# The Roles of Knowledge and Food Vouchers in Improving Child Nutrition*

Yaeeun Han[†], Hyuncheol Bryant Kim[‡], and Seollee Park[§]

November 2019

## Abstract

Mother's lack of knowledge about child nutrition and limited resources lead to poor diets among children in developing countries, increasing their risk of chronic undernutrition. We implemented a cluster randomized control trial that randomly provides Behavior Change Communication (BCC) and food vouchers in Ethiopia. We find an increase in child diet quality and a reduction in chronic child undernutrition only when BCC and vouchers are provided together. BCC or voucher alone had limited impacts. We also find substantial knowledge spillovers to untreated new mothers, implying sustainable impacts of BCC in the community.

Keywords: infant and child nutrition, health information, behavior change communication, food vouchers, randomized control trial, Ethiopia

*JEL* classification: I12, I26, J22, O12, O15

*We wish to thank John Hoddinott, David Just, Kyoungwoo Lee, and seminar participants at Cornell University for their invaluable feedback. We also thank Jieun Kim, Yong Hyun Nam, Dohyeong Kim, Bewuketu Assefa, Banchayew Asres, Betelhem Muleta, Tizita Bayisa, Dechassa Abebe, Minah Kim, Hyolim Kang, Jiwon Baek, Tembi Williams, Soo Sun You, Jeong Hyun Oh, Jiyeong Lee, Tae Jun Yoon, Hocheol Lee, Hyeli Lee, A-ra Ko, Bo Ram Sim, Seung Woo Nam, YoungKeun Loh, and YeonHee Kim for their excellent fieldwork, and Rahel Getachew, Chulsoo Kim, Hongryang Moon at Myungsung Christian Medical Center and Eun Woo Nam at Yonsei University for their support. This project was supported by Africa Future Foundation, Korea Foundation for International Healthcare (KOFIH), Seoul Women's Hospital, and Dr. Taehoon Kim. All views expressed are ours, and all errors are our own. The study was approved by ethical review committees at the Oromia Health Bureau (Ethiopia, BEIO/AHBHN/1-8/2670), Myungsung Medical College (Ethiopia), and Cornell University (USA, 1612006823).

[†]Division of Nutritional Sciences, Cornell University, yh296@cornell.edu

[‡]Department of Policy Analysis and Management, Cornell University, hk788@cornell.edu

[§]Harvard T.H. Chan School of Public Health, seolleepark@hsph.harvard.edu

# 1. Introduction

In developing countries, nutritional status is a critical component of health, especially for children under the age of two (Schwarzenberg et al. 2018). Child undernutrition is linked to nearly half of all deaths in children under five and affects more than 150 million young children (World Bank 2017). This is an important challenge for economic development because it leads to poorer health, education, and labor outcomes in adulthood (E. Black et al. 2008; Hoddinott, Behrman, et al. 2013).

Drawing from the large literature on the causes of chronic child undernutrition[1], many interventions have focused on addressing a single cause of undernutrition such as micronutrient deficiencies (Muller et al. 2003; der Merwe et al. 2013), lack of knowledge (Fitzsimons et al. 2016), and lack of income (Manley et al. 2013), but often found limited impact. Moreover, it is estimated that the summed impact of ten single-dimensional nutrition-specific interventions, scaled up to nearly full coverage, would reduce chronic child undernutrition by only 20% (Bhutta et al. 2013). This modest impact could be due to the single-dimensional approach that most interventions take, despite the multifaceted and interdependent causes of undernutrition. To illustrate, nutrition education might have limited impact if low level of income hinders knowledge application. On the other hand, impacts of transfer programs could be limited if lack of information is a binding constraint.

Despite the conceptual and instrumental importance of combining education with transfer programs, many do not have an educational component. In-kind and cash transfers, with improving nutritional status being one of their core aims, reach more than 1 billion people worldwide (Fiszbein et al. 2014; Alderman et al. 2018). Yet, the largest of such transfer programs including the Public Distribution System in India and the *Bolsa Familia* program in Brazil lack an effective educational component, even though its end goal is to improve diet quality (Alderman et al. 2018; Paes-Sousa et al. 2011). Moreover, nutrition-related messaging, where provided, is often delivered ineffectively, limiting its ability to affect behaviors

[1]The high prevalence of chronic child undernutrition could be explained by poor nutritional knowledge (Paul et al. 2011), low income (Smith and Haddad 2002), poor quality diets and food systems (Headey et al. 2012), genetic predispositions (Nube 2009), intrahousehold biases (Jayachandran and Pande 2017), low status of women (Schroff et al. 2009), and the inefficacy of nutritional programs and strategies (World Bank 2006).

(Rivera et al. 2019). Therefore, given the evidence on the limited impact of transfers on child nutrition (Manley et al. 2013), it seems crucial to couple transfers with nutrition education, and to test its effectiveness against standalone programs.

In this paper, we study the roles of knowledge and affordability in changing mothers' child-feeding practices, key barriers to improved child-feeding practices. We also study whether the effects of the knowledge intervention can be sustained in the treated villages even after intervention completion. To do so, we designed and implemented a community-based cluster randomized experiment in Ethiopia that provides nutrition education in the form of behavioral change communication (BCC) and food vouchers in collaboration with Africa Future Foundation (AFF), an international NGO focused on health and education programs in sub-Saharan Africa. Specifically, we randomly provided four-month-long BCC (*BCC*), voucher (*Voucher*), and both BCC and voucher (*BCC+Voucher*) interventions for mothers with one or more children between four and 20 months of age. This age range is important because stunting prevalence increases rapidly after the first six months as shown in Figure A1, which is when complementary feeding should start.[2] Thus, adopting healthy child-feeding practices during the transitional period from exclusive breastfeeding to complementary feeding is particularly crucial for preventing undernutrition (R. Black et al. 2013; Jones et al. 2003; Ruel et al. 2013).[3]

We find large impact of *BCC+Voucher*, limited impact of *BCC*, and no impact of *Voucher* on child-feeding behaviors. *BCC* improves maternal nutritional knowledge, children's diet quality, and increase purchase of more diverse food to some extent. However, these moderate improvements in child-feeding behaviors do not effectively lead to undernutrition reduction. As for the *Voucher* group, we find no effect on nutritional knowledge, child-feeding behaviors, and child growth. However, *BCC+Voucher* considerably augments the positive impacts on nutritional knowledge, child-feeding behaviors. We also find sug-

[2]Stunting prevalence is relatively low before six month from birth, but after six month from birth exclusive breastfeeding no longer meets the energy and nutrients needed for rapid child growth (R. Black et al. 2013; Cunningham et al. 1991; Dewey et al. 1995; Beaudry et al. 1995).

