nutrition, in the context of rural Bangladesh, we are using data generated from a randomized control trial titled the Transfer Modality Research Initiative (TMRI) conducted by IFPRI and WFP from May 2012 to April 2014. The TMRI was implemented over two years in two distinct regions – the northwest in Rangpur division and the south in Khulna and Barisal division (henceforth- North and South). Poverty and food insecurity are rampant in the North and South. Among the eight division in Bangladesh, Rangpur division has the highest extreme poverty rate at 30.5% while Barisal comes in at third highest with 14.5% and Khulna comes in at fifth with 12.4% (BBS, 2017). In terms of food security, HKI/JPGSPH (2016) reports that the highest proportion of households with sub-optimal food consumption, measured by low FCS, is in Rangpur (36%), Barisal (29%) and Khulna (24%) divisions. Markets function well in the North since the physical infrastructure in the region is reasonably well developed with good roads and connectivity. On the other hand, infrastructure and market functions are relatively poorer in the South, which is also vulnerable to climatic shocks due to its proximity to the Bay of Bengal.

Owing to such differences, along with the three transfer modalities of cash only (Cash), food only (Food), and half cash and half food combination (Cash+Food), a fourth modality of cash contingent on attending the nutrition BCC training is included in the North (Cash+BCC). Since, there is good connectivity and markets function well, beneficiaries can choose for themselves how best to utilize the transferred cash to achieve desired nutritional outcomes. In the South, since connectivity and market function are poor, a more paternalistic modality of food along with nutrition BCC (Food+BCC) was tested. Both the regions had a control group which did not receive any intervention. Careful attention was paid to ensure program design was homogenous across modalities with respect to transfer level, timing and frequency, and BCC messaging so that any difference in impact can be attributed to the form of transfer. Households selected in the study were poor, with at least one child aged between 0-24 month (the index child). Mother of the index child received the transfer and participated in the BCC activities (if relevant), and she along with her household/family members were the beneficiaries. Transfer payments and BCC were conducted for 24 months, from May 2012 to April 2014.

2.2 Description of transfer modalities

To be able to attribute any difference in outcomes to the form of transfer provided, the transfer value should be same for cash and food components of the intervention. The transfer value for the treatment households were standardized at 1500 taka (US$ 18.75) per household per month. This amount is equivalent to 32.3% of the average baseline food and 21% of the average baseline total expenditure. For Cash arm, the same value was used through the intervention period. For Food arm, a food ration equivalent to 1500 taka, which included 30 kilograms (kg) of rice, 2 kg of *mosoor* pulse (a type of lentil), and 2 liters of micronutrient-fortified cooking oil, was fixed at the beginning of the research and maintained throughout the intervention period. Beneficiaries in Cash+Food arm received half of each type of transfers – 750 taka, 15 kg of rice, 1 kg of *mosoor* pulse, and 1 liter of micronutrient-fortified cooking oil. Transfers were provided monthly to the beneficiaries.

Beneficiaries in Cash+BCC in the North and Food+BCC in the South received the same transfers as in Cash and Food respectively, along with an intensive nutrition BCC component. The nutrition BCC, designed by WFP and IFPRI in consultation with various local and international technical experts, consists of six modules, which were delivered over seven sessions: (1) overall importance of nutrition and dietary diversity for health; (2) handwashing and hygiene for improving nutrition and health; (3) micronutrients: diversifying diets, Vitamin A; (4) micronutrients: diversifying diets, iron, iodine, and zinc; (5) feeding young children: breastfeeding (6) feeding young children: complementary feeding; and (7) maternal nutrition. BCC training was imparted by Community Nutrition Workers (CNW), engaged by a local NGO working in the two regions of the intervention. CNWs, all women, were recruited from the same villages as the TMRI participants and received training prior to start of the interventions with refresher training 3 and 12 months after the start of the intervention. Various methods were employed to convey the modules such as presentations, interactive call and answer, songs and chants, role playing, question and answer, and practical demonstrations. The CNWs imparted training in four instances – (1) monthly group BCC trainings with the participants in each village (that is, in the Food+BCC or Cash+BCC arms), (2) three weekly group BCC trainings with participants and other influential family members (mother-in-law, husband, etc.) (3) monthly group meetings for community members, and (4) follow-up visits by the CNWs to the participants' homes in case the participant missed a session or to address specific concerns the participant may have.

2.3 Sampling Design and Data

Equivalent sampling procedures were employed for the North and the South to implement the cluster randomized design of the TMRI(see Appendix Figures 1 and 2 for a schematic depiction). First, two districts were chosen, from which five sub-districts (*upazilas*) were randomly selected to receive all interventions from a list of *upazilas* where the proportion of households living below Bangladesh's lower poverty line was 25% or higher based on the 2010 Bangladesh Poverty Map prepared by the Bangladesh Bureau of Statistics (BBS). All villages (clusters) were then listed within these *upazilas* from which 250 villages (50 per *upazila*) were randomly selected in each region. Treatment and control villages were randomly assigned among the 250 selected villages (50 per treatment arm and 50 for the control group).

Next, a complete village census was conducted in the 250 villages in each region to find eligible households based on the criteria that the household (i) were poor (based on a score calculated using indicators on age and education of household head, ownership of land and consumer durables, housing characteristics and household livelihoods), (ii) have at least one child aged between 0–24 months, and (iii) were not receiving benefits from any other safety-net interventions. 10 such eligible households were randomly selected from each village (cluster)

using simple random sampling yielding a total of 2500 households (500 per treatment arm and 500 control) in each region.

Two rounds of household survey of the TMRI beneficiaries in the treatment villages and non-beneficiaries in the control villages were conducted to collect data for the quantitative impact evaluation. The first survey served as the baseline survey and was conducted just before the start of the interventions in April 2012. The endline survey was conducted during the last month of interventions, 23 months after the start of the interventions in April 2014. A comprehensive questionnaire was administered to a primary female (typically the mother or, if absent, the primary caregiver of the less than 24-month-old child) and their spouse with men and women being interviewed separated by male and female enumerators, respectively. The survey collected detailed and at times sex-disaggregated information on household demographic composition, education attainment, occupation and employment, dwelling characteristics, assets, detailed food and nonfood expenditures, individual level dietary intake data from 24-hour recall, childcare, water and sanitation, anthropometric measurements of children, savings and loans, food security indicators, women's status, etc. to estimate the impact of the interventions.

2.4 Attrition and balance

From the 2500 households selected and invited to participate in the program, 2 and 6 households refused to participate making the baseline sample size 2498 and 2494 households respectively in the North and the South. The rate of attrition to endline was low at 4.2% in the North and 2.8% in the South making the final sample with complete information on all outcome variables to be 2395 households in the North and 2425 households in the South. Analysis of attrition using probit models reveal no significant association of attrition with treatment arms across regions (see Appendix Table A2). Nevertheless, in Section 6.2 we present results from an inverse probability of attrition weighted (IPW) model and an extended model adding control variables that may be associated with attrition.

We have computed a baseline balance test of characteristics for the non-attrited sample – if there is balance of baseline characteristics across the non-attrited sample, we can say that randomization has been successful, and attrition of sample has not resulted in any differences in means of characteristics of the remaining non-attrited sample. Appendix Tables A3 and A4 present means of various baseline characteristics by treatment arms and p-values of the difference in means between all combination of treatment arms and the control group. We find that randomization has largely been successful. In the North, only in one of the 210 (21 x 10) difference in means test can we reject the null hypothesis of no difference between the group at a 5% level of significance. Duflo et al. (2008) note that with 210 tests, the probability that we will reject at least one true null hypothesis, i.e. at least one covariate will show a significance difference in mean, is almost 100%. We find that average height for age z-score of children are statistically different in Food and Cash+BCC. In the South, only 4 of the 210 difference in means test are statistically significant at the 5% level of significance. We find that the average number of dependents is higher in Food compared to Food+BCC, and per capita monthly food and total expenditure is higher in Cash+Food compared to Food+BCC.

3. Outcome indicators

3.1 Unidimensional indicators

As outcome indicators we look at different measures of household food security along with measures of women's empowerment and living standards. Within these dimensions, we look at fifteen indicators to assess the impact of the transfers on deprivation of each of these indicators. These indicators are drawn from existing literature measuring outcome of food security and

nutrition and have been shown to correlate well with household diet quantity and quality. Measures of food security considered are Food Consumption Score (FCS), Minimum Dietary Diversity-Women (MDD-W), undernourishment, and Household Hunger Scale (HHS), all of which are extensively used in the literature (e.g. Aker, 2017; Cunha, 2014; Hidrobo et al., 2014). The FCS is calculated as a weighted summation (out of 112) of the number of days a household have consumed a food group (staples, pulses, vegetables, fruits, meat/fish, milk, sugar, and oil) in the past 7 days, where the weights reflect the differential nutritional benefit of each food group. Wiesmann, Bassett and Hoddinott (2009) showed the FCS to be highly correlated with other food security indicators such as household calorie consumption. A household is considered deprived if the score is less than 42 which is the typical threshold used to identify poor food consumption (Baumann, Webb and Zeller, 2013). The MDD-W is calculated as whether a women of reproductive age 15-49 years have consumed at least 5 of 10 food groups (grains/root/tubers, pulses (beans, peas and lentils), nuts/seeds, dairy, meat/poultry/fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, and other fruits) in the last 24 hours (FAO and FHI, 2016). A household is considered deprived if any women in the household has consumed less than 5 food groups. Earlier work on women's diet diversity measures by Arimond et al. (2010) showed such measures to be strongly associated with adequacy for 11 micronutrients, which, as discussed earlier, is essential to break the cycle of malnutrition of mother and child. The third measure, undernourishment, is a measure of the average adult equivalized calorie intake in the household in the last 24 hours. A household is deprived if adult equivalized calorie intake is less than 2,122 kcal/day. Finally, the Household Hunger Scale (HHS) is calculated using the frequency with which household members experienced in the last 4 weeks (1) no food at all in the house, (2) went to bed hungry, (3) went all day and night without eating. Responses are given the values: never (value = 0), rarely or sometimes (value = 1), often (value = 2). Values for the three questions are summed for each household, producing a HHS score ranging from 0 to 6. A household is deprived if the HHS score is greater than 2.

Two measures of child health and nutrition are also included namely, undernutrition (combining measures of stunting and wasting) and Minimum Dietary Diversity-Children (MDD-C), which are common measures of child nutrition in the literature (e.g. Ahmed et al., 2016; Gilligan et al., 2013). A household is deprived in the measure of undernutrition if any child in the household is below -2 SD (standard deviations) from the median height(weight)-for-age of the reference population aged 0-59 months. The MDD-C is calculated as the summation of the number of food groups a child has consumed in the past 24 hours of the following food groups: grains, root/tubers, legumes/nuts, dairy, eggs, flesh food, vitamin-A rich vegetables/fruits, and other vegetables/fruits (WHO, 2007). A household is deprived in MDD-C if any child in the household has consumed less than 4 food groups.

Social protection programs, that transfer resources to the hands of women, are expected to influence women's empowerment and bargaining power in the household. However, as Hashemi, Schuler and Riley (1996) note, to truly effect women's empowerment, ensuring female participation in these programs may not be sufficient, rather a more holistic approach where nonformal education, and social and political consciousness raising is incorporated in the intervention is necessary. Therefore, it is necessary to see whether incorporation of BCC - which incorporates education sessions not only of female participants but also their family members and other community members with transfers – have any differential impact on women's empowerment. We use three measures of women's empowerment namely, decision on mobility, control over household resources, and ability to participate in decision-making, that have been used in the literature to measure women's agency and bargaining power in the household (e.g. Roy et al., 2017; Sraboni et al., 2014). A household is deprived in decision on mobility if the female participant cannot solely take decision to visit at least one location - friends/family

outside community, marketplace, hospital/doctor, cinema/fair or NGO training program. Similarly, if the female participant is not in control of money needed to buy at basic items (food from market, clothes, medicine, or toiletries/cosmetics for self), the household is considered as deprived in control over household resources indicator. Finally, a household is deprived in ability to participate in decision making indicator if the female participant cannot participate solely or jointly in major household decisions regarding food, housing, healthcare, education, and clothing.

Finally, food security and nutrition are also sensitive to the measures of living standards, namely housing condition, asset, drinking water, sanitation, and cooking fuel, and are also used widely in the literature (Alkire et al., 2018). A household is deprived in housing if the roof and walls are made of rudimentary materials and are very damaged, in sanitation if the household doesn't have access to improved sanitation, in drinking water if the water is not safe and purified, in cooking fuel if the household cooks with dung, wood or charcoal, and in asset if the household does not own more than one of the following assets -radio, television, telephone, bicycle, rickshaw, van, animal cart, boat, motorcycle, engine boat, solar panel, electricity generator, IPS, tractor, power tiller, thresher, motor pump, harvester or fridge.

3.2 Multidimensional indicator

The problem of food security and nutrition is inherently multidimensional, and any action taken to amend the status quo has be undertaken simultaneously on multiple fronts (Osmani et al., 2016). The outcome surrounding this issue is innately interlaced with synergies existing between them. For example, diet diversity of women of reproductive age has an impact on health of young children with respect to birthweight and probability of being stunted or wasted, with a subsequent impact coming from IYCF practices and living conditions. However, if the objective of the intervention is measured using multiple outcome indicators, then the average impact of the intervention on the sample for each outcome indicator is obtained, while it is also important to understand what is happening at the household level overall, given the synergies that exist between the objectives of the intervention. Furthermore, indices can offer important advantages over single indicators by consolidating heterogenous information into a single metric for straight comparison across groups and thus eliminates the concern of selective reporting (Masset and Garcia-Hombrados, 2021) in addition to resolving the issue of increased probability of a type 1 error (a false positive finding) when carrying out multiple hypothesis tests (Anderson, 2008). Therefore, given that policymakers in developing countries face strict budget constraints with resources spread thin over households, analysis revealing the effectiveness of interventions in alleviating multiple deprivations of food security and nutrition simultaneously at a household level is thus essential to generate evidence for effective policymaking at the best cost-effective solution.

We use the Alkire and Foster (AF) counting approach (Alkire et al., 2015) to assess the number of deprivations faced by households in multiple dimensions of food security and nutrition to construct a nutritionally sensitive multidimensional poverty index (N-MPI). The AF method builds on the Foster-Greer-Thorbecke class of poverty measures (Foster, Greer and Thorbecke, 1984), and has two stages - (i) identification and (ii) aggregation. It uses a dual cut-off criterion to identify who is poor (identification) and then aggregating that information across the society to find out overall rate of multidimensional poverty (aggregation). In the identification stage, it requires to first select the dimensions of analysis and then select the indicators within each dimension. A deprivation matrix is then constructed where a set of deprivation cutoffs indicate whether each household is deprived in an indicator or not. Then each indicator is weighted where the indicator weights sum to one. The weighted share of deprivation or deprivation score, c_i, can then be calculated for each household by summing the weighted deprivation. Given this

deprivation matrix, it is now possible to identify the multidimensionally poor household. Using a second threshold, a poverty cutoff k, a household is said to be multidimensionally poor if the weight deprivation count $c_i \geq k$. Following this, three measures of poverty can be derived and are used in this paper. The first measure is the multidimensional headcount ratio or the average incidence of multidimensional poverty (H) is calculated as $H = \frac{1}{n}\sum_{i=1}^{n} q_i(k)$, where q is the number of poor people according to poverty cutoff k, and n is the total number of people. The second measure is the breadth or average intensity of multidimensional poverty (average deprivation share among the poor) is calculated as $A = \sum_{i=1}^{q} c_i\,(k)/q(k)$. This measure is *censored* in the sense that it does not consider the deprivation experienced by multidimensionally non-poor households. The third measure, the *adjusted headcount ratio*, M_0, is then derived as the product of H and A i.e. $M_0 = H * A = \frac{1}{n}\sum_{i=1}^{n} c_i(k)$. The M_0 ranges from 0 to 1 and increases when an additional household falls into multidimensional poverty or an already poor household becomes deprived in additional dimensions. Furthermore, the M_0 satisfies axioms desirable to poverty measures such as poverty focus i.e. poverty does not change with changes in achievements of the non-poor or deprivation focus i.e. the measure is sensitive to the amount of deprivations of the poor (Alkire et al., 2015).

Using the fifteen indicators within the three broad dimensions previously discussed (household food security, women's empowerment, and education and living standards), we construct the N-MPI as shown in Appendix Table A1. Weights were allocated to the dimensions in the following manner: household food security (50%), women's empowerment (25%), and living standard (25%). Indicator within the dimensions have equal weights, i.e. indicators in household food security and women's empowerment dimensions each have a weight of $1/12$ while indicators in living standard dimension have weight $1/24$.