[3]Appropriate complementary feeding means feeding children a diverse diet that meets the nutritional requirements. This entails feeding vitamin A-rich fruits and vegetables daily, in addition to a range of other fruits and vegetables. Meat, poultry, fish, or eggs also need to be consumed daily to ensure the intake of certain micronutrients critical for growth found only in animal source foods. In this regard, healthy food in this paper refers to these food groups (WHO 2010).

gestive evidence for stunting reduction in this group. These impacts, if any, are driven by the prevention of the stunting for those who were in the lower tail of the height-for-age distribution, rather than recovering stunted growth.

In addition, we examine whether knowledge from BCC could be sustained in the community. We find that untreated mothers of younger children who have a friend assigned to the BCC intervention are more likely to have better nutritional knowledge. The magnitude of this spillover knowledge gain is more than two-thirds of the increase among BCC participants. This demonstrates the potential of the BCC program for spreading and sustaining the impact of the BCC program to future mothers within the community.

Our results render important policy implications. For social protection or nutrition programs aiming to reduce child undernutrition, providing nutrition education and food voucher simultaneously could be more effective than single interventions. In addition, when implementing programs similar to *BCC+Voucher*, it may be best to target all infant and young children in the critical age range of 6 to 18 months, rather than targeting only the already undernourished children because *BCC+Voucher* is particularly effective in preventing stunting from occurring in this age range rather than reversing it. Lastly, when estimating the cost-effectiveness of development programs and assessing their sustainability, it is important to consider their impacts on not only the direct participants but also non-participants who may also indirectly be affected through spillovers.

This research contributes to several strands of literature. First, we contribute to the growing literature on the effectiveness of multifaceted programs on addressing multiple causes of poverty simultaneously. Many studies with effective multi-pronged interventions do not have a factorial design, and thus, are unable to establish complementarity (Banerjee et al. 2015; Bandiera et al. 2017). Even though complementarity may exist theoretically, there are only a few studies that empirically test it in child nutrition. For example, two studies show that a program that integrates a water, sanitation, and hygiene (WASH) intervention with nutrition supplements may not necessarily have complementary effects on diarrhea and child growth (Luby et al. 2018; Null et al. 2018). To our knowledge, this study is the first study to examine the combined effects of both nutrition education and vouchers and experimentally establish their complementarity.

Second, it also contributes to the empirical literature on the effects of single intervention programs to improve child-feeding practices and child nutrition such as nutrition education and income support. Our study is also unique in that we can directly compare nutrition education and transfers in the same setting. Recent experimental studies on BCC conducted in Bangladesh and Burkina Faso have provided causal evidence on the effectiveness of nutrition education programs on improving nutritional knowledge among caregivers and neighbors, feeding practices, and nutritional outcomes (Fitzsimons et al. 2016; Hoddinott, A. Ahmed, et al. 2018; Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015; Zongrone et al. 2018). Our study adds to the literature by showing that relatively short-term and cost-effective BCC program could also lead to better child nutrition.[4] On the other hand, we find that food vouchers without any educational component has no effect on child nutrition. This is in line with a meta-analysis examining 21 papers on 17 programs which finds that cash transfers have a positive but small and not statistically significant impact on child height (Manley et al. 2013).

Third, we add to the literature on intervention sustainability by estimating knowledge spillover to nontreated peers in the community. The idea that a one-time intervention could have a lasting effect on the community has increased the focus on sustainability in a wide array of development interventions. Some studies find this difficult to attain. For example, people were less likely to take up deworming drugs if their contacts were exposed to deworming (Kremer and Miguel 2007). On the other hand, a study in India finds that a mobile phone-based agricultural extension program had positive impacts on non-intervention farmers who had close ties to those in the intervention group (Cole and Fernando 2018). In addition, Hoddinott et al. (2017) provide some evidence that a BCC intervention in Bangladesh could increase knowledge on child-feeding practices among neighboring non-participant mothers, suggesting potential knowledge spillovers. We take a more rigorous approach to this question by estimating the extent of knowledge spillovers to non-participating mothers using detailed friendship networks.

The remainder of this paper is organized as follows: Section 2 presents the study design

[4] Existing studies provide evidence on interventions that are long-term, mostly two years, which are often costly and difficult to implement at large scale (Fitzsimons et al. 2016; Hoddinott, A. Ahmed, et al. 2018; Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015; Zongrone et al. 2018).

and the interventions; Section 3 describes the data and sample characteristics; Section 4 sets out the methods; Section 5 presents the results; and Section 6 shows treatment sustainability. We discuss the results in Section 7 and conclude in Section 8.

# 2. Study Design and the Interventions

## 2.1. Study Context

Ethiopia is one of the least developed countries in the world with GDP per capita in 2017 of US$768 and the second most populous country in sub-Saharan Africa (World Bank 2017). Ethiopia is an appropriate setting for this study with significant child nutrition challenges. The prevalence of stunting in Ethiopia, an indicator for chronic undernutrition, was 38% among children under five (Ethiopia DHS 2016). Stunting prevalence increases rapidly after the first six months: at the age of six months, 16% of children were stunted in Ethiopia but the corresponding number increases to 47% by 24 months (Ethiopia DHS 2016). Low dietary diversity is particularly striking among young children in Ethiopia, with only 7% of children aged 6-23 months meeting the minimum acceptable dietary standards (Ethiopia DHS 2016).

Our study area is Ejere district (woreda) located in the Oromia region of central Ethiopia, approximately 50 km west of the capital, Addis Ababa. Ejere is primarily a rural district which is further subdivided into three urban and 27 rural wards (kebeles). Ejere has a population of around 112,000 spread over these 30 wards, who are predominantly engaged in mixed crop-livestock farming at a small scale. Most farmers engage in traditional practices of rain-fed subsistence agriculture.[5] In the Oromia region in which Ejere is located, stunting prevalence among children under 5 in the Oromia region is 37% and only 9% of children under 24 months meet the minimum acceptable dietary standards (Ethiopia DHS 2016).

[5]Through a series of focus group discussions and pilot-testing, we find that mothers in study area often believe that babies under 12 months should not be fed animal source foods. Also, it is common to give infants as old as nine months only thin gruel, with the misbelief that they are not able to digest solid or semi-solid food. The widely available and inexpensive healthy food items in the area, such as mangos rich in vitamin A, are not well recognized.

## 2.2. Experimental Design

We implement a cluster randomized control trial that randomly provided nutrition BCC and food vouchers. Figure 1 summarizes the study design. The study area is three urban and three randomly selected rural wards out of 30 wards in Ejere (Figure A2). From these wards, we randomly selected 79 villages to be included in this study.[6] A total of 79 villages (garees) from these six wards in Ejere entered a lottery and were randomly selected into one of four arms: BCC only (*BCC*), vouchers only (*Voucher*), BCC and vouchers (*BCC+Voucher*), and the control group. Randomization was stratified by wards.

Through the census of the study area, we identified eligible mothers and children for this study. The eligibility criteria for the treatment and control groups is mothers with at least one child aged between 4 and 20 months living in the villages included in this study.[7] We also include pregnant women and women with children under 4 months in the same villages to study knowledge spillovers (spillover group). We found a total of 641 eligible mother and child pairs, all of which were included in the study for the treatment and control groups, and 344 mother and child pairs for the spillover group.[8] There are 101 (15), 96 (14), 154 (13), and 290 (37) mother and child pairs (villages) randomly assigned to the *BCC*, *Voucher*, *BCC+Voucher*, and control groups, respectively.[9] The corresponding numbers for the spillover group are 86, 54, 97, and 107 mother and child pairs, respectively.

[6]The six wards consisted of a total of 105 villages of which 79 villages were considered in this study as a part of a nested study design, and the remaining villages are considered in a separate study.

[7]As discussed in Section 1, we selected the age range between 4 and 20 months as the treatment eligibility criteria in order to target the age range that is most susceptible to undernutrition due to malpractices in child feeding. In particular, we seek to address chronic undernutrition caused by suboptimal practices in complementary feeding, which starts at 6 months of age.

[8]We initially planned a larger sample size with greater number of wards but ended up dropping dangerous wards in the initial phase of the study due to the political turmoil in the study area, during which more than 500 people are estimated to have been killed. See news report about the protest.

[9]To address the issue of small number of clusters, we use the wild-cluster bootstrap (Cameron et al. 2008) and randomization inference methods to obtain valid inference (Fisher 1966; Rosenbaum 2002; Small et al. 2008). We discuss it further in Section 4.

## 2.3. Interventions

***BCC.***[10] The BCC treatment was an interactive information intervention on infant and young child feeding (IYCF) complemented by various participatory learning methods including weekly sharing of mothers' experiences applying new IYCF activities, videos and visual aids, role-plays, and cooking sessions.[11] The BCC education is designed for a 16 week period to cover all of the key topics in IYCF while maximizing cost-effectiveness.[12] An overview of the BCC curriculum is provided in Appendix C. The focus of the BCC sessions was on the need to increase dietary diversity of children aged 6-23 months, with an emphasis on animal source foods and vitamin A-rich fruits and vegetables, appropriate feeding amounts and frequency, and feeding and caregiving practices. Each session ended with an action plan the mothers agreed upon, and the proceeding session reviewed and discussed past week's action plans. In addition, the BCC participants also received a small handbook containing a summary of IYCF contents and weekly action plans based on contents learned each week, and a self-check diary.

The BCC facilitators consisted of local female community workers who had been working in the community as AFF social workers for at least six months up to five years. All mothers who have a child from 4 to 20 months. Treated mothers living in the same village formed a group of seven to sixteen mothers to receive the BCC education. Each group had two designated facilitators—leader and helper. The lead facilitator taught the sessions and led discussions and role-plays, while supporting facilitator helped by encouraging discussion and assisting illiterate mothers. The sessions were conducted at the ward office or health

[10] BCC is the strategic use of communication to promote positive health outcomes, based on proven theories and models of behavior change. BCC employs a systematic process beginning with formative research and behavior analysis, followed by communication planning, implementation, and monitoring and evaluation. Audiences are carefully segmented, messages and materials are pre-tested, and mass media (which include radio, television, billboards, print material, internet), interpersonal channels (such as client-provider interaction, group presentations) and community mobilization are used to achieve defined behavioral objectives (MEASURE Evaluation 2018).

[11] The BCC program curriculum is developed based on the Alive & Thrive's BCC program implemented in Ethiopia. Alive & Thrive is an initiative to save lives, prevent illness, and ensure healthy growth and development through the promotion and support of optimal maternal nutrition, breastfeeding, and complementary feeding practices. Alive & Thrive has worked in Ethiopia since late 2009 to address widespread and limited recognition of the long-term consequences of stunting and find ways to reach mothers (Thrive 2018).

[12] Most existing studies evaluate 2-year-long BCC interventions which are difficult to implement at scale (Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015).

posts. Throughout the study, two supervisors randomly visited the BCC sessions for quality control. The supervisors also made home visits to mothers who missed more than two consecutive sessions to encourage attendance. The BCC facilitators, supervisors, and the study team had weekly group meetings to discuss progress and challenges.

***Food vouchers.*** The voucher treatment provided food vouchers of 200 ETB (approximately 10 USD) per month for four months to the household, which could be used at nearby markets.[13] Vouchers were given in denominations of 5, 10, and 20 ETB to facilitate small transactions, and were required to be redeemed within the expiration date (four weeks) noted in the voucher (Panel A of Figure A3). Food vouchers were redeemable for any kind of food items sold at the market including cereals, roots and tubers, fruits, vegetables, legumes, meat and fish, milk products, eggs, oil, sugar, and spices. All of these food groups were available in the weekly markets including dried meat. However, fresh meat was not available in the market but were sold in separate butcher shops or obtained from own or neighbor's livestock. Food vouchers were distributed every four weeks at the nearest market or at the participant's household if not picked up from the market. At the first disbursement, voucher recipients were provided detailed instructions on how to use the vouchers.

To prevent fraudulent transactions or transfers, study participants were required to present household photo IDs, provided by the study team, to redeem the vouchers, which were cross-checked by the merchants with the unique household ID number and names on the vouchers (Panel B of Figure A3).[14] On all market days of the study period, our voucher staff were stationed at the market to facilitate transactions and recorded voucher-based transactions.

[13]This amount is similar to the cash or food transfer amount of Ethiopia's Productive Safety Net Program which was set to be about 8.5 USD at the time of the program design (MOA 2014). We provide food vouchers instead of cash or food given evidence that food vouchers have been shown to be most effective in improving dietary diversity (Hidrobo et al. 2014).

[14]The vouchers and the IDs were stamped by the official AFF mark in blue in order to avoid duplicates.

# 3. Data

## 3.1. Data Sources

The primary data sources are (1) census data including household demographic and socioeconomic information, (2) the baseline and follow-up surveys, and (3) administrative data collected during the intervention including BCC attendance rates and voucher usage records. The timeline of the data collection and interventions is summarized in Figure A4.

AFF conducted a census of all households in 22 wards of Ejere in May-September 2016, covering approximately 22,000 households.[15] The census collected a variety of demographic, socioeconomic, and health variables such as the age of mother and children, marital status, education and employment, household asset, and birth history of the mother.

The baseline survey was conducted in April-August 2017 before the intervention program began. The follow-up survey was conducted upon program completion in December-March 2018, about 6 months after the baseline survey. Both the baseline and the follow-up questionnaires include detailed information on IYCF knowledge and practices, child food consumption, household food expenditures, health, gender, social networks, anthropometry, demographics, and socioeconomic information. The follow-up survey also has a section on the mothers' experience with the program.