4. Methods

The impact evaluation strategy for this paper relies on the randomized design of the intervention program. Due to the random assignment of clusters (villages) to treatment, households should have similar baseline characteristics, on average, across treatment arms and control group. The baseline balance test presented earlier demonstrate that randomization has large been successful thus eliminating the risk of selection bias in the impact estimates. Taking advantage of the baseline survey conducted and following Mckenzie (2012), we conduct an intent-to-treat (ITT) analysis using analysis of covariance (ANCOVA) method which allows for a household's outcome at follow-up to depend on the same household's outcome at baseline. The ANCOVA model is specified as:

$$Y_{ij1} = \alpha + \gamma Y_{ij0} + \sum_{g=1}^{4} \beta_g T_{gj} + \varepsilon_{ij} ,$$

where Y_{ij1} is the outcome of interest for household i from cluster j at endline, Y_{ij0} is the outcome of interest at baseline, T_{gj} is the treatment status g for households in cluster j with $g \in \{cash, food, cash + food, cash/food + BCC\}$, and β_g is the ITT estimator i.e. the impact on the outcome due to assignment to the treatment arm compared to control. To assess if there are differential impacts across the treatment arms, we conduct Wald χ^2 tests of equality and present the p-values. In all estimates, standard errors are clustered at the level of randomization i.e. the village level.

To estimate the impact of the cash or food intervention – with or without nutrition BCC, the outcome variables are the fifteen indicators in the three broad dimensions as explained before, along with three outcome variables generated from the AF measures: (1) the incidence (headcount) of N-MPI, H, which is a dichotomous variable =1 if household is

multidimensionally poor and =0 otherwise, (ii) intensity (depth) of poverty, A, among the multidimensionally poor where the variable is the deprivation score for the subsample of poor households, and (iii) the adjusted headcount measure, M_0, which is the deprivation score for the entire sample (poor and non-poor households). We estimate linear probability models for dichotomous outcome variables and OLS for continuous outcome variables.

5. Results

5.1 Treatment effects on unidimensional indicators

Table 1 present the incidence of deprivation by region of each of these indicators across rounds and treatment arms. In terms of household food security indicators, both regions had the greatest incidence of deprivation, in the baseline, in measures of women and child diet diversity and nutrition, namely, diet diversity of women (MDD-W) followed by diet diversity of children (MDD-C) and rates of undernutrition which reflects the low level of knowledge and IYCF practices. The levels of initial deprivation were, however, lower in the South compared to North. Looking at women's empowerment, around three fourth of women in both regions reported to lack freedom of mobility in the baseline. Around 65% of women also reported to have little control over resources needed to buy basic household items. With respect to living standards, over 90% of households in both regions reported the lack of basic assets with over 80% of households without access to improved sanitation facilities. Nearly 100% of households in both regions cook with elementary materials which may have adverse health implications due to (indoor) pollution concerns.

[TABLE 1 ABOUT HERE]

The impacts of the different modality of transfers in North and South are presented in Table 2. It is to be noted that comparison of impact of treatment across zones is not possible since randomization of treatment were stratified by zones. Overall, it is found that addition of the nutrition BCC with transfers led to the greatest impact on food security, women's empowerment, and living standard indicators in both regions with the magnitude of impact higher in the North, i.e. when cash was combined with BCC, than the South. A couple of contextual factors should be noted here regarding the zones that may likely affect the differences in consumption pattern and the magnitude of impact between the zones. First, as mentioned previously, households in the North, on average, have higher poverty (i.e. lower income) than households in the South while market connectivity in the North is better compared to the South. This implies that households in the North will have a greater propensity to consume along with lower transaction costs in converting transfers to consumption compared to households in the South (consistent with Engel's law), and therefore respond more to transfers. Second, the household size, on average, is smaller in the North (4.92 members) compared to the South (5.43 members). Since the TMRI transfer amount was fixed at the household level (worth Tk 1,500 per month) irrespective of household size, some per capita impacts may be larger in the North than in the South. Finally, the South, due to its close proximity to the Bay of Bengal, has a greater susceptibility to climatic shocks such as floods and cyclones compared to the North. This may result in a greater propensity to save for households in the South to self-insure against climatic shocks thus generating more precautionary savings in the South compared to that in the North. Therefore, given the differing context of the two zones, we can expect lower levels of consumption and potentially higher magnitudes of impact of the transfers on consumption in the North.

[TABLE 2 ABOUT HERE]

In terms of household diet diversity as measured by the FCS, transfers decreased the percentage of households with low diet diversity by 19 to 45% in the North depending on the transfer arm.

The greatest decrease is from Cash+BCC with the size of reduction significantly larger compared to all other arms (see p-values of difference in reduction). In the South, the reduction ranged from 9 to 18%. The greatest decrease came from Food+BCC which is also statistically significantly larger compared to all other arms. The Food arm performed better compared to Cash with a larger statistically significant decrease in households with low diet diversity. With respect to calorie intake in the North, Cash+BCC had a statistically significant differential impact with 14% reduction in households with low (<2,122kcal) adult equivalized calorie intake compared to 6% in the Food and 7% in the Cash+Food arm. In the South, although Food+BCC had the greatest impact of 11% compared to 8% in Cash and Cash+Food, this differential impact was not statistically significant. For households in moderate to severe hunger as captured by the deprivation in HHS, Cash+BCC in the North outperformed other arms. There was a 9% reduction in deprivation in the Cash+BCC compared to 4% in Cash and Cash+Food arm and 7% in Food arm. In the South, reductions were more comparable between arms with Food and Food+BCC reducing deprivation by 6% while it was 5% in Cash+Food and 4% in Cash.

With respect to reducing the percentage of households with low diet diversity of reproductive age women as measured by MDD-W, Cash+BCC had the greatest impact with 48% reduction compared to 10% and 11% reduction in Food and Cash+Food. This difference in impact of the Cash+BCC arm is also highly statistically significant. Similar results are found in the South, with Food+BCC performing best although the magnitude of reduction is much lower compared to the North.

In terms of child health and nutrition, only Cash+Food in the South had a statistically significant reduction in households with any children stunted or wasted. Lack of impact is not surprising, since not all the children in the sample, aged 0-60 months, were fully exposed to the intervention during the first 1000 days of life. Black et al. (2013) terms the first 1000 days as the window of opportunity for nourishing a child towards growth in length or height. The results here reflect an averaging effect over all children with varying lengths of exposure to the interventions. However, in terms of IYCF practices, BCC was again found to be the contrasting factor with Cash+BCC in the North causing a 41% reduction in households with low diet diversity of children compared to 7% in Food while Food+BCC in the South reducing deprived households by 33% compared to 11% in Cash+Food. As before, both differences are statistically significant with magnitude higher in the North compared to South.

On the other hand, little impact is found on the indicators of women's empowerment. In the North, the only impact comes through the Cash+BCC arm reducing deprivation in freedom of mobility by 8%. No other impact is seen via transfer arms on any other empowerment indicator. In the South, Food+BCC arm had a 6% reduction in deprivation of freedom of mobility with no impact coming from the other arms. In control over resources to purchase basic items, Cash, Cash+Food, and Food+BCC had impact ranging from 7 to 9%. However, the difference of impact across arms is not statistically significant.

With respect to living standards, in the North, Cash+BCC led to 13, 4 and 12% reductions in households deprived in housing condition, assets and sanitation. There is small impact of 1% reduction in households deprived in cooking fuel arising from Cash, Cash+Food and Cash+BCC. In the South, Cash+Food had a 7% reduction in deprivation of housing condition while the impact of Cash+Food and Food+BCC on deprivation in assets was 5% and 3%,

respectively. Cash had a 8% reduction of households deprived in improved sanitation in the South[5].

5.2 Treatment effects on multidimensional indicator

The analysis of treatment effect of the various arms of intervention on deprivation measures of household food security, nutrition, women's empowerment, and living standards show that the TMRI was successful in reducing deprivations in multiple outcome indicators. Next, using the three dimensions and fifteen indicators described, we look at the multidimensional index constructed using the AF methodology. The headcount ratio H (percentage of people that are poor), intensity A (average deprivation score of the poor) and the multidimensional measure M_0 (share of possible deprivations that poor people are experiencing) are presented in Table 3 by region, intervention arms and the poverty cutoff k (number of domains households are deprived in, on average).

[TABLE 3 ABOUT HERE]

Nearly all households were deprived in at least 25% of the weighted indicators ($k = 25$) in the baseline while over 70% of households in the North and over 50% of households in the South were deprived in at least 50% of the weighted indicators ($k = 50$). Average incidence of headcount, intensity and adjusted headcount measure of multidimensional poverty were lower in the South compared to the North. For both North and South, the biggest reduction in the levels of all three measures, across all k-cutoffs, were in the arm containing the nutrition BCC followed by the Food in the North and the Cash+Food in the South.

[TABLE 4 ABOUT HERE]

Table 4 presents the impact of treatment on the three measures of multidimensional poverty at three different cutoffs. We see the largest impact when transfers are combined with BCC irrespective of measure or poverty cutoff. For our preferred cutoff of $k = 50$, i.e. looking at households that are deprived in at least 50% of weighted indicators, in the North, multidimensional headcount fell by 9 to 36% with the largest and statistically significant differential reduction in the Cash+BCC arm. Furthermore, Cash+BCC had an impact on poverty intensity or A for our preferred cutoff, where A fell by 4 percentage points. The decline in both the incidence and intensity of poverty also produced Cash+BCC to have the largest and statistically significant differential reduction of the adjusted headcount ratio.

In the South, the magnitude of impact was lower compared to the North. For our preferred cutoff of $k = 50$, the multidimensional headcount fell by 12 to 23% while poverty intensity or A, fell by 2 to 3 percentage points with the largest and statistically significant differential reduction in the Food+BCC arm. Consequently, Food+BCC also had the largest and statistically significant differential reduction in the adjusted headcount ratio M_0.

6. Extensions and heterogeneity of treatment effects and robustness test

6.1 Disaggregate consumptions

Findings from our analysis suggest that transfers, especially when combined with BCC, has significant and, often, large decrease in household deprivation with respect to quantity and quality of diets as measured by FCS, HHS, calorie intake, and MDD for women and children. It

[5] We correct for multiple hypothesis testing using q-values based on Benjamini, Krieger, and Yekutieli (2006) and Benjamini and Hochberg (1995). Uncorrected p-values from regressions and corrected q-values are presented in Table A8 in the Appendix. Qualitatively our conclusions remain the same after correction.

would also be interesting to explore which food groups are driving these changes. Such analysis would also enable us to explore if paternalistic intention of food transfers is justified and if food transfers cause beneficiaries to substitute away from similar non-transferred goods.

Tables 5 and 6 report impacts on the frequency of consumption of 10 food groups, i.e. the number of days the household has consumed the specified food groups in the last seven days prior to the survey day, for North and South, respectively. In the North, it is seen that although transfers led to increased frequency of consumption of pulses, meat & poultry, eggs, fish, and dairy products, the magnitude of impact is greatest in the Cash+BCC arm with the difference in impact highly statistically significant compared to the other transfer arms. Cash+BCC also led to increase in the frequency of consumption of fruits and vegetables. The table also reports frequency of consumption of vices such as tobacco and alcohol. One factor that motivates paternalistic food transfers is that unconditional cash transfers can promote the consumption of such goods. We find that unconditional cash transfers (Cash) led to an increase in consumption of vices. Interestingly, the difference in impact compared to the Cash+BCC is statistically significant suggesting that the BCC was successful in deterring consumption of vices and promote healthy and diverse diet of beneficiaries. In the South, Cash increased the frequency of consumption of meat & poultry, eggs, and fish, Food increased consumption of pulses while Cash+Food led to increase in consumption of pulses, and eggs. Food+BCC transfer had the most diverse impact with increase in pulses, meat & poultry, eggs, fish and dairy products with the difference in impact highly statistically significant compared to the other transfer arms. Consumption of vices did not significantly increase for the beneficiaries across transfer arms. Higher consumption of vices in the North for unconditional cash transfer compared to the South may be a consequence of higher rates of poverty in the North compared to the South which is documented in the literature to significantly affect consumption of vices (Cerdá et al., 2010; Khan, Murray, and Barnes, 2002).

[TABLE 5 & 6 ABOUT HERE]

For food groups where the frequency of consumption in the baseline is already high – for example, households, in both regions, consume cereals and oil & fat almost every day as indicated by the baseline mean – we analyze the impact on disaggregated calorie intake to elicit if households are consuming a higher quantity of each of the food groups. The bottom panel of Table 5 and 6 reports impacts on daily adult equivalized calorie intake for each of the 10 food groups for North and South, respectively. Results follow a similar pattern to that of food consumption frequency with some exceptions. In the North, we find statistically significant differential impact of Cash+BCC across all 10 food groups. In addition, although the impact on frequency of consumption of fruits and vegetables were not significant across transfer arms, we find statistically significant increase in calorie intake across all transfer arms. For Food, and Cash+Food, we see that calorie intake from the food groups that constitute the items in the food basket – namely cereal, pulses, legumes & nuts, and oil & fat – decreased which suggests that these items were extramarginal[6]. The households seem to have substituted previous consumption of these food items for the TMRI basket and reallocated the resources for consumption of other food groups. In the South, a similar pattern emerges. We find statistically significant differential impact of Food+BCC in 6 out of 7 food groups keeping aside the three groups in the TMRI basket. Cash and Cash+Food had significant increase in calories from in fruits & vegetables, meat & poultry, eggs, and fish. Similar to the North, the arms receiving the TMRI food transfers in the South i.e. Food only, Cash+Food, and Food+BCC, we find households to substitute previous consumption of the food items for the TMRI basket, revealing the extramarginality of the items transferred.

[6] The calorie intake from the food transfer were not included in the estimation of calories intake for this table.

6.2 Robustness tests: IPW and extended model

Even though attrition was not statistically significantly associated with any treatment arm, and there was baseline balance on observable characteristics in the non-attrited sample, we nevertheless provide estimates from an inverse probability of attrition weighted (IPW) model and an extended model adding control variables to examine if there is any potential bias of attrition.

Table A5 reports the inverse probability-weighted estimates of treatment effect. The inverse probability of retention (non-attrition) was estimated using a probit model, and then are used as weights. The estimated effects are nearly identical with respect to magnitude and level of statistical significance. Similarly, estimated treatment effects from the extended model which includes additional covariates, namely age and years of education of household head, whether the household is female headed, number of children 0-5 years, and household expenditure quintiles also reveals nearly identical estimates as shown in Table A6. Thus, the treatment effects as estimated using the original model are found to be robust to any potential attrition bias.

6.3 Heterogeneity of treatment effects

By energy deficient households – To assess the impact of the transfers, it is often insightful for policy to explore if the effect of the transfers on energy consumption is primarily driven by increases in households that were not calorie deficit in the baseline. Following Hidrobo et al. (2014), we construct interaction terms of each treatment arms with an indicator that equals one when a household was energy adequate (consuming more than 2,122 kcal/aeu) in the baseline. The coefficient in the treatment indicator of the resulting specification thus denotes the impact of transfers on energy deficient households while the interaction term denotes the differential impact of consuming more than 2,122 kcals. Table A7 in the appendix reports the heterogenous treatment effect on calorie intake for the North and South. We find that Food, and Cash+BCC arm in the North led to significant increase in calorie intake for the energy deficient households, while in the South, Food, Cash+Food, and Food+BCC had significant increases. With respect to differential impact (as seen from the coefficients of the interaction term), no significant impact were seen in the North, while in the South, only Cash+Food arm had a statistically significant impact on calorie intake of households that were not energy deficit in the baseline.

By initial poverty status – To assess whether there is differential impact on households who were poor in the baseline according to the multidimensional index and our preferred cutoff of $k = 50$, we conduct a heterogeneity analysis interacting the baseline indicator for poverty with the treatment indicators. Table A8 shows that there is no consistent pattern of heterogeneous impact of treatment on outcome indicators for households which were initially poor, although aggregate measures of hunger and diet diversity at the household level improved for some arms. We find Cash+BCC in the North significantly reduced deprivation in FCS, HHS, and housing conditions of households which were initially poor while Cash+Food had similar effect for deprivations in FCS, and Cash and Food had similar effect for deprivations in HHS. In the South, Food, Cash+Food, and Food+BCC significantly reduced deprivations in FCS and HHS of households which were initially poor with Food+BCC having additional impact on deprivation in calorie intake and diet diversity of children. Cash+Food arm had heterogeneous impact on deprivations in women's empowerment in terms of deprivations in control over resources.

By baseline characteristics – To explore whether different groups of people are affected differently by the transfers, we explore the heterogenous treatment effects by different baseline characteristics namely – age of household head, education of household head, female headed household, and household head is farmer by interacting the baseline characteristic with the treatment indicators. We do not find the transfers to be benefiting a particular sub-group i.e.

there are no meaningful heterogenous effects with respect to these characteristics. Results are available on request. Particularly revealing in this analysis is that we find the deprivations in women's empowerment, and child education and nutrition practices are generally higher in households with older heads and no education.

7. Discussion and conclusions

This paper examined the impact of a randomized nutrition-sensitive social protection intervention, which combines cash and food transfers with nutrition behavioral change communication (BCC), in Northern and Southern Bangladesh on household food security, and women and child nutritional outcomes along with indicators for women's empowerment and living standards. Furthermore, we have also estimated the impact on the incidence and intensity of deprivations using a nutrition-sensitive multidimensional poverty index. Thus, this paper contributes to three important discussions in the literature – (i) the discussion on the form of social protection transfers (i.e. cash vs food), (ii) the efficacy of including complementary nutrition education with transfers, and (iii) the scant literature on impact evaluation using multidimensional outcome measure.