During the baseline and follow-up surveys, we asked study participants to list up to ten closest friends (including relatives) living in the same ward.[16] Using this social network data, we construct BCC peer variables including whether the mother has any BCC-participating friend and the number of BCC-participating friends by cross-referencing the networks with BCC participants and vice versa.[17] At baseline, 55% of BCC treatment mothers and 36% of spillover group mothers had at least one BCC-participating friend, defined either by own

[15] Out of 30 wards in Ejere, 8 wards in the southern part of the district were excluded from the census due to security reasons. There were anti-government sentiments in this region during which more than 500 people are estimated to have been killed. See news report about the protest.

[16] Respondents listed, on average, 3 closest friends, and only 5 respondents hit the maximum ten closest friends.

[17] Network matching was done initially by matching phone numbers, then by matching the friends' names with survey respondent and spouse names using the similarity score generated by the 'matchit' command in Stata. Name matches with similarity score above 0.6, out of a range from 0 to 1, were manually compared across name, spouse name, sex, ward, and phone number to confirm the match. Manual confirmation was necessary due to inconsistent spelling of Amharic and Oromo names.

network or the other person's network at baseline.

In addition, our research team collected administrative data on BCC attendance and voucher usage during the intervention. Administrative data show that mothers attended the BCC sessions regularly (74% attendance rate). On voucher usage, the voucher staff collected information on the type of food item, the quantity bought, and the amount spent using the vouchers.[18] These data show that most of the voucher participants utilized the vouchers to buy food at least once (94%), and 88% of face value of the voucher had been redeemed (on average 175 out of 200 ETB).

## 3.2. Outcome Variables

The prespecified primary outcomes for this study are mother's IYCF knowledge scores and child dietary diversity score (CDDS).[19] The mother's IYCF knowledge score is the percentage of questions answered correctly out of 34 questions (Appendix D). The CDDS, an indicator of dietary quality, sums the number of distinct food groups consumed by the child in the past 24 hours.[20]

As secondary outcomes, we measure child anthropometry such as height-for-age Z scores (HAZ) and stunting as well as weight-for-height Z scores (WHZ) and wasting. We measured height and weight three times during each survey to minimize errors, and used the mean of the three measurements in the analysis. HAZ and WHZ are standardized Z scores relative to the WHO reference population. Stunting or wasting is a dummy variable equal to 1 if a child's HAZ or WHZ is 2 standard deviations (SDs) below the WHO reference population.[21]

[18]When voucher-holders visited the market, the voucher staff followed the voucher-holders to record each transaction they made.

[19]The main and secondary outcome variables considered in this study are pre-specified in the pre-analysis plan at AEA RCT Registry (Han et al. 2017).

[20]This measure is based on seven different food groups: cereals, roots, and tubers; legumes, nuts, and seeds; dairy products; meat/poultry and fish; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables (WHO 2010). Dietary diversity is a useful indicator for diet quality, as it is shown to be positively associated with mean micronutrient density adequacy (Working Group on Infant and Young Child Feeding Indicators, 2006).

[21]In the anthropometry analysis, we dropped extreme outlier observations that are considered to be biologically implausible values based on WHO recommendations (Organization 1995). We dropped 42 and 39 observations at baseline and follow-up, respectively, where HAZ is less than -5.0 or greater than 3.0, and 28 and 19 observations at baseline and follow-up, respectively, where WHZ is less than -4.0 or greater than 5.0. We also excluded 18 observations that recorded a negative growth of less than -3.0kg or -3.0cm.

We also introduced other measures of child-feeding practices. Minimum acceptable diet is an additional child diet quality and quantity measure which is created based on WHO guidelines assessing two different IYCF components compiled into one index adjusted for child's age: minimum dietary diversity and minimum meal frequency.[22] Minimum acceptable diet differs from CDDS in that it accounts for feeding frequency in addition to diversity and focuses on improvements in the lower tail of the distribution (WHO 2010). We also examine timely introduction of complementary food using a standardized score aggregating indicator variables for whether the child started eating a certain food after six months but before 12 months of age across eight different complementary food items.[23]

We also collect household-level information. First, we calculate household food expenditure which is a sum of spending on cereals, roots and tubers, nuts and legumes, fruits and vegetables, meat and poultry, eggs, milk and milk products, and spices and condiments in the past seven days. All values are converted to weekly per capita values. Second, we construct a food consumption score (FCS) which measures household diet quality in terms of both energy and diversity (Weismann et al. 2009).[24] FCS less than or equal to 35 is considered having poor to borderline consumption (WFP 2008).

## 3.3. Sample Characteristics and Randomization Balance

Table 1 presents the summary statistics for the whole sample (Column 2), the control group (Column 3), and the difference between each treatment groups and the control group

[22]Minimum dietary diversity is proportion of children who receive food from 4 or more food group, and minimum meal frequency is the proportion of children who consumed minimum number of meals appropriate for the age (WHO 2010). Minimum dietary diversity is a proxy for adequate micronutrient density of foods. The four food groups should come from a list of seven food groups: grains, roots, and tubers; legumes and nuts; dairy products (milk yogurt, cheese); flesh foods (meat, fish, poultry, and liver/organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables. Minimum meal frequency, a proxy for a child's energy requirements, examines the number of times children received foods other than breastmilk. The minimum number is specific to the age and breastfeeding status of the child (WHO 2010).

[23]This outcome measures how well mothers are doing in terms of introducing various complementary food to their children at appropriate ages—not too early as to incur digestive problems but not too late so that children are not undernourished. The complementary food items asked are water or other non-breastmilk liquids, solid or semi-solid food, meat, eggs, legumes, green vegetables, fruits, and snacks.

[24]The FCS is calculated by summing the number of days that the household consumed each of the eight food groups (staples, pulses, vegetables, fruit, meat and fish, milk and dairy, sugar and honey, oils and fats), multiplying the summed number of days by the food group's weighted frequencies, and summing these weighted scores across food groups.

(Columns 4-6) and between treatment groups (Columns 7-9). Panels A, B, and C present mother, child, and household characteristics at baseline, respectively. Mothers in our sample are, on average, 28 years old, 77% are Oromos, 84% are Orthodox Christians, 77% are married, 57% have work, 49% are able to read, 48% are able to write, have about 4 years of schooling, and the mean mother IYCF knowledge score is 21.5 out of 32 (67%). Mean age of the eligible child is approximately 12 months, the mean CDDS is 2.4, only 13% met the minimum acceptable diet at baseline, and the mean HAZ is -1.1 with a 27% stunting prevalence. At the household level, 14% are female-headed, average household size is 4.5, have approximately 2 children, and 45% are from rural areas. Average total weekly food expenditure per capita are approximately 132 ETB, with FCS of 43.

Columns 4 to 9 confirm that the randomization was successful, with the sample well balanced across treatment and control groups at baseline. Across 138 difference-in-means tests, only two differences are statistically significant at the 5% level, suggesting that the baseline characteristics are balanced overall.

As shown in Panel D, eligible mothers' attrition rate at the follow-up survey is 8.4%. Table 1 shows no significant difference in attrition rates across intervention groups. The attrition rate of follow-up child anthropometry is 18.9%. It is significantly different between the *Voucher* and the *BCC+Voucher* groups (Column 9), but this comparison is not the main focus of our analysis on anthropometry.

# 4. Conceptual Framework and Methods

## 4.1 Conceptual Framework

To help understand our results, we develop a simple conceptual model where households optimize child nutrition input choices given a child health production function and a budget constraint; where child health is a function of nutritional input and IYCF knowledge. Appendix B lays out the detailed model and the proof of the proposition.

We assume two different types of child health production function and compare the expected results. First, we present a general case where the $C$ and $K$ are imperfect complements, represented by a Cobb-Douglas child health production function. Alternatively, we illustrate a case where the child health inputs are highly interdependent with each other—i.e., the usage of knowledge is constrained by nutritional input and vice versa. This case is characterized by a perfect complementary relationship expressed by a Leontief child health production function.

The above two cases of child health production functions that assume a general relationships versus a (near) perfect complementary relationship between nutrition input, $C$, and knowledge, $K$, allow us to establish the following proposition:

**Proposition.** If $C$ and $K$ are imperfect complements, then $H^0 < H^V \lesseqgtr H^B < H^{BV}$. However, if $C$ and $K$ are (near) perfect complements, then $H^0 \backsimeq H^V \leq H^B < H^{BV}$.

where $H^0$, $H^V$, $H^B$, and $H^{BV}$ are child health outcomes in the control, *Voucher*, *BCC*, and *BCC+Voucher* groups, respectively.

The intuition is that if nutritional input and mothers' knowledge are imperfect complements for child health, then each of the single interventions will improve child nutritional outcomes to some extent, with the improvement in the *BCC+Voucher* group being the sum of the two separate effects. However, if nutritional input and mothers' knowledge are strong complements, then single interventions may not improve child health depending on the binding constraint. Child health improvements will be greatest for the *BCC+Voucher* group, with positive complementary effects of combining BCC and vouchers. Whether the first or the second case holds is ultimately an empirical issue, which we estimate using the methods below.

## 4.2 Methods

Our estimation strategy relies on the randomized design of the program, which provides a clean source of identification. Our basic treatment effects specification estimates the following equation:

$$y_{ijk1} = \beta_0 + \beta_1 BCC_{ijk} + \beta_2 Voucher_{ijk} + \beta_3 BCC\&Voucher_{ijk} + \beta_4 y_{ijk0} + \beta_5 X_{ijk} + \gamma_k + \varepsilon_{ijk}$$

where $y_{ijk}$ is the outcome of interest for household $i$ from village $j$ in ward $k$ at follow-up including mother's nutritional knowledge score, household food expenditures, nutrition indicators including CDDS, minimum acceptable diet, FCS, and child HAZ score. $BCC_{ijk}$ , $Voucher_{ijk}$ , and $BCC\&Voucher_{ijk}$ are dummy variables equal to one if the respondent was living in the *BCC*, *Voucher*, or the *BCC+Voucher* treatment villages, respectively, at baseline and zero otherwise. Hence, $\beta_1$ , $\beta_2$ , and $\beta_3$ represent the intent-to-treat estimators. $y_{ijk0}$ is the outcome of interest at baseline. $X_{ijk}$ is a control vector of household $i$ 's characteristics including demographic variables (mother's age, eligible child's age, marital status, household size, number of children, ethnicity, religion) and socioeconomic status (mother's literacy, years of schooling, employment status, and household assets). $\gamma_k$ is ward fixed effects. $\varepsilon_{ijk}$ is an error term and errors are clustered at the village level. We present results using the specification that includes the control vector, but the results are nearly identical when different specifications are used.[25] Also, the results are robust to other variations in the set of control variables (available upon request).

To address the issue of small number of clusters, we use the wild-cluster bootstrap (Cameron et al. 2008) and randomization inference methods to obtain valid inference (Rosenbaum 2002).[26] In each results table, we report clustered standard errors as well as the p-values computed using both the wild-bootstrap cluster procedure and randomization inference.

In order to account for multiple hypotheses testing (Christensen and Miguel 2018), we group child diet quality outcome measures into one domain and take an average standardized treatment effect for several outcome variables such as child diet quality and food consumption (Finkelstein et al. 2012; Kling et al. 2007).[27] We compute the average standardized treatment effect by stacking the data for the individual outcomes within the domain and estimating a single regression equation while clustering standard errors both at the village level and at

[25]The estimation and selection of the baseline controls follows Section 4 of the pre-analysis plan at AEA RCT Registry (AEARCTR-0002320, Han et al. 2017).

[26]We use the Stata command 'boottest' and 'ritest' to obtain the wild-cluster bootstrap and randomization inference p-values, respectively. In both procedures, we use 999 replications and the seed number 20000.

[27]We summarize multiple findings across related outcomes within a domain $J$ by the average standardized treatment effect: $\sum_{j\in J} \frac{1}{J}\frac{\rho_{1j}}{\sigma_j}$ where $\sigma_j$ is the SD of $y_j$ in the control group and $\rho_{1j}$ is the coefficient of interest for outcome $j$. In order to account for covariance in the estimates of $\frac{\rho_{1j}}{\sigma_j}$, we estimate pooled OLS for all outcomes $j \in J$.

the individual level.

# 5. Results

## 5.1. First Stage Outcomes: IYCF Knowledge and Voucher Redemption

### 5.1.1 BCC Attendance and IYCF Knowledge

We first show whether the BCC treatment successfully improved knowledge on IYCF. Table 2 presents the impacts on BCC attendance and mothers' IYCF knowledge. Column 1 of Table 2 compares the overall BCC attendance rates across treatment. Note that attendance rate for the *Voucher* group and the control group are zero as expected. On average, the *BCC* and the *BCC+Voucher* group have 73% and 75% attendance rates, respectively, and they are not statistically different from each other.

In Column 2, we find that attendance in the BCC sessions led to significant knowledge gains: 0.48 SDs and 0.42 SDs for the *BCC* and the *BCC+Voucher* groups, respectively.[28] This is comparable to other studies with longer intervention periods lasting up to two years (Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015). Hence, we show that a similar or greater impact on mothers' knowledge can be attained with a relatively short treatment length at least in the short run. However, receipt of the voucher alone has no such effect as expected. We cannot reject the null that the magnitudes of the impact of *BCC* and *BCC+Voucher* differs, suggesting that receiving vouchers in addition to the BCC intervention does not further increase knowledge gains.

### 5.1.2 Voucher Redemption

We also show results on voucher redemption using the voucher administrative data (Table 3).[29] Column 1 shows that both the *Voucher* and the *BCC+Voucher* groups spent, on average, 44 ETB worth of food vouchers per week, redeeming about 88% of the disbursed

[28] Attendance rate and knowledge scores by IYCF topic are presented in Table A1.