On the question of the form of social protection transfer that impacts food security and nutrition the most, we find that in the North, food transfers led to impacts on a wider range of indicators than cash transfers. While cash statistically significantly reduced households in hunger and with low diet diversity, food transfers helped to reduce households with low diet diversity at the household, women, and child level along with households in hunger and with low calorie intake. The magnitude of impact was also statistically significantly higher for food transfers compared to cash. In the South, we observe the opposite. Cash transfers had impact over a wider range of indicators, reducing the number of households in hunger and with low household and women diet diversity, calorie intake while food transfers reduced households in hunger and with low diet diversity at household and women level. Furthermore, cash transfers also had impact on indicators of women's empowerment and living standard reducing households with low control over resource for women and without proper sanitation facilities. However, the difference in magnitude of impact were mixed and not statistically significant.

On the other hand, regarding the efficacy of including nutrition behavioral change communication (BCC) with transfers, we find that transfers with BCC led to the greatest impact on food security, women's empowerment, and living standard indicators in both the North and the South. Specifically, Cash+BCC in the North had a statistically significant differential impact compared to cash only, food only and half-cash-half-food on reducing households in hunger and with low diet diversity at the household, women, and child level, calorie intake, low freedom of mobility of women, while Food+BCC in the South additionally reducing households with low control over resource for women. Cash+BCC also had impacts on several living standards indicators reducing households with poor housing conditions, poor sanitation facilities, with low level of assets, and uses rudimentary cooking fuel. Food+BCC only had impact on assets in the South. Improvements in housing condition along with sanitation facilities and cooking fuel are vital complimentary investments to ensure hygiene and healthy living. Likewise, investment in assets can be seen as a strategy that allows households to smooth consumption in difficult times as well as a strategy that can help engage in income-generating activities. The above impacts for both Cash+BCC and Food+BCC was, on most cases, statistically significantly different (larger) than impacts of the other arms.

When consumption was decomposed by food groups, we find that higher impact coming from the BCC arms is mainly due to consumption of a more diverse diet both with respect to number of days consumed in past 7 days and daily adult equivalized calorie intake. Households in the BCC arms decreased reliance on staples and increased consumption of meat and poultry, eggs,

fish, dairy, fruits and vegetables. On the other hand, analysis reveals that transfers with BCC had a statistically significant impact on households with that were energy deficient in the baseline. The above points demonstrate significant additional benefits from including complementary nutrition education with transfers.

We also find transfers combined with BCC to have the greatest impact on the nutrition-sensitive multidimensional poverty index, constructed from three dimensions, namely – household food security, women's empowerment, and living standards. The higher differential impact of Cash+BCC in the North, and Food+BCC in the South, on headcount rate, intensity of poverty and multidimensional poverty score is also found to be highly statistically significant. This indicates that not only the incidence of the composite indicator has reduced but the depth of deprivation that is household's distance from the poverty cutoff has also reduced for transfers with complementary nutrition education. This result holds irrespective of the multidimensional poverty cutoff. It is also found that deprivations in diet diversity of women, and children, child undernutrition, and mobility of women remain as the highest contributor to multidimensional poverty in both North and South, with deprivations in assets and access to improved sanitation a great concern as well.

The findings from this paper has some key policy implications in shaping the provision of social protection in Bangladesh and around the world. On the issue of cash against food transfers, we see that cash worked better for the South while food was better in the North. This highlights the importance of context. The North is poorer with lower levels of food security and nutrition thus transferring food allowed them to ease the subsistence nature of their consumption while cash in the South allowed households to diversify their diets and increase quantity of consumption. Ultimately since social protection programs generally target the poor population, the decision on the form of transfer i.e. cash or food depends on the needs of the program, which is consistent with evidence found previously (Gentilini, 2016).

However, what is clear is that combining high quality nutrition BCC with transfers can lead to large reductions in deprivations in key indicators of diet quantity and quality in the household, particularly of women and children along with indicators of women's empowerment and living standards. A well-developed and highly intensive BCC on the importance of diet diversity, IYCF practices and maternal nutrition bestows mothers with knowledge and combining BCC with transfers empowers mothers to act on this knowledge. Any intervention should also recognize the role of women as targets and facilitators of change. Health of mothers is an important determinant of children's health and helps ensure health and nutrition of the household and proper IYCF practices. Structural reforms are thus important in the current social protection system and changes in cultural and social norms brought about by carefully constructed BCC is required to achieve progress in food security and nutrition.

References

Ahmed, A., Quisumbing, A.R., Nasreen, M., Hoddinott, J.F., and Bryan, E. (2009). *Comparing Food and Cash Transfers to the Ultra-poor in Bangladesh*. Research Monograph 163. Washington, D.C.: International Food Policy Research Institute.

Ahmed, A., Hoddinott, J.F., Roy, S., Sraboni, E., Quabili, W.R., and Margolies, A. (2016). 'Which Kinds of Social Safety Net Transfers Work Best for the Ultra Poor in Bangladesh? Operation and Impacts of the Transfer Modality Research Initiative.' Research Report. International Food Policy Research Institute, Bangladesh.

Ahmed, A., Hoddinott, J.F., and Roy, S. (2019a). 'Food Transfers, Cash Transfers, Behavior Change Communication and Child Nutrition: Evidence from Bangladesh.'

Ahmed, A., Hoddinott, J.F., and Roy, S. (2019b). 'Transfers, Nutrition Behavior Change Communication, and Household Well-being: Experimental Evidence from Bangladesh'. IFPRI: Washington, DC.

Aker, J. C. (2017). 'Comparing Cash and Voucher Transfers in a Humanitarian Context: Evidence from the Democratic Republic of Congo.' *World Bank Economic Review*, 31 (1): 44–70.

Alkire, S., Foster, J.E., Seth, S., Santos, M.E., Roche, J.M., and Ballon, P. (2015). *Multidimensional Poverty Measurement and Analysis*. Oxford: Oxford University Press.

Alkire, S., Kanagaratnam, U., and Suppa, N. (2018). 'The Global Multidimensional Poverty Index (MPI): 2018 revision.' OPHI MPI Methodological Notes 46, Oxford Poverty and Human Development Initiative (OPHI), University of Oxford.

Anderson, M. L. (2008). 'Multiple inference and gender differences in the effects of early intervention: A re-evaluation of the Abecedarian, Perry Preschool, and Early Training Projects.' *Journal of the American Statistical Association*, vol. 103(484), pp. 1481–1495.

Andrews, C., Lopez, A. and Baez, J. (2014). 'What are We Learning on Safety Net Impacts? Reviewing Evidence from 2010–2013.' Social Protection Discussion Paper Series, World Bank, Washington, DC.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M.C., Deitchler, M., Fanou-Fogny, N. et al. (2010). 'Simple Food Group Diversity Indicators Predict Micronutrient Adequacy of Women's Diets in 5 Diverse, Resource-Poor Settings.' *The Journal of Nutrition* 140 (11): 2059S-2069S. https://doi.org/10.3945/jn.110.123414.

Attanasio, O., Battistin, E., Fitzsimons, E., Mesnard, A. and Vera-Hernandez, M. 2005. 'How Effective Are Conditional Cash Transfers? Evidence from Colombia.' https://doi.org/10.1920/bn.ifs.2005.0054.

Bastagli, F., Hagen-Zanker, J., Harman, L., Barca, V., Sturge, G., Schmidt, T. and Pellerano, L. (2016). 'Cash Transfers: What Does the Evidence Say? A Rigorous Review of Programme Impact and of the Role of Design and Implementation Features'. (July): 300.

BBS (Bangladesh Bureau of Statistics). (2017). *Preliminary Report on Household Income and Expenditure Survey 2016*. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Benjamini, Y., Krieger, A.M. and Yekutieli, D. (2006). 'Adaptive Linear Step-up Procedures That Control the False Discovery Rate.' *Biometrika* 93 (3): 491–507. https://doi.org/10.1093/biomet/93.3.491.

Benjamini, Y., and Hochberg, Y. (1995). 'Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing.' *Journal of the Royal Statistical Society: Series B (Methodological)* 57 (1): 289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x.

Black, R. E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., Onis, M., Ezzati, M. et al. (2013). 'Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries.' *The Lancet* 382 (9890): 427–51. https://doi.org/10.1016/S0140-6736(13)60937-X.

Bredenkamp, C., Buisman, L.R. and Poel, E.V. (2014). 'Persistent Inequalities in Child Undernutrition: Evidence from 80 Countries, from 1990 to Today.' *International Journal of Epidemiology* 43 (4): 1328–35. https://doi.org/10.1093/ije/dyu075.

Cerdá, M., Diez-Roux, A.V., Tchetgen, E., Gordon-Larsen, P., and Kiefe, C. (2010). 'The Relationship Between Neighborhood Poverty and Alcohol Use: Estimation by Marginal

Structural Models:' *Epidemiology* 21 (4): 482–89. https://doi.org/10.1097/EDE.0b013e3181e13539.

Cunha, J. M. 2014. 'Testing Paternalism: Cash versus In-Kind Transfers.' *American Economic Journal: Applied Economics* 6 (2): 195–230. https://doi.org/10.1257/app.6.2.195.

Duflo, E., Glennerster, R. and Kremer, M. (2008). *Using Randomization in Development Economics Research: A Toolkit*. Handbook of Development Economics, Volume 4.

Duflo, E. 2000. 'Child Health and Household Resources in South Africa: Evidence from the Old Age Pension Program.' *American Economic Review* 90 (2): 393–98. https://doi.org/10.1257/aer.90.2.393.

Fiszbein, A., Schady, N., Ferreira, F., Grosh, M., Keleher, N., Olinto, P., and Skoufias, E. (2009). 'Conditional Cash Transfers: Reducing Present and Future Poverty'. World Bank Policy Research Report 47603.

Food and Agriculture Organization (FAO) and FHI 360. 2016. *Minimum Dietary Diversity for Women: A Guide for Measurement*. Rome: FAO.

Foster, J., Greer, J., and Thorbecke, E. (1984). 'A Class of Decomposable Poverty Measures.' *Econometrica* 52 (3): 761. https://doi.org/10.2307/1913475.

Garcia, M., and Moore, C.M.T. (2012). 'The Cash Dividend: The Rise of Cash Transfer Programs in Sub-Saharan Africa'. Washington, DC: World Bank.

Gentilini, U. (2016). 'Revisiting the "Cash versus Food" Debate: New Evidence for an Old Puzzle?' *The World Bank Research Observer*, https://doi.org/10.1093/wbro/lkv012

Gilligan, D., Margolies, A., Quiñones, E., and Roy, S. (2013). *Impact evaluation of cash and food transfers at early childhood development centers in Karamoja, Uganda.* Project report prepared for World Food Programme. Washington, D.C.: International Food Policy Research Institute.

Hashemi, S.M., Schuler, S.R., and Riley, A.P. (1996). 'Rural Credit Programs and Women's Empowerment in Bangladesh.' *World Development.* Vol 24, No 4, pp 635-653.

Helen Keller International (HKI) and James P. Grant School of Public Health (JPGSPH). (2016). *State of Food Security and Nutrition in Bangladesh: 2014*. Dhaka, BD: HKI and JPGSPH.

Hidrobo, M., Hoddinott, J., Peterman, A., Margolies, A. and Moreira, V. (2014). 'Cash, Food, or Vouchers? Evidence from a Randomized Experiment in Northern Ecuador.' *Journal of Development Economics* 107 (March): 144–56. https://doi.org/10.1016/j.jdeveco.2013.11.009.

Hoddinott, J., Ahmed, A. and Roy, S. (2018a). 'Randomized Control Trials Demonstrate That Nutrition-Sensitive Social Protection Interventions Increase the Use of Multiple-Micronutrient Powders and Iron Supplements in Rural Pre-School Bangladeshi Children.' *Public Health Nutrition* 21 (9): 1753–61. https://doi.org/10.1017/S1368980017004232.

Hoddinott, J., Ahmed, A., Karachiwalla, N.I., and Roy, S. (2018b). 'Nutrition Behaviour Change Communication Causes Sustained Effects on IYCN Knowledge in Two Cluster-Randomised Trials in Bangladesh.' *Maternal & Child Nutrition* 14 (1): e12498. https://doi.org/10.1111/mcn.12498.

Hoddinott, J. (2010). 'Nutrition and Conditional Cash Transfer Programs.' In Conditional Cash Transfers in Latin America, edited by M. Adato and J. Hoddinott. Baltimore: Johns Hopkins University Press.

Khan, S., Murray, R.P. and Barnes, G.E. (2002). 'A Structural Equation Model of the Effect of Poverty and Unemployment on Alcohol Abuse.' *Addictive Behaviors* 27 (3): 405–23. https://doi.org/10.1016/S0306-4603(01)00181-2.

Maluccio, J. A., and Flores, R. (2005). 'Impact Evaluation of a Conditional Cash Transfer Program: The Nicaraguan Red de Protección Social'. FCND Discussion Paper 184. International Food Policy Research Institute. https://doi.org/10.2499/0896291464RR141.

Masset, E., and García-Hombrados, J. (2021). Sensitivity matters. Comparing the use of multiple indicators and of a multidimensional poverty index in the evaluation of a poverty eradication program. *World Development*, 137, 105162. https://doi.org/10.1016/j.worlddev.2020.105162

McKenzie, D. (2012). 'Beyond Baseline and Follow-up: The Case for More T in Experiments.' *Journal of Development Economics* 99 (2): 210–21. https://doi.org/10.1016/j.jdeveco.2012.01.002.

Moffitt, R. (1983). 'An Economic Model of Welfare Stigma.' *American Economic Review*, 73 (5): 1023–35.

Morris, S.S., Olinto, P., Flores, R., Nilson, E.A.F. and Figueiró, A.C. (2004). 'Conditional Cash Transfers Are Associated with a Small Reduction in the Rate of Weight Gain of Preschool Children in Northeast Brazil.' *The Journal of Nutrition* 134 (9): 2336–41. https://doi.org/10.1093/jn/134.9.2336.

Osmani, S.R., Ahmed, A., Ahmed, T., Hossain, N., Huq, S. and Shahan, A. (2016). *Strategic Review of Food Security and Nutrition in Bangladesh*. World Food Programme.

Paxson, C., and Schady, N. (2010). 'Does Money Matter? The Effects of Cash Transfers on Child Development in Rural Ecuador.' *Economic Development and Cultural Change* 59 (1): 187–229. https://doi.org/10.1086/655458.

Roy, S., Hidrobo, M., Hoddinott, J., and Ahmed, A. (2017). 'Transfers, Behavior Change Communication, and Intimate Partner Violence: Postprogram Evidence from Rural Bangladesh.' IFPRI Discussion Paper 01676.

Ruel, M.T, and Alderman, H. (2013). 'Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?' *The Lancet* 382 (9891): 536–51. https://doi.org/10.1016/S0140-6736(13)60843-0.

Southworth, H. M. (1945). 'The Economics of Public Measures to Subsidize Food Consumption.' *American Journal of Agricultural Economics*, 27 (1): 38–66.

Sraboni, E., Malapit, H.J., Quisumbing, A.R. and Ahmed, A. (2014). 'Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh?' *World Development*. 61: 11–52.

Wiesmann, D., Bassett, L., Benson, T. and Hoddinott, J. (2009). 'Validation of the World Food Programme's Food Consumption Score and Alternative Indicators of Household Food Security.' IFPRI Discussion Paper 00870, Washington DC: International Food Policy Research Institute.

World Health Organization (WHO). 2007. *Indicators for assessing infant and young child feeding practices: conclusions of a consensus meeting held*. Washington DC: World Health Organization.