[29] The voucher redemption amount of the control group are zero as they did not receive vouchers, and the *BCC* group is not included in this analysis.

voucher amount. The total amount redeemed per week is not statistically different between the *Voucher* and the *BCC+Voucher* groups.

Columns 2-10 show that the food vouchers are spent on most food groups in similar amounts between *Voucher* and *BCC+Voucher*. While large amounts are spent on starchy staples and oils and fats, households allocate a third of their voucher spending on non-staple food including dairy products, eggs, fruits and vegetables, and nuts and legumes. This is consistent with the literature on income elasticity for nutrients suggesting that increased income leads to a preference for higher quality foods and more diversified non-staple diets (Bilal et al. 2013; Skoufias et al. 2011). Meat is not usually bought with vouchers, as they are usually not sold in the market but obtained from their own or neighbor's livestock. Voucher redemption patterns over time are front-loaded in any given month except for the first month, and voucher redemption by food group change little over time (Figures A5 and A6).

## 5.2. Child Diet Quality

We now look at effects on mothers' child-feeding behaviors reflecting the quality of children's diets. It is worth noting that the results on children's dietary intake based on mothers' reports are subject to social desirability bias or recall errors. Nevertheless, the comparisons between treatment arms—e.g., *BCC* and *BCC+Voucher*—are unlikely to be biased because the difference between the two groups would negate the bias which both groups are susceptible to. The results on child-feeding practices and household expenditures do not reflect the immediate, contemporaneous impacts of the treatments on food consumption, as these outcomes were measured at the follow-up survey implemented after one month from intervention completion.

We find that CDDS increased by 0.33 and 0.59 food groups in the *BCC* and *BCC+Voucher* group, respectively (Column 1 of Table 4), while there is no impact among the *Voucher* group. The results on minimum acceptable diet (Column 2) is similar to that of CDDS: the magnitude of the increase for the *BCC+Voucher* group is also almost double that of the *BCC* group. We also find that *BCC+Voucher* had the largest impact on minimum dietary diversity (Column 3) and the minimum acceptable diet (Column 4), while there are no statistically significant changes in the *BCC* and *Voucher* groups. In terms of standardized treatment effect, we find improvements in child diet quality for the *BCC* and *BCC+Voucher* groups by 0.04 SDs and 0.09 SDs, respectively, and the difference between two groups is statistically significant at the 5% level (Column 5). We also find evidence for complementarities between the voucher and BCC interventions. The impact of *BCC+Voucher* treatment is greater than the sum of the individual impacts of *BCC* and *Voucher* interventions, a difference that is statistically significant at the 10% level (Column 5).

These impacts are relatively larger compared to the results from existing literature where the length of BCC or nutrition education program is longer (Olney et al. 2015; Reinbott et al. 2016). For example, Olney et al. (2015) show that BCC combined with agriculture input support and training increases the proportion of children meeting minimum dietary diversity by 12.6 percentage points, but do not report results on other child diet quality measures. A similar study that evaluates the impact of a nutrition education program coupled with agricultural intervention finds a 9.0 and 9.3 percentage point increase in the proportion of children meeting the minimum dietary diversity and the minimum acceptable diet standards, respectively, but no effect on CDDS (Reinbott et al. 2016).

By examining child food consumption by food groups, we further explain that the greater improvements in diet quality in the *BCC+Voucher* group is driven by the consumption of animal source foods and vitamin A-rich fruits and vegetables (Table 5).[30] Among children in the *BCC* and *BCC+Voucher* groups, we find significant increases in children's consumption of food groups that the BCC program highlighted as important sources of micronutrients needed for healthy child growth (Column 5). Again, the impact size is considerably larger in the *BCC+Voucher* group compared to the *BCC* group.

We also find several interesting findings on other measures of children's diet quality (Table A2). First, we find that mothers in the *BCC* group breastfeed more frequently (Column 1), whereas mothers in the *Voucher* and *BCC+Voucher* groups feed (semi-)solid food more frequently (Column 2). Second, the impact size on timely introduction of complemen-

[30]The outcome variables in Table 5 are dummy variables indicating whether the eligible child ate any food item in the respective food group in the past 24 hours. The BCC program emphasized the importance of feeding animal products (Columns 1 to 3) and vitamin A-rich fruits and vegetables (Column 4). We present standardized treatment effects on these food groups in Column 5. Food groups in Columns 6 to 8 were not emphasized in the BCC program.

tary food for *BCC* and *BCC+Voucher* group is nearly the same, unlike the results of main child diet quality measures in Table 4. A possible explanation for this discrepancy is that there is relatively little or no cost to breastfeeding or adjusting the timing of introducing various foods compared to feeding solid food or increasing food diversity—i.e., income is not a binding constraint for these actions. Lastly, mothers in the *Voucher* group perceive that their children have better diet quality when, in fact, they do not (Column 4). This suggests that a lack of appropriate nutritional knowledge may lead to misconceptions about what constitutes a good diet for their children.

In addition, while our interventions focused on improving young children's diets, we also study *household-level* food consumption and expenditure after intervention completion. In Table A3, we find positive impacts of *BCC* and *BCC+Voucher* on diet quality at the household level, similar to child-level results (Table 5).[31] Also, in Table A4, we find that the changes in expenditures driven by the interventions remain even after the intervention ended. Column 1 shows positive coefficients on total food expenditures, though not statistically significant. In Columns 2-11, we find that *BCC+Voucher* continued to spend significantly more on healthy non-staple food than *BCC* and *Voucher* groups (Column 6).[32] [33]

In summary, the results on child diet quality demonstrate that appropriate nutrition education alone could lead to better nutrition for children to some extent, but that additional financial support could bring about even greater improvements. In other words, both knowledge and income are binding constraints in this context, and the null effect of $Voucher$ and the limited effect of $BCC$ suggest that these constraints are complementary. This finding

[31] It is possible that some nutritional information with general application was applied to the overall household diet—e.g., the emphasis on dietary diversity and essential micronutrients. Columns 2-11 show that improvements in household diet quality is driven by the consumption of food groups highlighted in the BCC sessions.

[32] Increased household and child consumption of meat across all treatment groups is not necessarily supported by voucher usage in Section 6.2 but is supported by expenditures shown in Table A4. This could be because markets in which vouchers could be used were not the primary sources of meat for most households. Households typically procure meat from their or neighbor's livestock or butcher shops that are mostly outside the market. As vouchers were a fungible means of exchange within the market, voucher recipient households would have saved money that would otherwise be spent on other food items to buy meat from other sources.

[33] Some impact evaluations on transfer programs find positive effects on household dietary diversity, but do not report young child dietary outcomes (Hidrobo et al. 2014). By showing that voucher could have no effect on child nutrition while improving overall household nutrition, measured by FCS, we caution that positive impacts on household-level nutrition outcomes do not necessarily mean similar effects on child-level outcomes.

is confirmed by various measures of child diet quality, food group analysis, and household consumption and expenditures.