Figures and Tables

Table 1 Percentage of households deprived in each indicator

	Indicator -deprived in	Cash only			Food only			Cash + Food			Cash + BCC			Control		
		Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ
North	FCS	56.55	29.88	-26.67	54.26	20.95	-33.31	59.09	27.27	-31.82	55.70	4.64	-51.05	52.22	48.84	-3.38
	Per aeu calorie	30.77	23.86	-6.91	27.44	21.37	-6.07	32.02	21.49	-10.54	27.64	14.14	-13.50	29.18	27.91	-1.27
	HHS	32.22	5.39	-26.83	28.27	2.28	-25.99	32.02	5.99	-26.03	35.65	1.27	-34.39	30.02	9.73	-20.30
	MDD-W	85.45	72.61	-12.83	83.78	65.35	-18.43	85.54	64.26	-21.28	83.76	27.43	-56.33	84.57	75.48	-9.09
	Under nutrition	57.26	57.05	-0.21	58.30	55.39	-2.90	59.09	58.88	-0.21	56.33	51.69	-4.64	58.14	56.45	-1.69
	MDD-C	78.38	76.56	-1.82	82.12	70.54	-11.58	79.55	74.59	-4.96	80.38	35.44	-44.94	78.01	76.53	-1.48
	Mobility	75.47	69.50	-5.97	77.13	67.43	-9.70	76.86	68.80	-8.06	74.47	60.34	-14.14	78.01	68.29	-9.73
	Control resources	68.61	32.99	-35.62	67.98	29.05	-38.94	62.60	33.26	-29.34	67.30	26.79	-40.51	68.50	31.71	-36.79
	Decision making	48.65	20.54	-28.11	48.86	14.52	-34.33	47.31	17.36	-29.96	45.15	14.56	-30.59	52.43	19.45	-32.98
	Child education	9.98	7.68	-2.30	11.64	9.34	-2.31	13.02	12.40	-0.62	12.87	10.55	-2.32	9.09	8.46	-0.63
	Housing condition	64.24	40.46	-23.78	73.18	53.32	-19.86	62.60	40.50	-22.11	59.28	30.17	-29.11	63.85	45.24	-18.60
	Assets	93.14	88.38	-4.76	94.18	90.25	-3.93	96.07	89.26	-6.82	92.41	85.86	-6.54	91.33	89.43	-1.90
	Sanitation	85.86	83.40	-2.46	85.86	84.23	-1.63	88.22	85.12	-3.10	87.55	71.73	-15.82	87.32	84.14	-3.17
	Drinking water	1.46	1.87	0.41	0.62	1.04	0.41	1.03	2.69	1.65	0.84	1.48	0.63	1.06	1.90	0.85
	Cooking fuel	99.17	99.17	0.00	99.79	99.59	-0.21	99.17	98.55	-0.62	99.58	98.52	-1.05	99.79	100.00	0.21
	Indicator -deprived in	Cash only			Food only			Cash + Food			Food + BCC			Control		
		Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ	Baseline	Endline	Δ
South	FCS	37.63	14.11	-23.52	35.11	11.07	-24.05	31.60	11.41	-20.19	29.13	3.92	-25.21	38.46	23.08	-15.38
	Per aeu calorie	23.93	20.04	-3.89	28.13	24.18	-3.95	21.62	20.54	-1.08	23.14	17.32	-5.82	27.86	28.69	0.83
	HHS	26.99	3.68	-23.31	27.10	1.84	-25.26	21.00	2.49	-18.51	20.45	1.24	-19.22	27.44	7.90	-19.54
	MDD-W	71.57	58.28	-13.29	71.05	54.10	-16.95	72.56	55.60	-16.96	70.25	35.88	-34.37	71.10	64.03	-7.07
	Under nutrition	55.62	55.62	0.00	54.30	56.35	2.05	56.22	52.70	-3.53	53.81	53.20	-0.62	54.89	58.63	3.74
	MDD-C	71.57	64.01	-7.57	74.33	64.14	-10.19	71.52	59.13	-12.39	69.63	37.11	-32.51	74.22	70.48	-3.74
	Mobility	73.82	65.44	-8.38	74.13	61.68	-12.45	72.77	63.90	-8.86	72.11	59.59	-12.52	74.64	65.70	-8.94
	Control resources	63.19	31.70	-31.49	62.83	34.84	-28.00	64.45	33.82	-30.63	56.61	31.75	-24.86	62.79	40.75	-22.04
	Decision making	39.88	24.54	-15.34	38.60	22.75	-15.86	40.96	22.82	-18.13	37.81	21.24	-16.57	42.00	21.62	-20.37
	Child education	15.54	16.77	1.23	16.84	14.55	-2.29	13.10	9.13	-3.97	13.02	10.31	-2.71	18.09	12.06	-6.03
	Housing condition	67.08	48.47	-18.61	56.06	44.06	-12.00	57.59	41.49	-16.09	61.57	46.60	-14.97	64.03	52.18	-11.85
	Assets	92.43	86.30	-6.13	93.43	87.50	-5.93	91.89	84.02	-7.87	95.45	87.84	-7.62	94.59	90.85	-3.74
	Sanitation	82.00	56.24	-25.77	78.03	56.97	-21.06	86.07	64.32	-21.76	83.06	61.65	-21.41	82.95	64.66	-18.30
	Drinking water	19.84	18.81	-1.02	13.76	11.48	-2.28	16.42	12.45	-3.98	20.04	15.26	-4.78	24.53	19.33	-5.20
	Cooking fuel	99.80	98.77	-1.02	99.38	99.59	0.21	99.58	99.38	-0.21	99.17	99.18	0.00	99.58	99.58	0.00

Δ – change (endline – baseline). BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children.

Table 2 Impact of treatment on outcome indicators

		FCS	Per aeu calorie	HHS	MDD-W	Under nutrition	MDD-C	Mobility	Control resources	Decision making	Child education	Housing condition	Assets	Sanitation	Drinking water	Cooking fuel
North	Cash only	-0.19	-0.04	-0.04	-0.03	0.01	0.00	0.01	0.01	0.01	-0.01	-0.05	-0.02	-0.01	-0.00	-0.01
		(0.04)***	(0.03)	(0.02)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.00)**
	Food only	-0.28	-0.06	-0.07	-0.10	-0.01	-0.06	-0.01	-0.03	-0.05	0.00	0.04	-0.01	0.00	-0.01	-0.00
		(0.04)***	(0.03)**	(0.02)***	(0.03)***	(0.03)	(0.03)*	(0.03)	(0.04)	(0.03)	(0.02)	(0.05)	(0.02)	(0.03)	(0.01)	(0.00)
	Cash+food	-0.22	-0.07	-0.04	-0.11	0.02	-0.02	0.01	0.02	-0.02	0.03	-0.04	-0.03	0.01	0.01	-0.01
		(0.04)***	(0.03)**	(0.02)*	(0.03)***	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.01)**
	Cash+BCC	-0.45	-0.14	-0.09	-0.48	-0.04	-0.41	-0.08	-0.05	-0.05	0.01	-0.13	-0.04	-0.12	-0.00	-0.01
		(0.03)***	(0.03)***	(0.02)***	(0.03)***	(0.03)	(0.03)***	(0.04)**	(0.04)	(0.03)	(0.02)	(0.04)***	(0.02)**	(0.04)***	(0.01)	(0.01)**
	R^2	0.12	0.02	0.04	0.13	0.15	0.11	0.01	0.02	0.01	0.08	0.23	0.19	0.02	0.00	0.00
	N	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395
	P-values:															
	Cash=Cash+BCC	0.00	0.00	0.00	0.00	0.12	0.00	0.02	0.15	0.06	0.32	0.06	0.29	0.01	0.65	0.37
	Food=Cash+BCC	0.00	0.01	0.10	0.00	0.30	0.00	0.08	0.61	0.93	0.70	0.00	0.04	0.00	0.56	0.11
	Cash+food=Cash+BCC	0.00	0.01	0.00	0.00	0.06	0.00	0.04	0.12	0.31	0.41	0.05	0.49	0.00	0.19	0.97
	Cash=Cash+food	0.41	0.39	0.71	0.01	0.72	0.51	0.82	0.83	0.32	0.04	0.86	0.68	0.63	0.36	0.39
	Food=Cash+food	0.09	0.96	0.01	0.68	0.26	0.24	0.68	0.28	0.25	0.19	0.09	0.22	0.80	0.05	0.11
	Cash=Food	0.01	0.44	0.03	0.02	0.44	0.06	0.49	0.36	0.05	0.54	0.06	0.49	0.80	0.26	0.39
South	Cash only	-0.09	-0.08	-0.04	-0.06	-0.03	-0.06	-0.00	-0.09	0.03	0.06	-0.05	-0.04	-0.08	0.01	-0.01
		(0.02)***	(0.03)***	(0.02)**	(0.03)*	(0.03)	(0.04)	(0.03)	(0.04)**	(0.03)	(0.03)**	(0.04)	(0.02)	(0.05)*	(0.04)	(0.01)
	Food only	-0.12	-0.05	-0.06	-0.10	-0.02	-0.06	-0.04	-0.06	0.01	0.03	-0.04	-0.03	-0.08	-0.03	0.00
		(0.02)***	(0.03)	(0.02)***	(0.04)***	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.05)	(0.04)	(0.00)
	Cash+food	-0.11	-0.08	-0.05	-0.09	-0.06	-0.11	-0.02	-0.07	0.01	-0.01	-0.07	-0.05	-0.00	-0.03	-0.00
		(0.02)***	(0.03)**	(0.02)***	(0.03)**	(0.03)**	(0.04)***	(0.03)	(0.04)*	(0.03)	(0.02)	(0.04)**	(0.02)***	(0.05)	(0.03)	(0.00)
	Food+BCC	-0.18	-0.11	-0.06	-0.28	-0.05	-0.33	-0.06	-0.08	-0.00	-0.00	-0.04	-0.03	-0.03	-0.02	-0.00
		(0.02)***	(0.03)***	(0.01)***	(0.04)***	(0.03)	(0.04)***	(0.03)*	(0.04)**	(0.03)	(0.02)	(0.04)	(0.02)*	(0.05)	(0.04)	(0.00)
	R^2	0.07	0.02	0.04	0.05	0.15	0.06	0.01	0.01	0.00	0.13	0.25	0.12	0.01	0.22	0.00
	N	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425
	P-values:															
	Cash=Food+BCC	0.00	0.00	0.34	0.58	0.00	0.00	0.09	0.86	0.30	0.02	0.80	0.93	0.24	0.28	0.56
	Food=Food+BCC	0.00	0.00	0.04	0.33	0.00	0.00	0.60	0.53	0.61	0.13	0.94	0.79	0.29	0.71	0.39
	Cash+food=Food+BCC	0.00	0.00	0.24	0.62	0.00	0.00	0.21	0.71	0.63	0.49	0.39	0.34	0.58	0.65	0.70
	Cash=Cash+food	0.40	0.41	0.81	0.26	0.21	0.39	0.63	0.56	0.55	0.00	0.59	0.46	0.09	0.11	0.36
	Food=Cash+food	0.72	0.72	0.37	0.11	0.22	0.93	0.50	0.77	0.99	0.03	0.33	0.22	0.11	0.95	0.64
	Cash=Food	0.23	0.23	0.25	0.68	1.00	0.29	0.26	0.40	0.55	0.28	0.74	0.75	0.84	0.14	0.19

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Each column shows an outcome indicator that a household may be deprived in. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children.

Table 3 Incidence (H), intensity (A) and adjusted headcount ratio (M_0) of the N-MPI

k Poverty Cutoff	North									South								
	Baseline			Endline			Change in …			Baseline			Endline			Change in …		
	H	A	M_0	H	A	M_0	ΔH	ΔA	ΔM_0	H	A	M_0	H	A	M_0	ΔH	ΔA	ΔM_0
					Cash only									Cash only				
1	99.79	59.20	0.591	100.00	45.74	0.457	0.21	-13.46	-0.133	100.00	54.38	0.544	100.00	41.68	0.417	0.00	-12.70	-0.127
25	99.79	59.20	0.591	96.47	46.70	0.451	-3.32	-12.50	-0.140	98.57	54.92	0.541	91.00	44.04	0.401	-7.57	-10.87	-0.141
50	70.95	65.72	0.466	34.02	59.65	0.203	-36.93	-6.06	-0.263	58.28	64.12	0.374	24.95	58.98	0.147	-33.33	-5.14	-0.227
75	17.84	79.07	0.141	1.66	79.17	0.013	-16.18	0.10	-0.128	9.82	82.20	0.081	1.02	77.50	0.008	-8.79	-4.70	-0.073
100	0.00	-	0.000	0.00	-	0	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000
					Food only									Food only				
1	99.79	59.24	0.591	100.00	42.98	0.430	0.21	-16.26	-0.161	99.80	53.70	0.536	100.00	40.67	0.407	0.20	-13.04	-0.129
25	98.96	59.58	0.590	91.29	45.35	0.414	-7.68	-14.23	-0.176	98.57	54.15	0.534	91.80	42.79	0.393	-6.76	-11.36	-0.141
50	74.27	64.92	0.482	26.14	59.23	0.155	-48.13	-5.69	-0.327	57.79	63.48	0.367	21.52	59.13	0.127	-36.27	-4.35	-0.240
75	15.56	78.00	0.121	0.83	75.00	0.006	-14.73	-3.00	-0.115	7.79	79.61	0.062	0.20	75.00	0.002	-7.58	-4.61	-0.060
100	0.00	-	0.000	0.00	-	0	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000
					Cash + Food									Cash + Food				
1	100.00	59.51	0.595	100.00	44.68	0.447	0.00	-14.83	-0.148	99.79	52.93	0.528	100.00	39.82	0.398	0.21	-13.11	-0.130
25	99.59	59.67	0.594	94.63	46.18	0.437	-4.96	-13.49	-0.157	97.51	53.75	0.524	89.00	42.40	0.377	-8.51	-11.35	-0.147
50	70.87	66.23	0.469	30.37	60.54	0.184	-40.50	-5.69	-0.285	52.49	64.28	0.337	20.54	58.12	0.119	-31.95	-6.16	-0.218
75	19.63	79.91	0.157	2.27	75.76	0.017	-17.36	-4.15	-0.140	9.54	79.80	0.076	0.83	76.04	0.006	-8.71	-3.76	-0.070
100	0.00	-	0.000	0.00	-	0	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000
					Cash + BCC									Food + BCC				
1	100.00	58.55	0.586	100.00	32.12	0.321	0.00	-26.43	-0.264	99.79	51.60	0.515	100.00	35.14	0.351	0.21	-16.46	-0.164
25	99.58	58.72	0.585	76.58	36.78	0.282	-23.00	-21.94	-0.303	97.53	52.37	0.511	83.71	38.59	0.323	-13.81	-13.78	-0.188
50	70.25	65.12	0.457	6.33	57.36	0.036	-63.92	-7.75	-0.421	50.72	63.13	0.320	12.58	57.65	0.073	-38.14	-5.48	-0.248
75	15.40	79.11	0.122	0.63	75.00	0.005	-14.77	-4.11	-0.117	6.39	80.11	0.051	0.21	75.00	0.002	-6.19	-5.11	-0.050
100	0.00	-	0.000	0.00	-	0	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000
					Control									Control				
1	100.00	58.94	0.589	100.00	48.25	0.482	0.00	-10.69	-0.107	100.00	55.44	0.554	100.00	45.85	0.459	0.00	-9.59	-0.096
25	99.79	59.02	0.589	96.41	49.36	0.476	-3.38	-9.66	-0.113	99.79	55.52	0.554	93.35	47.80	0.446	-6.44	-7.72	-0.108
50	68.71	66.18	0.455	42.28	60.94	0.258	-26.43	-5.24	-0.197	58.63	65.22	0.382	36.59	60.96	0.223	-22.04	-4.26	-0.159
75	18.39	79.17	0.146	4.02	76.32	0.031	-14.38	-2.85	-0.115	11.85	79.82	0.095	3.33	79.17	0.026	-8.52	-0.66	-0.068
100	0.00	-	0.000	0.00	-	0	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000	0.00	-	0.000

***** Δ – change (endline – baseline); BCC - (high quality nutrition) behavioral change communication.

Table 4 Impact of treatment on multidimensional deprivation index by different poverty cutoff (k)

		Incidence (H)			Intensity (A)			Adjusted headcount ratio (M_0)		
		k = 25	k = 50	k = 75	k = 25	k = 50	k = 75	k = 25	k = 50	k = 75
North	Cash only	0.00	-0.09	-0.02	-0.03	-0.01	0.03	-0.03	-0.06	-0.02
		(0.01)	(0.04)**	(0.01)**	(0.01)***	(0.01)	(0.01)**	(0.01)**	(0.02)**	(0.01)*
	Food only	-0.05	-0.17	-0.03	-0.04	-0.02	-0.01	-0.06	-0.11	-0.02
		(0.02)***	(0.04)***	(0.01)***	(0.01)***	(0.01)**	(0.01)	(0.01)***	(0.02)***	(0.01)***
	Cash+food	-0.02	-0.12	-0.02	-0.03	-0.00	-0.01	-0.04	-0.08	-0.01
		(0.01)	(0.04)***	(0.01)	(0.01)***	(0.01)	(0.01)	(0.01)***	(0.02)***	(0.01)
	Cash+BCC	-0.20	-0.36	-0.03	-0.13	-0.04	-0.02	-0.19	-0.22	-0.03
		(0.03)***	(0.03)***	(0.01)***	(0.01)***	(0.02)**	(0.01)**	(0.02)***	(0.02)***	(0.01)***
	R^2	0.08	0.08	0.02	0.15	0.03	0.19	0.20	0.09	0.02
	N	2,395	2,395	2,395	2,182	667	45	2,395	2,395	2,395
	P-values:									
	Cash=Cash+BCC	0.00	0.00	0.23	0.00	0.14	0.00	0.00	0.00	0.21
	Food=Cash+BCC	0.00	0.00	0.75	0.00	0.20	0.42	0.00	0.00	0.74
	Cash+food=Cash+BCC	0.00	0.00	0.08	0.00	0.04	0.09	0.00	0.00	0.08
	Cash=Cash+food	0.20	0.29	0.57	0.51	0.34	0.02	0.22	0.35	0.64
	Food=Cash+food	0.11	0.17	0.11	0.35	0.09	0.37	0.10	0.12	0.12
	Cash=Food	0.01	0.01	0.32	0.08	0.61	0.00	0.00	0.01	0.29
South	Cash only	-0.02	-0.12	-0.02	-0.04	-0.02	-0.01	-0.04	-0.07	-0.02
		(0.02)	(0.04)***	(0.01)**	(0.01)***	(0.01)**	(0.03)	(0.01)***	(0.02)***	(0.01)**
	Food only	-0.01	-0.15	-0.03	-0.05	-0.02	-0.03	-0.05	-0.09	-0.02
		(0.02)	(0.04)***	(0.01)***	(0.01)***	(0.01)*	(0.02)**	(0.01)***	(0.02)***	(0.01)***
	Cash+food	-0.04	-0.15	-0.02	-0.05	-0.03	-0.04	-0.06	-0.10	-0.02
		(0.02)*	(0.04)***	(0.01)**	(0.01)***	(0.01)***	(0.02)**	(0.01)***	(0.02)***	(0.01)**
	Food+BCC	-0.10	-0.23	-0.03	-0.08	-0.03	-0.03	-0.11	-0.14	-0.02
		(0.02)***	(0.03)***	(0.01)***	(0.01)***	(0.01)***	(0.02)**	(0.01)***	(0.02)***	(0.01)***
	R^2	0.01	0.06	0.02	0.10	0.06	0.13	0.10	0.07	0.02
	N	2,425	2,425	2,425	2,177	563	27	2,425	2,425	2,425
	P-values:									
	Cash=Food+BCC	0.00	0.00	0.14	0.00	0.14	0.41	0.00	0.00	0.15
	Food=Food+BCC	0.00	0.00	0.86	0.00	0.17	.	0.00	0.00	0.85
	Cash+food=Food+BCC	0.04	0.00	0.22	0.00	0.64	0.74	0.00	0.00	0.21
	Cash=Cash+food	0.41	0.22	0.74	0.09	0.34	0.34	0.16	0.19	0.74
	Food=Cash+food	0.20	0.92	0.16	0.69	0.38	0.74	0.32	0.83	0.16
	Cash=Food	0.70	0.29	0.11	0.24	0.98	0.41	0.63	0.30	0.11

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication.

Table 5 Impact of treatment on frequency of consumption and calorie intake by food groups, North

	Cereal	Pulses, legumes & nuts	Oils & fats	Roots & tubers	Fruit & Vegetables	Meat & poultry	Eggs	Fish	Dairy (milk/cheese)	Sugar & honey	Tobacco/alcohol
					Number of days household consumed the food group in the last 7 days						
Cash only	0.00	0.43	-0.00	-0.10	0.01	0.28	0.44	0.56	0.27	0.24	0.78
	(0.00)	(0.09)***	(0.00)	(0.08)	(0.12)	(0.05)***	(0.12)***	(0.11)***	(0.16)*	(0.16)	(0.30)***
Food only	0.00	1.48	-0.00	-0.08	0.09	0.16	0.26	0.48	0.32	0.35	0.48
	(0.00)	(0.13)***	(0.00)	(0.08)	(0.12)	(0.06)***	(0.11)**	(0.11)***	(0.15)**	(0.16)**	(0.30)
Cash+food	0.00	1.12	-0.00	-0.09	-0.04	0.19	0.16	0.43	0.17	0.17	0.15
	(0.00)	(0.11)***	(0.00)	(0.08)	(0.14)	(0.06)***	(0.11)	(0.11)***	(0.17)	(0.17)	(0.32)
Cash+BCC	0.00	1.70	0.00	-0.06	0.22	0.90	1.93	1.45	1.55	1.70	0.19
	(0.00)	(0.12)***	(0.00)	(0.08)	(0.10)**	(0.06)***	(0.15)***	(0.12)***	(0.20)***	(0.18)***	(0.33)
Baseline mean	6.99	0.83	6.88	6.62	5.78	0.32	0.94	1.58	1.29	1.80	4.25
P-values:											
Cash=Cash+BCC	0.69	0.00	0.32	0.67	0.02	0.00	0.00	0.00	0.00	0.00	0.05
Food=Cash+BCC	0.36	0.13	0.54	0.84	0.11	0.00	0.00	0.00	0.00	0.00	0.34
Cash+food=Cash+BCC	0.31	0.00	0.31	0.73	0.01	0.00	0.00	0.00	0.00	0.00	0.92
Cash=Cash+food	0.31	0.00	0.98	0.93	0.68	0.16	0.02	0.24	0.58	0.66	0.03
Food=Cash+food	0.31	0.01	0.31	0.90	0.29	0.62	0.35	0.69	0.38	0.29	0.27
Cash=Food	0.37	0.00	0.33	0.83	0.48	0.04	0.13	0.47	0.74	0.53	0.26
					Log daily per adult equivalent unit calorie intake						
Cash only	0.04	0.68	0.08	-0.04	0.20	0.74	0.30	0.50	0.15	0.26	-
	(0.02)**	(0.15)***	(0.04)**	(0.06)	(0.06)***	(0.15)***	(0.10)***	(0.12)***	(0.12)	(0.15)*	-
Food only	-2.73	-1.33	-2.35	-0.05	0.14	0.36	0.17	0.40	0.19	0.59	-
	(0.17)***	(0.16)***	(0.11)***	(0.05)	(0.05)***	(0.15)**	(0.10)*	(0.11)***	(0.12)	(0.15)***	-
Cash+food	-1.30	-0.92	-1.95	-0.02	0.15	0.46	0.12	0.44	0.25	0.02	-
	(0.14)***	(0.17)***	(0.15)***	(0.06)	(0.05)***	(0.16)***	(0.10)	(0.11)***	(0.14)*	(0.16)	-
Cash+BCC	0.05	1.62	0.21	-0.23	0.61	1.74	0.96	1.12	1.14	1.33	-
	(0.02)***	(0.13)***	(0.04)***	(0.07)***	(0.06)***	(0.13)***	(0.09)***	(0.09)***	(0.14)***	(0.15)***	-
Baseline mean	2220.92	26.04	118.95	121.05	78.69	15.10	6.37	25.17	15.46	24.64	-
P-values:											-
Cash=Cash+BCC	0.53	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-
Food=Cash+BCC	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-
Cash+food=Cash+BCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Cash=Cash+food	0.00	0.00	0.00	0.66	0.27	0.09	0.08	0.53	0.45	0.12	-
Food=Cash+food	0.00	0.01	0.04	0.49	0.86	0.56	0.59	0.70	0.66	0.00	-
Cash=Food	0.00	0.00	0.00	0.85	0.19	0.02	0.21	0.35	0.72	0.02	-
N	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	-

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication.

Table 6 Impact of treatment on frequency of consumption and calorie intake by food groups, South

	Cereal	Pulses, legumes & nuts	Oils & fats	Roots & tubers	Fruit & Vegetables	Meat & poultry	Eggs	Fish	Dairy (milk/cheese)	Sugar & honey	Tobacco/alcohol
					Number of days household consumed the food group in the last 7 days						
Cash only	-0.00	0.00	0.00	-0.07	-0.03	0.15	0.34	0.40	0.05	0.21	-0.21
	(0.00)	(0.15)	(0.00)	(0.15)	(0.11)	(0.06)**	(0.12)***	(0.15)***	(0.18)	(0.22)	(0.29)
Food only	-0.00	1.34	0.00	-0.28	0.03	0.02	0.06	0.13	0.09	0.27	-0.44
	(0.00)	(0.15)***	(0.00)	(0.15)*	(0.12)	(0.06)	(0.11)	(0.16)	(0.21)	(0.22)	(0.29)
Cash+food	-0.00	0.84	0.00	0.05	-0.16	0.07	0.27	0.19	0.26	0.41	0.28
	(0.00)	(0.15)***	(0.00)	(0.13)	(0.12)	(0.06)	(0.12)**	(0.15)	(0.23)	(0.23)*	(0.27)
Food+BCC	-0.00	1.42	0.00	0.08	0.01	0.44	1.10	0.96	0.57	0.87	-0.28
	(0.00)	(0.14)***	(0.00)	(0.16)	(0.12)	(0.07)***	(0.13)***	(0.18)***	(0.23)**	(0.21)***	(0.32)
Baseline mean	6.99	1.94	6.92	5.35	6.90	0.31	0.94	2.64	1.31	2.06	3.20
P-values:											
Cash=Food+BCC	0.31	0.00	0.29	0.39	0.76	0.00	0.00	0.00	0.02	0.00	0.83
Food=Food+BCC	0.32	0.58	0.58	0.03	0.85	0.00	0.00	0.00	0.05	0.00	0.61
Cash+food=Food+BCC	0.55	0.00	0.58	0.83	0.19	0.00	0.00	0.00	0.24	0.03	0.07
Cash=Cash+food	0.15	0.00	0.17	0.44	0.26	0.18	0.59	0.15	0.32	0.34	0.08
Food=Cash+food	0.15	0.00	0.99	0.02	0.14	0.37	0.08	0.67	0.45	0.53	0.01
Cash=Food	0.46	0.00	0.17	0.18	0.61	0.03	0.02	0.08	0.87	0.76	0.44
					Log daily per adult equivalent unit calorie intake						
Cash only	-0.01	0.12	0.06	-0.17	0.16	0.51	0.32	0.33	0.04	0.32	-
	(0.02)	(0.13)	(0.04)	(0.07)**	(0.05)***	(0.16)***	(0.11)***	(0.09)***	(0.13)	(0.15)**	-
Food only	-2.32	-1.80	-2.39	-0.10	0.09	0.23	0.12	0.10	0.05	0.31	-
	(0.20)***	(0.15)***	(0.15)***	(0.06)*	(0.06)	(0.17)	(0.11)	(0.09)	(0.14)	(0.15)**	-
Cash+food	-0.81	-0.94	-1.07	-0.03	0.18	0.25	0.28	0.19	0.16	0.28	-
	(0.12)***	(0.17)***	(0.15)***	(0.06)	(0.05)***	(0.15)*	(0.11)**	(0.09)*	(0.16)	(0.15)*	-
Food+BCC	-1.78	-1.46	-2.11	-0.07	0.35	1.26	0.85	0.46	0.36	0.89	-
	(0.13)***	(0.15)***	(0.13)***	(0.05)	(0.05)***	(0.16)***	(0.10)***	(0.09)***	(0.17)**	(0.13)***	-
Baseline mean	2280.77	72.90	174.01	78.75	109.58	19.48	5.83	40.19	13.91	39.93	-
P-values:											-
Cash=Food+BCC	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.08	0.03	0.00	-
Food=Food+BCC	0.02	0.03	0.15	0.58	0.00	0.00	0.00	0.00	0.05	0.00	-
Cash+food=Food+BCC	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.26	0.00	-
Cash=Cash+food	0.00	0.00	0.00	0.03	0.72	0.11	0.76	0.09	0.39	0.75	-
Food=Cash+food	0.00	0.00	0.00	0.18	0.13	0.91	0.19	0.32	0.44	0.83	-
Cash=Food	0.00	0.00	0.00	0.29	0.23	0.12	0.10	0.01	0.98	0.92	-
N	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	-

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication.

Appendices to "The importance of nutrition education in achieving food security and adequate nutrition of the poor: Experimental evidence from rural Bangladesh"

Appendix A. Current food security and nutrition situation in Bangladesh

1. Progress thus far

Bangladesh has made considerable progress in improving food and security nutrition of its population in the last three decades buoyed by increase in the availability of and access to food. Aggregate deficits in food that existed in the 1970s were wiped out by an expansion in rice production which tripled over the last three decades, outpacing the growth in population of about 60 percent. Subsequently, non-crop agriculture witnessed a fast growth from 35 percent to 45 percent of the share of agricultural GDP over the same period (Osmani et al. 2016).

Coupled with availability, access to food has also improved due to sustained economic growth increasing the purchasing power of the population. The rate of GDP growth averaged around 6.5 percent in the 2010s while population grew at around 1 percent over the same period according to the World Bank. On the other hand, per capita income grew from 1.7 percent in the 1990s to around 4.8 percent in the 2010s – meaning that an average individual in the 2010s was almost three times as well off than in the 1990s. At the national level, the headcount measure of poverty has also halved falling from 48.9 percent in 2000 to 24.3 percent in 2016 (BBS 2017).

In terms of nutrition, Bangladesh has achieved the fastest prolonged reductions in child underweight and stunting prevalence during 1997 to 2007 according to a cross-country study conducted by Headey (2013). The Demographic and Health Surveys (DHS) report a reduction in the rate of stunting (low height-for-age), from 55 percent in 1996-97 to 36 percent in 2014. On the other hand, measures of maternal nutrition have also seen improvement in the last two decades with low body mass index, i.e. a BMI less than 18.5, among women of reproductive age declining from 34 percent in 2004 to 19 percent in 2014 according to estimates from the DHS. This reduction has in turn lead to reductions in under-five child deaths with DHS estimates show a decline from 133 to 46 deaths per 1000 live births from 1993-94 to 2014 (NIPORT et al. 2016).

2. Persisting concerns

Despite admirable progress over the last few decades in improving the state of food security and nutrition in the country, a worryingly large number of people are still in the clutches of food and nutrition insecurity. The prevalence of undernourishment, defined and tracked by the FAO as the percentage of the population who are unable to consume a minimum dietary energy level necessary for a given population, shows that, in Bangladesh, undernourishment has declined from 20.8 percent in 2000 to 15.2 percent in 2016 (World Bank 2017). However, this decline is of little comfort since almost 24 million people are still hungry in Bangladesh according to this measure. Similarly, using estimates of extreme poverty, headcount rate of extreme poverty in Bangladesh stands at 12.9 percent in 2016 (BBS 2017) which translates to more than 20 million people. There is also considerable churning around the poverty line – Ahmed and Tauseef (2018), using data from a nationally representative rural panel over the period 2011/12 to 2015, showed that 15.5 percent of the population moved out while 9.4 percent fell into poverty between the rounds of the survey.

Furthermore, the segment of the population dwelling in the bottom quintiles of the income distribution are seen to lag behind considerably compared to the top quintiles. Using the Household Food Insecurity Access Scale (HFIAS), which aggregates information from different

dimensions of food insecurity and hunger as experienced by the households, and wealth quintiles, HKI/JPGSPH (2016) found that in 2014 55 percent of households in the bottom two quintiles were food insecure compared to just 3 percent in the richest quintile. On the other hand, quality and diverse diet, which is an important dimension of food security, were also found to be poor. Using the Food Consumption Score (FCS), an indicator of diet diversity as defined by the UN-WFP, HKI/JPGSPH (2016) reports that almost half of the households in the bottom wealth quintile have a low FCS in 2014. And with respect to nutrition, in 2014, almost half of the children (49.2%) in the bottom wealth quintile were stunted and 17.1 percent was wasted while the numbers are 19.4 percent and 11.7 percent respectively in the highest wealth quintile (NIPORT et al. 2016).

One possible explanation of this stickiness in the reduction of rates of stunting and wasting may be poor infant and young child feeding (IYCF) practices. More than half of the children (55%) in Bangladesh are still not exclusively breastfed (EBF) during the first six months of their lives as reported by DHS 2014 (NIPORT et al. 2016). Similar worrying trend is seen in feeding practices after six months of life. According to DHS in 2014, only 23 percent of children aged 6-23 months in Bangladesh are fed according to recommended minimum acceptable diet (MAD) criteria[7], with around 14 percent in the lowest wealth quintile compared to around 33 percent in the highest quintile (NIPORT et al. 2016). This in turn has serious implications for physical and cognitive development due to lack of appropriate micronutrients.

It is notable that in the study of nutritional status in Bangladesh by Headey et al. (2014) almost half of the improvements in nutritional status could not be explained by the variables they have considered such as wealth accumulation of households, institutional education especially maternal education, improvement in the state of healthcare and sanitation, etc. Behrman and Deolilakar (1987) also note that the view that malnutrition will disappear with increase in income associated with economic development may be flawed because of low nutrient elasticities with respect to income or expenditure. Osmani et al. (2016) note that nutritional status is affected by a myriad of factors in Bangladesh and the work undertaken by NGOs through nutrition-specific interventions and the increasing trend in women empowerment are possible factors. In fact, Sraboni et al. (2014), using a carefully constructed index of women's empowerment, demonstrated that women's empowerment is positively associated with household and child food security in Bangladesh. Similarly, Smith (2015), using data from a project aimed to reducing food insecurity and child nutrition through nutrition specific interventions, found that women's empowerment has contributed strongly to reducing food insecurity and child undernutrition. Therefore, increase in economic resources by provision of social protection is important but no less important are interventions aimed to amend the cultural and social norms pertaining to dietary intake and IYCF practices. It is thus important to evaluate if changes in cultural and social norms, brought about by carefully constructed BCC, is required to achieve progress in food security and nutrition.

Appendix B. Beneficiaries' preference of transfer

In addition to the impact of transfers on food security and nutrition outcomes, one factor that should be taken into account when assessing the relative efficacy of cash against food transfers is the beneficiaries' cost (time or money) related with receiving the transfer and their reported preference of the form of transfer. In the endline survey, the beneficiaries were asked questions regarding the cost they incurred to collect the transfer and their preferred modality of transfer, namely cash, food, or a combination of cash and food, if the government decided to run such a

[7] Minimum acceptable diet (MAD) of a child, aged 6 – 23 months, should consist of food from at least 4 different food groups, along with milk and milk products, and should be fed at least a recommended minimum number of times.

program in the future. In terms of cost of transporting the transferred good back to their houses, costs were higher in the South than in the North owing to the larger dispersion of villages and poorer communication infrastructure in the South compared to the North. In the South, it costs beneficiaries in the modalities with food transfer an average of 22.58 taka (US$ 0.27) on average to collect the transfer while in the North it was 13.77 taka (US$0.17).