### 5.3. Child Physical Growth

In this section, we present result on physical growth of children. As mentioned in Section 3.2, although our study is primarily designed to assess impacts on child-feeding practices, we also study impacts on child growth which is the ultimate goal of the intervention. Panels A and B of Figure 2 presents the distribution of HAZ and WHZ scores across study groups, respectively. The top and bottom figures present scores at baseline and follow-up, respectively. The red vertical lines are the cutoff for stunting and wasting.

Descriptive illustration shows that, the overall HAZ scores decrease over the 6-month-period between baseline and follow-up without any treatment (Panel A of Figure 2). Average HAZ score decreased from -1.09 to -1.52 and stunting prevalence increased from 26% to 41% in the control group from baseline to follow-up.[34] Wasting prevalence is fairly constant over time in the control group—8.7% at baseline and 7.4% at follow-up—which is to be expected as wasting changes in atypical situations such as acute starvation or severe disease. Amid the rapidly decreasing trend of HAZ, one notable finding is that there is a considerable improvement in the HAZ distribution for the *BCC+Voucher* group (Panel A of Figure 2). In particular, compared to the control group, the lower tail of the HAZ distribution shifted rightward rather than the upper tail for *BCC+Voucher*, suggesting effects on stunting prevalence.

Table 6 shows formal regression results confirming the findings from Figure 2. Stunting prevalence significantly decreases by 10.1 percentage points among children in the *BCC+Voucher* group compared to the control group, while we do not find such evidence in *BCC* and *Voucher* treatment groups (Column 1).[35] This is in line with the large impact of *BCC+Voucher* on minimum acceptable diet in Section 6.3 (Table 4), a measure that also focuses on improvements in the lower tail of the distribution.

[34] This rapidly increasing pattern of stunting prevalence with age is similar to that of children over six months in developing countries (Figure A1).

[35] Stunting prevalence remained constant from baseline to follow-up for the *BCC+Voucher* group (30% at baseline and 30% at follow-up), while it increased for all other groups.

We further explain the effects on stunting using subgroup analysis by stunting status at baseline. One interesting finding is that *BCC+Voucher* prevented stunting from occurring, rather than reversing stunted growth (Table A5 and Figure A7): Impacts on stunting status is driven mainly by those who were not stunted at baseline.[36] Moreover, we find that the null effect of *BCC+Voucher* on stunting among those stunted at baseline is unlikely to be a result of low effort in mothers' feeding behaviors. Table A6 shows that mothers of stunted children do not necessarily exert less effort. If anything, mothers of stunted children in both *BCC* and *BCC+Voucher* groups seem to be exerting more effort. This suggests that it is difficult to improve the growth of children who are stunted at baseline, as there may be pre-existing conditions linked to stunting such as low birthweight, illness, or other factors that hinder optimal growth.

We do not find statistically significant positive impacts of *BCC+Voucher* on the HAZ score although the coefficient is relatively large positive (Column 2), which may raise concerns on the robustness of the result. To address this, we estimate the effects of *BCC+Voucher* on stunting prevalence using various possible stunting cutoffs ranges from -1.6 to -2.4 SD cutoff. Figure A8 shows that *BCC+Voucher* consistently has a negative effect on stunting across various stunting cutoffs, with more pronounced effects at and near the -2 SD cutoff. This affirms that the impact of *BCC+Voucher* on stunting reduction is robust, with minor differences in precision depending on the cutoff.

In terms of children's weight given height, we find an increase in WHZ scores for the *BCC* group by 0.33 SDs and a decrease in wasting prevalence, but the latter is not statistically significant (Columns 3 and 4 of Table 6). As Panel B of Figure 2 illustrates, WHZ scores improve for the upper tail of the distribution for the *BCC* group, suggesting improvements among those already relatively well-nourished. Such improvement in the upper tail of the distribution explains why improved WHZ in the *BCC* group did not lead to wasting reduction. As for the *BCC+Voucher* group, we do not find effects on WHZ. This could be because child height increased, and hence, by nature of the indicator, WHZ would

[36] For those not stunted at baseline, stunting prevalence at follow-up was lower among children in the *BCC+Voucher* group (19%) than the control group (33%). However, for those stunted at baseline, stunting prevalence at follow-up was similar, with 65% and 67% in the *BCC+Voucher* and the control groups, respectively (Figure A7).

not increase unless weight gain is faster than height gain.

In summary, we find suggestive evidence that chronic child undernutrition could be improved only when BCC and vouchers are provided together. It is in line with our conceptual framework which predicts that, if nutritional knowledge and inputs are mutually constraining—i.e., they are (near) perfect complements—then *Voucher* will have no impact, *BCC* will have no or moderate impact depending on budget constraint, and *BCC+Voucher* will have the greatest positive impact on child nutrition outcomes.

# 6. Sustainability: Spillover Effects

In this section, we examine whether our one-time BCC intervention could be sustained in the community through peer networks. It is plausible that mothers primarily seek IYCF advice from their peers who gave birth just a few months ahead of them, in which case we expect the spillover group mothers (those with children under 4 months or pregnant at baseline) who have any BCC-participating friend to be better-informed than those who do not.

To assess this, we take advantage of the network data which reveals relationship between mothers in the intervention groups and mothers in the spillover group. Using this information, we estimate whether the BCC treatment influenced the level of IYCF knowledge of the friends in the Spillover group. The extent of such spillover effects or information spillovers can be estimated with the following specification:

$$y_{ijk1} = \alpha_0 + \alpha_1 Peer_{ijk} + \alpha_2 y_{ijk0} + \alpha_3 X_{ijk} + \gamma_k + \varepsilon_{ij}$$

where $y_{ijk1}$ and $y_{ijk0}$ are nutritional knowledge scores for household $i$ from village $j$ in ward $k$ at follow-up and baseline, respectively. We use four different definitions of the $Peer_{ijk}$ variable based on the network information collected at baseline survey: 1) whether the spillover group mother has friends who are eligible for BCC treatment, 2) whether she has close friends (among top 2) who are eligible for BCC treatment, 3) the proportion of friends who are eligible for BCC among full list of friends, and 4) whether she lives in BCC treatment village and has friends who are eligible for BCC treatment. These peer variables were constructed from two different sources of network information: network reported by spillover group mothers (Column 1) and network reported by BCC participant (Column 2). The spillover effects estimated by this regression is causal, as whether the spillover group mother has friends who received BCC should be random by the random assignment of the BCC treatment.

In Table 7, we find evidence that knowledge on IYCF can be transferred among mother's peer group. Those in the spillover group who have any friend who received the BCC treatment have higher IYCF knowledge score compared to those who do not (Panel A). The coefficients are all positive and economically large and statistically significant. The magnitude of spillover impacts (0.26-0.37 SDs) is more than two-thirds of the direct BCC impacts (0.42-0.48 SDs). We also find similar evidence in other peer definitions we used (Panels B-D). Pooled effects of Columns 1 and 2 present similar effect sizes (0.26-0.30 SDs) while it is statistically significant at the 10% level (Column 3).