With respect to the preferred transfer modality, more than 90 percent of the beneficiaries receiving cash expressed preference for cash transfers in both regions while the preference for food transfers for beneficiaries receiving food was much lower. In the North, for the food-recipient group, only 47.0 percent preferred food transfers while in the South it was 63.2 percent for food only recipients and 70.1 percent for Food+BCC recipients. This question was also asked to control households and reveals a general preference for cash transfer – 46.8 percent in the North and 43.1 percent in the South preferred cash while 20.7 percent in the North and 28.9 percent in the South. Preference for cash and food combination were 32.5 percent and 27.9 percent in North and South respectively. When asked the reason for this preference, around 70 percent of beneficiaries in both North and South who preferred cash responded that if they received a food ration instead of cash, they would have to sell a portion of the ration to have money to buy other food and non-food items. Around 75 percent in the North and 68 percent in the South of those who preferred food transfer responded that the ration is better since it would support their families' food and nutrition requirement. Lastly, the majority of beneficiaries who preferred a combination of cash and food reasoned that the ration was important for food security while the cash was important to buy non-food items.

Appendix references

Ahmed, Akhter and Salauddin Tauseef. 2018. "Climbing up the Ladder and Watching out for the Fall: Poverty Dynamics in rural Bangladesh." Discussion Paper 1791. International Food Policy Research Institute: Washington, DC. Available at SSRN: https://ssrn.com/abstract=3324541

BBS (Bangladesh Bureau of Statistics). 2017. *Preliminary Report on Household Income and Expenditure Survey 2016*. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Behrman, Jere R., and Anil B. Deolalikar. 1987. "Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India." *Journal of Political Economy* 95 (3): 492–507. https://doi.org/10.1086/261469.

Headey, Derek D. 2013. "Developmental Drivers of Nutritional Change: A Cross-country Analysis." *World Development*. 42: 76–88.

Headey, Derek D., John F. Hoddinott, Disha Ali, Roman Tesfaye, and Mekdim Dereje. 2014. "The Other Asian Enigma: Explaining the Rapid Reduction of Undernutrition in Bangladesh." Discussion Paper 01358. International Food Policy Research Institute: Washington, DC.

Helen Keller International (HKI) and James P. Grant School of Public Health (JPGSPH). 2016. *State of Food Security and Nutrition in Bangladesh: 2014*. Dhaka, BD: HKI and JPGSPH.

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. 2016. *Bangladesh Demographic and Health Survey 2014*. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.

Osmani, S.R., Akhter Ahmed, Tahmeed Ahmed, Naomi Hossain, Saleemul Huq, and Asif Shahan. 2016. *Strategic Review of Food Security and Nutrition in Bangladesh*. World Food Programme.

Smith, L. C. 2015. *Quantitative Impact Evaluation of the SHOUHARDO II Project in Bangladesh*. TANGO International for USAID and CARE: Bangladesh.

Sraboni, Esha, Hazel J. Malapit, Agnes R. Quisumbing, and Akhter U. Ahmed. 2014. "Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh?" *World Development*. 61: 11–52.

World Bank, World Development Indicators. 2017. *Prevalence of undernourishment (% of population).* Retrieved from https://data.worldbank.org/indicator/SN.ITK.DEFC.ZS

Appendix Figures and Tables

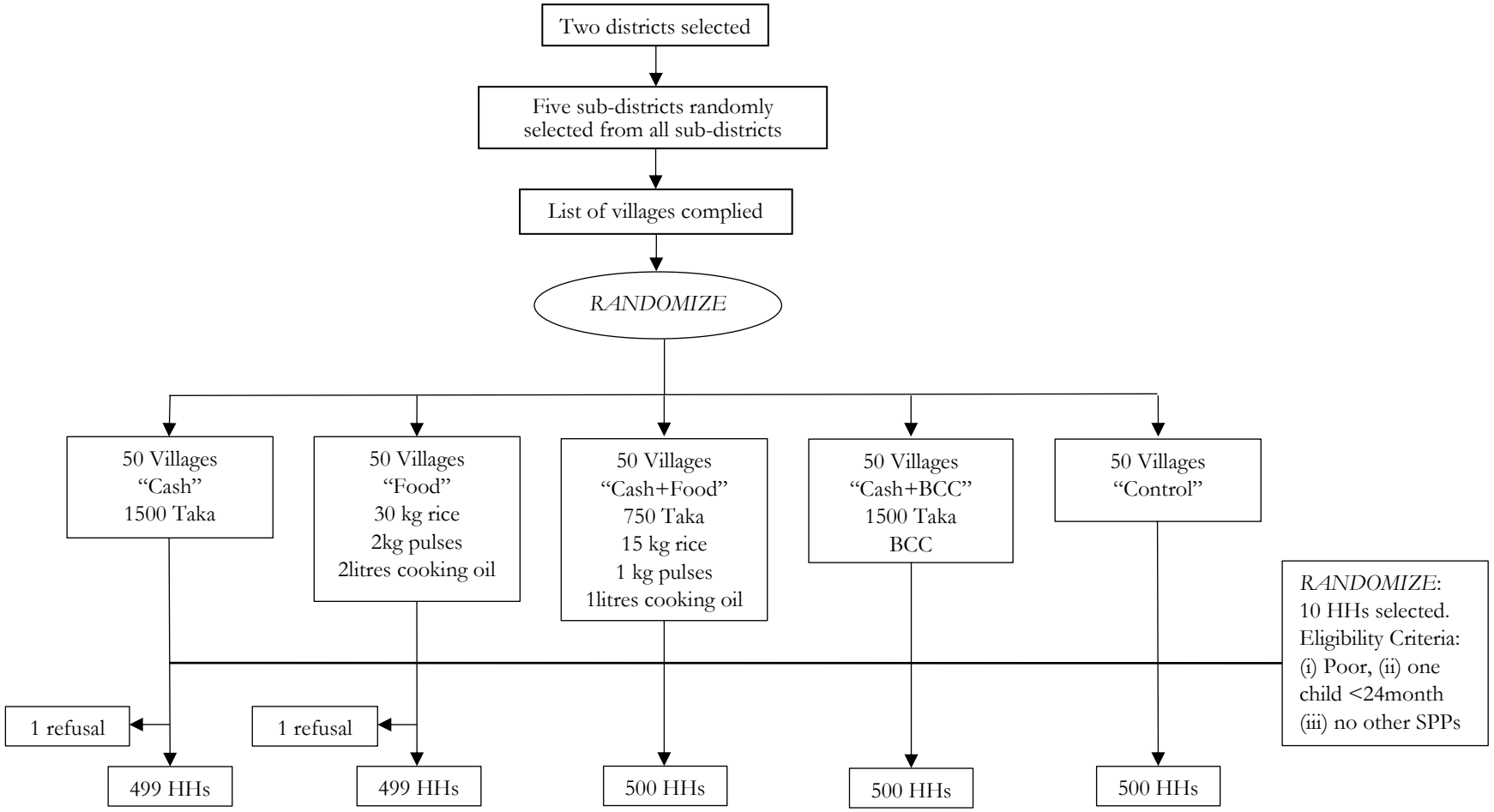

Figure 1 Flow diagram of household selection in the North randomized control trial conducted in north-west rural Bangladesh, March 2012 – May 2014 (BCC, (high quality nutrition) behavioral change communication)

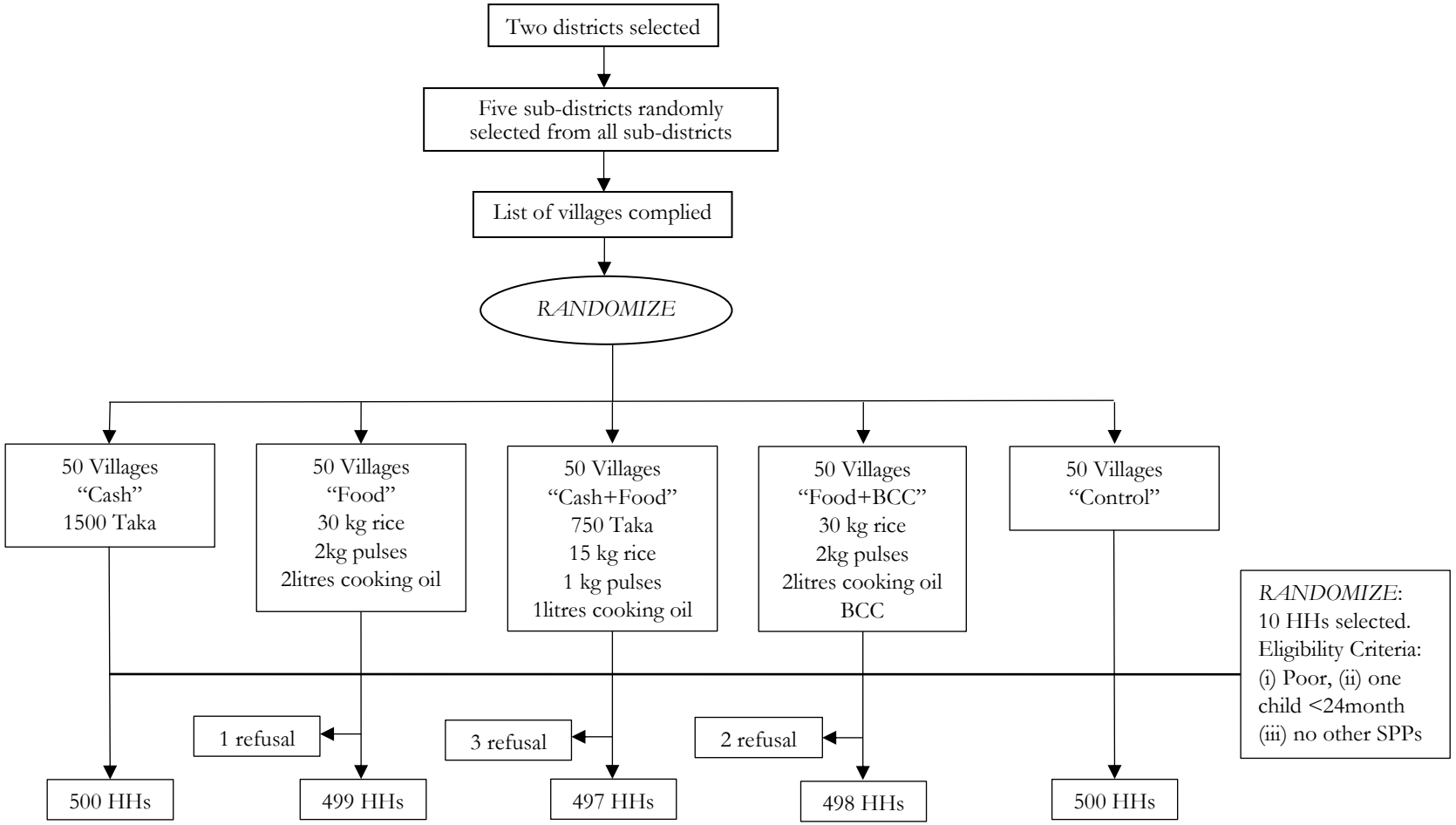

Figure 2 Flow diagram of household selection in the South randomized control trial conducted in south rural Bangladesh, March 2012 – May 2014 (BCC, (high quality nutrition) behavioral change communication)

Table A1 Nutrition-sensitive multidimensional poverty index (N-MPI)

Dimension	Indicator	Definition	Deprived if …	Weight
Household Food Security	Food Consumption Score (FCS)	Weighted score (out of 112) of the number of times household members have consumed a food group (staples, pulses, vegetables, fruits, meat/fish, milk, sugar or oil) in the past 7 days	FCS < 42	1/12
	Undernourishment	Consumption per adult equivalent unit (AEU) of the number of calories in the last 24 hours	AEU calorie < 2,122 kcal	1/12
	Household Hunger Scale	Frequency with which household members experienced the following in the last 4 weeks (1) no food at all in the house, (2) went to bed hungry, (3) went all day and night without eating. Responses are given the values: never (value = 0), rarely or sometimes (value = 1), often (value = 2), then aggregated for the HHS score ranging from 0 to 6.	HHS > 2	1/12
	Minimum Diet Diversity – Women (MDD-W)	Number of food groups (grains/root/tubers, pulses (beans, peas and lentils), nuts/seeds, dairy, meat/poultry/fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, and other fruits) consumed by women of reproductive age 15-49 years in the last 24 hours	Any women of reproductive age in the household consumed less than 5 food groups (MDD-W < 5)	1/12
	Undernutrition	Child is below minus two standard deviations from median height(weight)-for-age of reference population aged 0-59 months.	Any child in the household is stunted or wasted	1/12
	Minimum Diet Diversity – Children (MDD-C)	Number of food groups (grains, root and tubers, legumes and nuts, dairy, eggs, flesh food, Vit A rich vegetables and fruits, and other fruits and vegetables) consumed by the youngest child aged 6- 59 months	Any child in the household consumed less than 4 food groups (MDD-C < 4)	1/12
Women's Empowerment	Decision on mobility	Decision to visit at least one location (friends/family outside community, marketplace, hospital/doctor, cinema/fair or NGO training program)	Female participant cannot take decision herself	1/12
	Control over household resources	Control of money needed to buy at basic items (food from market, clothes, medicine, or toiletries/cosmetics for self)	Does not control money needed to buy at least 3 items	1/12
	Ability to participate in decision making	Participation in major household decisions (food, housing, healthcare, education, and clothing)	Female participant cannot participate solely or jointly in at least 3 decisions	1/12
Living Standards	School attendance	All children of school age in the household are attending school up to the age at which they would complete Grade 10	Any child in the household is not attending school	1/24
	Housing condition	Material used to build roof and walls, and the condition of the housing	Roof and walls are made of rudimentary materials and are very damaged	1/24
	Assets	Household owns radio, television, telephone, bicycle, rickshaw, van, animal cart, boat, motorcycle, engine boat, solar panel, electricity generator, IPS, tractor, power tiller, thresher, motor pump, harvester or fridge	Household does not own more than one of these assets	1/24
	Sanitation	Household have access to improved sanitation if it has some type of flush toilet or latrine, or ventilated improved pit or composting toilet	Household does not have access to improved sanitation	1/24
	Drinking water	Source of drinking water is safe, and the water is purified before drinking	The water is not safe and not purified	1/24
	Cooking fuel	Material used as cooking fuel	Household cooks with dung, wood, or charcoal	1/24

Table A2: Impact of treatment on attrition, by region

	North	South
Cash	-0.02	-0.02
	(0.01)	(0.01)
Food	-0.02	-0.01
	(0.01)	(0.01)
Cash and food	-0.02	-0.00
	(0.01)	(0.01)
Cash + BCC	-0.00	-0.01
	(0.02)	(0.01)
R^2	0.00	0.00
N	2,500	2,500
Mean of Control	0.05	0.04
P-value: Cash=Cash+BCC	0.32	0.44
P-value: Food=Cash+BCC	0.31	0.58
P-value: Cash and food=Cash+BCC	0.20	0.59
P-value: Cash=Cash and food	0.75	0.12
P-value: Food=Cash and food	0.74	0.21
P-value: Cash=Food	1.00	0.82

Standard errors clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Dependent variable is a dummy with value 1 if household has attrited and 0 otherwise. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication.

Table A3 Baseline means of sample variables by intervention arm - North

	Means					P-values of differences									
	Cash	Food	Cash+ Food	Cash+ BCC	Control	Cash - Food	Cash - Cash+Food	Cash - Cash+BCC	Cash - Control	Food - Cash+Food	Food - Cash+BCC	Food - Control	Cash+Food - Cash+BCC	Cash+Food - Control	Cash+BCC - Control
Household characteristics															
Age of head	36.97	37.39	36.89	37.13	37.56	0.65	0.92	0.85	0.51	0.57	0.77	0.86	0.76	0.42	0.60
Education of head (years)	1.52	1.27	1.32	1.47	1.44	0.21	0.31	0.80	0.69	0.77	0.26	0.36	0.38	0.51	0.86
Education of main female (years)	2.30	2.14	2.03	2.10	2.37	0.47	0.23	0.40	0.76	0.63	0.88	0.30	0.76	0.12	0.25
Female headed household	0.06	0.08	0.08	0.08	0.06	0.35	0.48	0.51	0.95	0.73	0.71	0.28	0.98	0.40	0.43
Head is agri day laborer	0.37	0.33	0.39	0.38	0.37	0.34	0.64	0.79	0.96	0.12	0.18	0.35	0.83	0.60	0.74
Head is salaried employee	0.02	0.02	0.02	0.01	0.01	0.51	0.81	0.63	0.18	0.65	0.30	0.07	0.48	0.12	0.42
Head is farmer	0.20	0.23	0.18	0.24	0.21	0.34	0.51	0.31	0.81	0.08	0.83	0.42	0.09	0.32	0.37
Household Characteristics															
No. of dependents <15 or >=60 years	2.42	2.46	2.49	2.49	2.43	0.60	0.37	0.48	0.90	0.69	0.77	0.68	0.97	0.43	0.54
No. of members 15 to <60 years	2.42	2.38	2.38	2.40	2.44	0.62	0.63	0.82	0.83	0.96	0.78	0.49	0.80	0.48	0.66
Household size	4.92	4.90	4.92	4.96	4.94	0.83	1.00	0.75	0.86	0.83	0.63	0.71	0.75	0.86	0.86
Owns land	0.86	0.88	0.86	0.84	0.88	0.58	0.98	0.55	0.50	0.60	0.29	0.95	0.53	0.52	0.23
Value of assets (Tk)	16,767.46	19,275.39	14,825.38	16,368.72	17,433.99	0.38	0.28	0.83	0.74	0.10	0.29	0.51	0.34	0.13	0.56
Owns mobile phone	0.43	0.44	0.41	0.47	0.45	0.82	0.55	0.39	0.73	0.42	0.52	0.89	0.17	0.37	0.63
Has electricity connection	0.12	0.12	0.10	0.09	0.11	0.91	0.50	0.41	0.75	0.56	0.47	0.84	0.82	0.68	0.56
Household health and nutrition															
Per aeu calorie intake (kcal)	2,440.69	2,450.81	2,408.05	2,478.98	2,428.27	0.83	0.48	0.44	0.78	0.35	0.57	0.61	0.15	0.65	0.29
Food Consumption Score	43.75	44.00	42.32	44.23	44.70	0.85	0.23	0.69	0.48	0.18	0.86	0.62	0.10	0.07	0.72
Per capita monthly food expenditure	875.73	869.69	808.54	898.40	850.68	0.88	0.06	0.78	0.51	0.08	0.72	0.61	0.25	0.21	0.54
Per capita monthly non-food expenditure	459.24	460.91	443.42	440.18	459.09	0.94	0.45	0.41	0.99	0.37	0.34	0.94	0.87	0.46	0.42
Per capita monthly expenditure	1,369.48	1,373.61	1,273.63	1,363.01	1,331.09	0.95	0.10	0.95	0.55	0.07	0.91	0.49	0.31	0.29	0.73
Avg weight- for-age Z-score	-1.85	-1.89	-1.77	-1.69	-1.76	0.72	0.45	0.13	0.39	0.17	0.02	0.13	0.40	0.92	0.45
Avg height-for-age Z-score	-1.56	-1.57	-1.60	-1.54	-1.56	0.83	0.56	0.80	0.94	0.70	0.62	0.89	0.36	0.60	0.72

P-values are reported from Wald tests on the equality of means of control and each treatment for each variable. Standard errors are clustered at the village level. BCC - (high quality nutrition) behavioral change communication.

Table A4 Baseline means of sample variables by intervention arm – South

	Means					P-values of differences									
	Cash	Food	Cash+ Food	Food+ BCC	Control	Cash - Food	Cash - Cash+Food	Cash - Food+BCC	Cash - Control	Food - Cash+Food	Food - Food+BCC	Food - Control	Cash+Food - Food+BCC	Cash+Food - Control	Food+BCC - Control
Household head characteristics															
Age of head	38.74	39.28	39.97	38.49	38.58	0.52	0.22	0.76	0.85	0.49	0.36	0.42	0.15	0.18	0.91
Education of head (years)	1.91	1.93	1.99	2.29	2.19	0.94	0.78	0.18	0.28	0.82	0.17	0.28	0.29	0.45	0.72
Education of main female (years)	2.52	2.49	2.82	3.01	3.08	0.90	0.35	0.12	0.08	0.20	0.04	0.02	0.53	0.40	0.84
Female headed household	0.09	0.13	0.10	0.13	0.12	0.19	0.66	0.18	0.37	0.36	0.93	0.72	0.33	0.62	0.67
Head is agri day laborer	0.17	0.19	0.16	0.19	0.18	0.59	0.72	0.60	0.75	0.37	0.93	0.83	0.36	0.50	0.88
Head is salaried employee	0.02	0.02	0.02	0.04	0.02	0.82	0.81	0.24	0.70	0.64	0.16	0.84	0.34	0.55	0.14
Head is farmer	0.33	0.34	0.33	0.30	0.38	0.62	0.86	0.46	0.24	0.76	0.20	0.45	0.36	0.32	0.06
Household Characteristics															
No. of dependents <15 or >=60 years	2.85	2.91	2.73	2.67	2.85	0.61	0.24	0.13	0.97	0.10	0.05	0.58	0.60	0.25	0.13
No. of members 15 to <60 years	2.47	2.49	2.54	2.53	2.59	0.80	0.30	0.51	0.14	0.46	0.67	0.22	0.85	0.51	0.48
Household size	5.42	5.50	5.39	5.31	5.56	0.52	0.80	0.39	0.25	0.40	0.18	0.66	0.55	0.19	0.07
Owns land	0.81	0.82	0.86	0.83	0.87	0.90	0.29	0.68	0.14	0.34	0.78	0.17	0.46	0.65	0.22
Value of assets (Tk)	20,720.18	20,347.89	23,561.12	23,280.25	24,987.90	0.85	0.26	0.28	0.11	0.19	0.20	0.07	0.92	0.63	0.55
Owns mobile phone	0.61	0.68	0.67	0.62	0.64	0.07	0.10	0.81	0.50	0.79	0.08	0.25	0.12	0.35	0.63
Has electricity connection	0.15	0.19	0.14	0.14	0.13	0.40	0.74	0.77	0.60	0.24	0.25	0.19	0.97	0.82	0.79
Household health and nutrition															
Per aeu calorie intake (kcal)	2,495.60	2,503.62	2,539.47	2,535.09	2,451.16	0.87	0.35	0.36	0.36	0.47	0.49	0.30	0.92	0.08	0.08
Food Consumption Score	50.25	50.74	51.38	52.21	49.96	0.71	0.38	0.14	0.82	0.61	0.26	0.54	0.51	0.25	0.08
Per capita monthly food expenditure	1,029.21	1,105.16	1,164.27	1,021.03	1,179.78	0.30	0.04	0.86	0.22	0.50	0.25	0.58	0.03	0.91	0.20
Per capita monthly non-food expenditure	511.61	533.59	550.53	543.75	519.06	0.30	0.10	0.16	0.74	0.48	0.66	0.52	0.79	0.21	0.31
Per capita monthly expenditure	1,570.11	1,699.01	1,775.25	1,589.25	1,736.62	0.14	0.02	0.76	0.20	0.48	0.22	0.79	0.04	0.79	0.26
Avg weight- for-age Z-score	-1.68	-1.64	-1.69	-1.70	-1.68	0.70	0.91	0.82	1.00	0.60	0.49	0.69	0.91	0.91	0.81
Avg height-for-age Z-score	-1.59	-1.50	-1.52	-1.52	-1.54	0.18	0.34	0.31	0.44	0.74	0.74	0.57	0.99	0.83	0.82

P-values are reported from Wald tests on the equality of means of control and each treatment for each variable. Standard errors are clustered at the village level. BCC - (high quality nutrition) behavioral change communication.

Table A5 Impact of treatment on outcome indicators – Inverse Probability Weighted (IPW)

		FCS	Per aeu calorie	HHS	MDD-W	Under nutrition	MDD-C	Mobility	Control resources	Decision making	Child education	Housing condition	Assets	Sanitation	Drinking water	Cooking fuel
North	Cash	-0.20	-0.04	-0.05	-0.03	0.01	0.00	0.01	0.01	0.01	-0.01	-0.05	-0.02	-0.01	-0.00	-0.01
		(0.04)***	(0.03)	(0.02)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.00)**
	Food	-0.28	-0.06	-0.07	-0.10	-0.01	-0.06	-0.01	-0.03	-0.05	0.00	0.04	-0.01	0.00	-0.01	-0.00
		(0.04)***	(0.03)**	(0.02)***	(0.03)***	(0.03)	(0.03)*	(0.03)	(0.04)	(0.03)	(0.02)	(0.05)	(0.01)	(0.03)	(0.01)	(0.00)
	Cash+food	-0.23	-0.07	-0.04	-0.11	0.02	-0.02	0.01	0.02	-0.02	0.03	-0.04	-0.03	0.01	0.01	-0.01
		(0.04)***	(0.03)**	(0.02)*	(0.03)***	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)*	(0.03)	(0.01)	(0.01)**
	Cash+BCC	-0.45	-0.14	-0.09	-0.48	-0.04	-0.41	-0.08	-0.05	-0.04	0.01	-0.13	-0.04	-0.12	-0.00	-0.01
		(0.03)***	(0.03)***	(0.02)***	(0.03)***	(0.03)	(0.03)***	(0.04)**	(0.04)	(0.03)	(0.02)	(0.04)***	(0.02)**	(0.04)***	(0.01)	(0.01)**
	R^2	0.10	0.01	0.03	0.06	0.14	0.05	0.00	0.01	0.01	0.09	0.24	0.28	0.02	0.00	0.01
	N	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395
	P-values:															
	Cash=Cash+BCC	0.00	0.00	0.00	0.00	0.12	0.00	0.02	0.15	0.06	0.33	0.06	0.29	0.00	0.63	0.37
	Food=Cash+BCC	0.00	0.01	0.08	0.00	0.30	0.00	0.08	0.61	0.92	0.71	0.00	0.04	0.00	0.55	0.11
	Cash+food=Cash+BCC	0.00	0.01	0.00	0.00	0.06	0.00	0.04	0.12	0.31	0.40	0.05	0.54	0.00	0.19	0.97
	Cash=Cash+food	0.38	0.40	0.71	0.01	0.72	0.50	0.83	0.83	0.32	0.04	0.85	0.64	0.68	0.37	0.38
	Food=Cash+food	0.11	0.98	0.02	0.67	0.26	0.23	0.68	0.28	0.25	0.20	0.10	0.20	0.86	0.05	0.11
	Cash=Food	0.01	0.43	0.04	0.02	0.44	0.05	0.50	0.36	0.05	0.55	0.06	0.51	0.80	0.24	0.40
South	Cash	-0.09	-0.08	-0.04	-0.06	-0.03	-0.06	-0.00	-0.09	0.03	0.05	-0.05	-0.04	-0.08	0.02	-0.01
		(0.02)***	(0.03)***	(0.02)**	(0.03)*	(0.03)	(0.04)	(0.03)	(0.03)***	(0.03)	(0.03)**	(0.04)	(0.03)	(0.05)*	(0.04)	(0.01)
	Food	-0.11	-0.05	-0.06	-0.10	-0.02	-0.06	-0.04	-0.06	0.01	0.03	-0.04	-0.03	-0.07	-0.03	0.00
		(0.02)***	(0.03)	(0.02)***	(0.03)***	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.05)	(0.03)	(0.00)
	Cash+food	-0.10	-0.07	-0.05	-0.09	-0.06	-0.11	-0.02	-0.07	0.01	-0.02	-0.08	-0.06	-0.00	-0.03	-0.00
		(0.02)***	(0.03)**	(0.01)***	(0.03)**	(0.03)**	(0.04)***	(0.03)	(0.04)*	(0.03)	(0.02)	(0.04)**	(0.02)***	(0.05)	(0.03)	(0.00)
	Food+BCC	-0.17	-0.11	-0.06	-0.28	-0.05	-0.33	-0.06	-0.08	-0.00	-0.00	-0.04	-0.03	-0.03	-0.02	-0.00
		(0.02)***	(0.03)***	(0.01)***	(0.04)***	(0.03)	(0.04)***	(0.03)*	(0.04)**	(0.03)	(0.02)	(0.04)	(0.02)	(0.05)	(0.03)	(0.00)
	R^2	0.06	0.03	0.02	0.04	0.12	0.03	0.00	0.02	0.00	0.10	0.20	0.09	0.00	0.24	0.00
	N	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425
	P-values:															
	Cash=Food+BCC	0.00	0.35	0.07	0.00	0.56	0.00	0.08	0.79	0.29	0.02	0.86	0.86	0.24	0.27	0.56
	Food=Food+BCC	0.00	0.05	0.85	0.00	0.33	0.00	0.59	0.57	0.61	0.11	1.00	0.86	0.30	0.74	0.39
	Cash+food=Food+BCC	0.00	0.22	0.14	0.00	0.65	0.00	0.21	0.79	0.62	0.50	0.38	0.28	0.58	0.67	0.70
	Cash=Cash+food	0.48	0.77	0.49	0.39	0.26	0.21	0.63	0.57	0.55	0.00	0.52	0.45	0.09	0.11	0.36
	Food=Cash+food	0.66	0.43	0.25	0.73	0.12	0.23	0.51	0.76	1.00	0.02	0.36	0.21	0.11	0.93	0.64
	Cash=Food	0.25	0.28	0.11	0.23	0.69	0.98	0.26	0.39	0.55	0.30	0.85	0.74	0.84	0.15	0.19

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Each column shows an outcome indicator that a household may be deprived in. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children.

Table A6 Impact of treatment on outcome indicators - Extended model

		FCS	Per aeu calorie	HHS	MDD-W	Under nutrition	MDD-C	Mobility	Control resources	Decision making	Child education	Housing condition	Assets	Sanitation	Drinking water	Cooking fuel
North	Cash	-0.19	-0.04	-0.04	-0.03	0.01	0.00	0.01	0.02	0.02	-0.01	-0.05	-0.02	-0.01	-0.00	-0.01
		(0.04)***	(0.03)	(0.02)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.00)**
	Food	-0.28	-0.06	-0.07	-0.10	-0.01	-0.06	-0.00	-0.02	-0.04	0.00	0.03	-0.00	0.00	-0.01	-0.00
		(0.03)***	(0.03)**	(0.02)***	(0.03)***	(0.03)	(0.03)*	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.00)
	Cash+food	-0.23	-0.06	-0.04	-0.12	0.02	-0.03	0.01	0.03	-0.01	0.02	-0.04	-0.03	0.01	0.01	-0.01
		(0.04)***	(0.03)**	(0.02)**	(0.03)***	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)	(0.01)**
	Cash+BCC	-0.45	-0.13	-0.09	-0.48	-0.04	-0.41	-0.08	-0.04	-0.04	0.01	-0.13	-0.04	-0.13	-0.00	-0.02
		(0.03)***	(0.03)***	(0.02)***	(0.03)***	(0.03)	(0.03)***	(0.04)*	(0.04)	(0.03)	(0.02)	(0.04)***	(0.02)**	(0.04)***	(0.01)	(0.01)**
	R^2	0.15	0.03	0.04	0.14	0.16	0.13	0.02	0.03	0.05	0.14	0.24	0.21	0.03	0.01	0.01
	N	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393	2,393
	P-values:															
	Cash=Cash+BCC	0.00	0.00	0.00	0.00	0.10	0.00	0.02	0.14	0.05	0.46	0.06	0.29	0.00	0.69	0.36
	Food=Cash+BCC	0.00	0.01	0.10	0.00	0.31	0.00	0.06	0.58	0.93	0.83	0.00	0.03	0.00	0.51	0.11
	Cash+food=Cash+BCC	0.00	0.00	0.00	0.00	0.08	0.00	0.04	0.12	0.27	0.43	0.04	0.53	0.00	0.22	0.96
	Cash=Cash+food	0.30	0.41	0.78	0.00	0.81	0.31	0.91	0.86	0.34	0.10	0.84	0.64	0.69	0.37	0.40
	Food=Cash+food	0.11	0.99	0.02	0.57	0.30	0.33	0.76	0.30	0.21	0.30	0.10	0.18	0.87	0.05	0.12
	Cash=Food	0.00	0.42	0.03	0.02	0.40	0.04	0.65	0.36	0.03	0.61	0.06	0.47	0.79	0.24	0.41
South	Cash	-0.09	-0.08	-0.04	-0.06	-0.03	-0.07	-0.01	-0.09	0.03	0.05	-0.05	-0.03	-0.09	0.02	-0.01
		(0.02)***	(0.03)***	(0.02)**	(0.03)*	(0.03)	(0.04)*	(0.03)	(0.03)***	(0.03)	(0.02)**	(0.04)	(0.02)	(0.05)*	(0.04)	(0.01)
	Food	-0.11	-0.04	-0.06	-0.10	-0.02	-0.06	-0.04	-0.06	0.01	0.02	-0.04	-0.03	-0.07	-0.03	0.00
		(0.02)***	(0.03)	(0.02)***	(0.04)***	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.05)	(0.03)	(0.00)
	Cash+food	-0.10	-0.07	-0.05	-0.09	-0.06	-0.11	-0.02	-0.08	-0.00	-0.01	-0.07	-0.05	0.00	-0.04	-0.00
		(0.02)***	(0.03)**	(0.01)***	(0.04)**	(0.03)**	(0.04)***	(0.03)	(0.04)**	(0.03)	(0.02)	(0.03)**	(0.02)***	(0.05)	(0.03)	(0.00)
	Food+BCC	-0.18	-0.11	-0.06	-0.28	-0.05	-0.33	-0.06	-0.09	-0.01	0.01	-0.05	-0.04	-0.03	-0.02	-0.00
		(0.02)***	(0.03)***	(0.01)***	(0.04)***	(0.03)	(0.04)***	(0.03)**	(0.04)**	(0.03)	(0.02)	(0.04)	(0.02)*	(0.05)	(0.04)	(0.00)
	R^2	0.08	0.04	0.05	0.05	0.16	0.07	0.05	0.04	0.07	0.18	0.28	0.14	0.02	0.23	0.01
	N	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420	2,420
	P-values:															
	Cash=Food+BCC	0.00	0.23	0.07	0.00	0.61	0.00	0.10	0.85	0.18	0.05	0.83	0.93	0.21	0.23	0.62
	Food=Food+BCC	0.00	0.03	0.98	0.00	0.39	0.00	0.45	0.41	0.54	0.37	0.84	0.84	0.32	0.78	0.34
	Cash+food=Food+BCC	0.00	0.18	0.10	0.00	0.80	0.00	0.24	0.77	0.83	0.30	0.41	0.40	0.45	0.69	0.62
	Cash=Cash+food	0.54	0.85	0.63	0.44	0.40	0.30	0.61	0.62	0.23	0.01	0.59	0.42	0.05	0.10	0.37
	Food=Cash+food	0.70	0.37	0.14	0.79	0.22	0.25	0.72	0.60	0.68	0.07	0.30	0.30	0.07	0.92	0.64
	Cash=Food	0.32	0.26	0.09	0.28	0.73	0.89	0.40	0.29	0.44	0.32	0.68	0.93	0.74	0.14	0.18

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Each column shows an outcome indicator that a household may be deprived in. Estimations control for baseline outcome variable and the following covariates - age and years of education of household head, whether the household is female headed, number of children 0-5 years, and household expenditure quintiles. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children.

Table A7 Heterogeneity of treatment effect on calorie intake

	Log adult equivalized calorie intake	
	North	South
Cash	0.00	0.08
	(0.05)	(0.05)
Food	0.09	0.11
	(0.05)*	(0.04)**
Cash+food	0.06	0.08
	(0.04)	(0.05)*
Cash+BCC	0.13	
	(0.05)***	
Food+BCC		0.13
		(0.05)**
High calorie intake*Cash	0.08	-0.06
	(0.06)	(0.06)
High calorie intake*Food	0.01	-0.09
	(0.05)	(0.05)*
High calorie intake*Cash+food	0.03	-0.02
	(0.05)	(0.05)
High calorie intake*Cash+BCC	0.04	
	(0.05)	
High calorie intake*Food+BCC		-0.04
		(0.05)
High calorie intake (>2,122kcal)	0.00	0.11
	(0.04)	(0.04)***
R^2	0.04	0.03
N	2,395	2,425
P-values:		
Cash=Cash+BCC	0.01	
Food=Cash+BCC	0.32	
Cash+food=Cash+BCC	0.07	
Cash=Cash+food	0.17	0.99
Food=Cash+food	0.50	0.56
Cash=Food	0.08	0.61
Cash=Food+BCC		0.40
Food=Food+BCC		0.67
Cash+food=Food+BCC		0.35

Standard errors in parenthesis clustered at the village level. * $p<0.1$ ** $p<0.05$; *** $p<0.01$. Estimations control for baseline outcome variable. p-values reported from Wald tests of equality of coefficients of the treatment variables. BCC - (high quality nutrition) behavioral change communication.

Table A8 Heterogenous effects of treatment on outcome indicators by baseline poverty status ($k = 50$)

		FCS	Per aeu calorie	HHS	MDD-W	Under nutrition	MDD-C	Mobility	Control resources	Decision making	Child education	Housing condition	Assets	Sanitation	Drinking water	Cooking fuel
North	Cash only	-0.13	0.00	-0.00	0.00	-0.11	0.07	0.04	0.02	0.03	-0.00	-0.03	-0.03	-0.02	-0.01	-0.01
		(0.06)**	(0.05)	(0.02)	(0.06)	(0.06)**	(0.06)	(0.06)	(0.06)	(0.06)	(0.03)	(0.06)	(0.05)	(0.05)	(0.01)	(0.01)
	Food only	-0.22	0.01	-0.02	-0.10	-0.01	-0.07	-0.07	-0.09	-0.08	0.03	0.06	0.03	-0.01	0.00	-0.00
		(0.05)***	(0.06)	(0.02)	(0.06)*	(0.05)	(0.07)	(0.06)	(0.07)	(0.05)	(0.03)	(0.06)	(0.04)	(0.06)	(0.01)	(0.00)
	Cash+food	-0.15	-0.03	-0.03	-0.10	0.01	-0.00	0.00	0.03	-0.02	0.03	-0.04	-0.04	0.05	0.00	-0.03
		(0.05)***	(0.05)	(0.02)	(0.06)	(0.05)	(0.07)	(0.06)	(0.07)	(0.05)	(0.03)	(0.06)	(0.04)	(0.05)	(0.01)	(0.01)**
	Cash+BCC	-0.33	-0.12	-0.05	-0.43	-0.08	-0.42	-0.08	-0.03	-0.06	0.01	-0.03	-0.02	-0.11	0.01	-0.01
		(0.04)***	(0.04)**	(0.02)***	(0.05)***	(0.05)	(0.06)***	(0.07)	(0.06)	(0.05)	(0.03)	(0.06)	(0.04)	(0.06)*	(0.01)	(0.01)
	Poor*Cash	-0.10	-0.06	-0.06	-0.04	0.17	-0.10	-0.04	-0.00	-0.02	-0.01	-0.03	0.02	0.01	0.01	0.01
		(0.07)	(0.06)	(0.03)*	(0.06)	(0.07)***	(0.07)	(0.07)	(0.07)	(0.07)	(0.03)	(0.06)	(0.05)	(0.05)	(0.01)	(0.01)
	Poor*Food	-0.09	-0.10	-0.08	-0.00	0.00	0.00	0.09	0.09	0.04	-0.04	-0.03	-0.06	0.01	-0.01	-0.01
		(0.06)	(0.06)	(0.03)***	(0.07)	(0.06)	(0.08)	(0.07)	(0.07)	(0.06)	(0.03)	(0.06)	(0.04)	(0.06)	(0.01)	(0.00)
	Poor*Cash+food	-0.11	-0.05	-0.02	-0.03	0.01	-0.03	0.00	-0.01	0.01	-0.00	-0.00	0.02	-0.05	0.01	0.02
		(0.06)*	(0.06)	(0.03)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)	(0.03)	(0.06)	(0.04)	(0.05)	(0.02)	(0.01)
	Poor*Cash+BCC	-0.17	-0.03	-0.06	-0.08	0.06	0.01	0.00	-0.03	0.02	0.01	-0.15	-0.03	-0.02	-0.02	-0.01
		(0.05)***	(0.05)	(0.03)**	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)	(0.04)	(0.06)**	(0.05)	(0.06)	(0.02)	(0.01)
	Baseline poverty status	0.14	0.02	0.06	0.11	-0.05	0.08	0.02	-0.03	-0.02	0.02	0.04	0.03	0.04	0.02	0.00
	(poor=1)	(0.05)***	(0.04)	(0.03)**	(0.05)**	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)	(0.02)	(0.04)	(0.03)	(0.03)	(0.01)	(0.00)
	R^2	0.13	0.02	0.05	0.13	0.15	0.12	0.01	0.02	0.01	0.08	0.23	0.20	0.02	0.01	0.01
	N	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395	2,395
South	Cash only	-0.04	-0.04	-0.02	-0.12	-0.04	-0.06	0.03	-0.04	0.06	0.07	-0.01	-0.04	-0.06	0.02	-0.00
		(0.03)	(0.04)	(0.02)	(0.05)**	(0.05)	(0.06)	(0.06)	(0.05)	(0.04)	(0.03)*	(0.05)	(0.03)	(0.07)	(0.03)	(0.01)
	Food only	-0.05	-0.01	-0.04	-0.07	-0.06	-0.03	-0.03	-0.02	0.02	0.03	-0.01	-0.03	-0.03	0.00	-0.00
		(0.03)	(0.04)	(0.01)***	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.04)	(0.03)	(0.05)	(0.03)	(0.06)	(0.03)	(0.01)
	Cash+food	-0.06	-0.05	-0.02	-0.10	-0.08	-0.13	0.03	0.03	0.05	-0.02	-0.08	-0.04	-0.02	-0.04	0.00
		(0.03)*	(0.04)	(0.01)*	(0.05)**	(0.05)*	(0.06)**	(0.05)	(0.05)	(0.04)	(0.02)	(0.05)	(0.03)	(0.06)	(0.03)	(0.01)
	Food+BCC	-0.11	-0.06	-0.03	-0.23	-0.08	-0.27	-0.02	-0.03	-0.01	-0.00	-0.01	-0.04	0.02	-0.02	-0.01
		(0.03)***	(0.04)	(0.01)**	(0.05)***	(0.05)	(0.05)***	(0.05)	(0.05)	(0.04)	(0.03)	(0.05)	(0.03)	(0.06)	(0.03)	(0.01)
	Poor*Cash	-0.07	-0.07	-0.04	0.10	0.02	0.00	-0.06	-0.08	-0.06	-0.02	-0.07	0.01	-0.03	-0.01	-0.01
		(0.05)	(0.05)	(0.03)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.05)	(0.06)	(0.04)	(0.07)	(0.05)	(0.01)
	Poor*Food	-0.11	-0.06	-0.04	-0.05	0.06	-0.05	-0.01	-0.06	-0.02	-0.01	-0.06	-0.00	-0.07	-0.06	0.01
		(0.05)**	(0.05)	(0.02)*	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)	(0.06)	(0.04)	(0.06)	(0.04)	(0.07)	(0.05)	(0.01)
	Poor*Cash+food	-0.08	-0.03	-0.04	0.04	0.03	0.05	-0.09	-0.16	-0.07	0.01	0.02	-0.03	0.04	0.01	-0.00
		(0.04)*	(0.05)	(0.02)*	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)**	(0.06)	(0.04)	(0.05)	(0.04)	(0.07)	(0.05)	(0.01)
	Poor*Food+BCC	-0.13	-0.09	-0.05	-0.09	0.06	-0.12	-0.06	-0.09	0.02	0.01	-0.05	0.00	-0.09	-0.01	0.01
		(0.04)***	(0.05)*	(0.02)**	(0.06)	(0.07)	(0.06)*	(0.07)	(0.06)	(0.06)	(0.04)	(0.05)	(0.04)	(0.07)	(0.06)	(0.01)
	Baseline poverty status	0.10	0.05	0.05	0.07	-0.05	0.06	0.09	0.17	0.00	0.02	0.13	-0.00	0.06	0.03	0.00
	(poor=1)	(0.04)***	(0.03)	(0.02)**	(0.05)	(0.05)	(0.05)	(0.05)*	(0.04)***	(0.04)	(0.03)	(0.04)***	(0.03)	(0.05)	(0.04)	(0.01)
	R^2	0.07	0.02	0.04	0.06	0.15	0.06	0.01	0.02	0.01	0.13	0.26	0.12	0.01	0.22	0.00
	N	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425

Standard errors in parenthesis clustered at the village level. * p<0.1 ** p<0.05; *** p<0.01. Each column shows an outcome indicator that a household may be deprived in. BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children.

Table A9 Corrected p-values for multiple hypothesis testing

		p value	BKY (2006) q value	BH (1995) q value	p value	BKY (2006) q value	BH (1995) q value
		North			South		
FCS	Cash	0.00	0.00	0.00	0.00	0.00	0.00
	Food	0.00	0.00	0.00	0.00	0.00	0.00
	Cash+food	0.00	0.00	0.00	0.00	0.00	0.00
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
Per aeu calorie intake	Cash	0.19	0.22	0.32	0.01	0.01	0.02
	Food	0.04	0.07	0.09	0.17	0.14	0.25
	Cash+food	0.03	0.05	0.07	0.02	0.02	0.03
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
HHS	Cash	0.02	0.04	0.06	0.01	0.02	0.03
	Food	0.00	0.00	0.00	0.00	0.00	0.00
	Cash+food	0.05	0.09	0.13	0.00	0.00	0.00
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
MDD-W	Cash	0.36	0.32	0.51	0.07	0.07	0.13
	Food	0.00	0.01	0.01	0.01	0.01	0.02
	Cash+food	0.00	0.00	0.00	0.01	0.02	0.03
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
Under nutrition	Cash	0.75	0.49	0.84	0.29	0.19	0.37
	Food	0.67	0.46	0.78	0.50	0.27	0.59
	Cash+food	0.50	0.41	0.68	0.02	0.03	0.05
	Cash/Food+BCC	0.20	0.22	0.32	0.11	0.10	0.18
MDD-C	Cash	1.00	0.61	1.00	0.11	0.10	0.18
	Food	0.08	0.12	0.17	0.12	0.10	0.19
	Cash+food	0.55	0.44	0.71	0.00	0.01	0.01
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
Mobility	Cash	0.67	0.46	0.78	0.95	0.38	0.97
	Food	0.80	0.51	0.86	0.25	0.18	0.34
	Cash+food	0.87	0.56	0.91	0.60	0.29	0.67
	Cash/Food+BCC	0.05	0.08	0.12	0.08	0.08	0.15
Control resources	Cash	0.77	0.50	0.85	0.01	0.02	0.03
	Food	0.55	0.44	0.71	0.14	0.12	0.22
	Cash+food	0.62	0.46	0.75	0.06	0.07	0.12
	Cash/Food+BCC	0.27	0.27	0.42	0.03	0.03	0.06
Decision making	Cash	0.71	0.48	0.80	0.31	0.20	0.39
	Food	0.10	0.14	0.21	0.64	0.31	0.70
	Cash+food	0.54	0.44	0.71	0.66	0.31	0.71
	Cash/Food+BCC	0.13	0.17	0.24	0.96	0.38	0.97
Child education	Cash	0.58	0.45	0.73	0.04	0.04	0.07
	Food	0.91	0.57	0.95	0.21	0.15	0.29
	Cash+food	0.12	0.16	0.24	0.53	0.28	0.62
	Cash/Food+BCC	0.61	0.45	0.75	0.96	0.38	0.97
Housing condition	Cash	0.22	0.25	0.36	0.19	0.15	0.27
	Food	0.40	0.35	0.56	0.29	0.19	0.37
	Cash+food	0.32	0.31	0.47	0.04	0.05	0.09
	Cash/Food+BCC	0.00	0.01	0.01	0.27	0.18	0.35
Assets	Cash	0.33	0.31	0.47	0.15	0.12	0.23
	Food	0.67	0.46	0.78	0.19	0.15	0.27
	Cash+food	0.12	0.16	0.24	0.01	0.02	0.02
	Cash/Food+BCC	0.02	0.04	0.05	0.11	0.10	0.18
Sanitation	Cash	0.83	0.54	0.89	0.09	0.09	0.16
	Food	0.97	0.60	0.98	0.11	0.10	0.18
	Cash+food	0.78	0.50	0.85	0.93	0.38	0.97
	Cash/Food+BCC	0.00	0.01	0.01	0.54	0.28	0.62
Drinking water	Cash	0.96	0.60	0.98	0.70	0.33	0.75
	Food	0.26	0.26	0.42	0.36	0.22	0.44
	Cash+food	0.41	0.35	0.56	0.32	0.20	0.40
	Cash/Food+BCC	0.63	0.46	0.75	0.56	0.28	0.64
Cooking fuel	Cash	0.04	0.07	0.09	0.20	0.15	0.27
	Food	0.15	0.18	0.26	0.99	0.40	0.99
	Cash+food	0.01	0.03	0.04	0.65	0.31	0.70
	Cash/Food+BCC	0.01	0.03	0.04	0.40	0.22	0.48
NMPI incidence (H), k=25	Cash	0.56	0.44	0.72	0.09	0.08	0.15
	Food	0.00	0.01	0.01	0.24	0.18	0.33
	Cash+food	0.10	0.14	0.21	0.08	0.08	0.14
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
NMPI incidence (H), k=50	Cash	0.15	0.18	0.26	0.01	0.02	0.03
	Food	0.00	0.00	0.00	0.00	0.01	0.01
	Cash+food	0.01	0.03	0.04	0.00	0.00	0.00
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
NMPI incidence (H), k=75	Cash	0.15	0.18	0.26	0.00	0.01	0.01
	Food	0.10	0.14	0.21	0.01	0.02	0.03
	Cash+food	0.31	0.30	0.47	0.00	0.01	0.01

		p value	BKY (2006) q value	BH (1995) q value	p value	BKY (2006) q value	BH (1995) q value
		North			South		
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
NMPI adjusted	Cash	0.08	0.12	0.17	0.01	0.02	0.03
headcount ratio,	Food	0.00	0.00	0.00	0.00	0.01	0.01
k=25	Cash+food	0.01	0.03	0.04	0.00	0.00	0.00
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
NMPI adjusted	Cash	0.10	0.14	0.21	0.01	0.02	0.02
headcount ratio,	Food	0.00	0.00	0.00	0.00	0.00	0.00
k=50	Cash+food	0.01	0.03	0.04	0.00	0.00	0.00
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00
NMPI adjusted	Cash	0.18	0.21	0.31	0.00	0.01	0.01
headcount ratio,	Food	0.09	0.14	0.20	0.01	0.02	0.02
k=75	Cash+food	0.30	0.29	0.46	0.00	0.01	0.01
	Cash/Food+BCC	0.00	0.00	0.00	0.00	0.00	0.00

BCC - (high quality nutrition) behavioral change communication. FCS – Food consumption score; HHS- Household Hunger Scale; MDD-W – Minimum Diet Diversity for women; MDD-C - Minimum Diet Diversity of children. Cash+BCC for North and Food+BCC for South. p-value presents uncorrected p-values from regressions. BKY (2006) - Benjamini, Krieger, and Yekutieli (2006); BH (1995) - Benjamini and Hochberg (1995).