These results suggest that a one-time BCC intervention promotes improved IYCF knowledge among not only the targeted mothers who participate in the BCC program but also non-targeted and/or future mothers, thereby generating sustainable nutritional knowledge improvements in the community.

# 7. Further Results

## 7.1 Heterogeneity Analysis

We conduct heterogeneity analysis to assess whether treatment impacts differ by various household characteristics including IYCF knowledge score, CDDS, exposure to child nutrition education, whether new mother (first child), child gender (female), and whether mother has income (Figures A9 to A11).[37] Overall, for the most part, we do not find statistically

[37] We test for heterogeneous treatment effects using the following specification: $y_{ij1} = \beta_0 + \beta_1 X_{ij0} BCC_{ij} + \beta_2 X_{ij0} Voucher_{ij} + \beta_3 X_{ij0} BCC\&Voucher_{ij} + \beta_4 BCC_{ij} + \beta_5 Voucher_{ij} + \beta_6 BCC\&Voucher_{ij} + \beta_7 X_{ij0} + \beta_8 y_{ij0} + \varepsilon_{ij}$. $y_{ij}$ is the outcome of interest for household $i$ from village $j$. $BCC_{ij}$, $Voucher_{ij}$, and $BCC\&Voucher_{ij}$ are treatment indicators equal to one for households living in treated villages, and $X_{ij0}$ is a dummy variable for the baseline characteristic of interest. Thus, the coefficients $\beta_1$, $\beta_2$, and $\beta_3$ on the interaction between the baseline characteristic dummy and the treatment variables represent the heterogeneous treatment effects. Standard errors are clustered at the village level, the unit of randomization.

significant heterogeneous treatment effects by the baseline characteristics we examined.[38]

## 7.2 Cost-effectivenss Analysis

We also carried out a cost-effectiveness analysis on stunting reduction.[39] The outcomes for this analysis include cost per case of stunting averted and per disability-adjusted life years (DALY) averted.[40] The number of cases of stunting averted by the intervention relative to the control group were calculated using the associated point estimate reported in Table 8, and the total population of children in intervention and control villages.

Program cost data were extracted from AFF accounting ledgers to assess costs associated with the *BCC+Voucher* intervention. Costs were assessed over the implementation period of the *BCC+Voucher* intervention covering beneficiary selection and 4 months of the program implementation. Start-up costs and intervention piloting costs and costs incurred outside of the intervention period were not assessed. All costs are expressed in 2018 US dollars. Costs were not adjusted for inflation due to interventions lasting less than one year.

Total costs of the *BCC+Voucher* intervention is presented in Table 8, including program costs and costs borne by program participants. The *BCC+Voucher* intervention with 154 program participants had a total cost of US$11,712 with 84% of the total cost attributed to program operational and transfer costs and 16% borne by program participants. Costs of implementing the 16-week-long BCC program were US$3,063 with most costs related to personnel. Implementation costs for the voucher program, including the transfers, were US$5,544. The actual transfer amount accounted for 82% of the voucher program costs.

[38]Among the few heterogeneous impacts we find, the positive impact of *BCC+Voucher* is significantly smaller for female children and greater for children from poor households.

[39]Cost-effectiveness analysis is conducted for the *BCC+Voucher* intervention only because the intent-to-treat impact of the interventions on stunting is statistically significant for this group only.

[40]DALY is an index used to measure health outcomes which consists of years of life lost (YLL) and years lived with disability (YLD). We assume that the age at onset of stunting to be the average children age at follow-up, i.e., 18 months, and the duration of illness to be lifelong. Life-expectancy was calculated as a sex-weighted average using local life expectancy of males (63.7) and females (67.3) (WHO 2018). The disability weight for stunting (0.0002) was taken from the Global Burden of Disease study published in 1990 (Murray and Lopez 1996) and retained in subsequent studies. The disability weight for death is 1.000. To calculate YLL, expected mortality was calculated using the under 5-year mortality rate (UNICEF 2018) adjusted to exclude mortality in children aged less than 1 year (You et al. 2015) and mortality due to stunting (McDonald et al. 2013). YLL and YLD components were calculated and summed to estimate the number of DALY averted for *BCC+Voucher*.

The direct and indirect costs borne by *BCC+Voucher* participants include transportation fares and time participating in the BCC sessions.[41] Average transportation cost to BCC session locations was US$0.36 per roundtrip for *BCC+Voucher* participants which was multiplied by 16 BCC sessions. Average time cost for participating in the BCC sessions was US$0.21 per hour for *BCC+Voucher* participants, multiplied by 16 hourly BCC sessions. Based on household surveys, we estimated that a roundtrip from house to BCC session took one hour. No cost was incurred for the control group.

On average, the total cost of *BCC+Voucher* per household was US$76 and approximately US$15 per month. This cost is considerably lower than other similar integrated nutrition programs.[42] The cost per case of stunting averted by *BCC+Voucher* was US$753 and cost per DALY was US$265 which is considered highly cost-effective in WHO standards (WHO 2014).

# 8. Conclusion

Stunting results in impaired brain development, low levels of education, and poor health and labor market attainment in adulthood (Hoddinott, Behrman, et al. 2013; Schwarzenberg et al. 2018). Many interventions that target a single dimension of causes of child undernutrition have often found limited effects. Combined interventions that address multidimensional and interrelated causes of undernutrition may be more effective for healthy child development. We test this by implementing a community-based cluster randomized experiment in Ethiopia that randomly provides IYCF education through a nutrition BCC and food vouchers to mothers of children aged between 4 and 20 months. We also test the sustainability of the education intervention by estimating knowledge spillovers to untreated mothers of younger children who are friends of those assigned to the BCC intervention.

We have two major findings. We find that providing nutrition education only (*BCC*)

[41] We did not consider travel and time costs for voucher distribution because voucher was distributed at the participants' closest market to which she would have traveled regardless of voucher distribution for personal grocery shopping. When the participant didn't obtain the vouchers from the market, voucher staff visited their household.

[42] For example, Rwanda's Gikuriro, an integrated nutrition program funded by the USAID and implemented by Catholic Relief Services, cost US$142 per household and find no effect on stunting (McIntosh and Zeitlin 2018).

or voucher only (*Voucher*) has limited effects on improving child diet quality and growth. However, when provided education and voucher together, child diet quality was significantly improved. We also find suggestive evidence that stunting prevalence decreases only among those treated both nutrition education and vouchers (*BCC+Voucher*). This impact, if any, is driven by the prevention of stunting rather than reversing it. Second, we find that a one-time BCC intervention could be sustained in the community through knowledge spillovers among peers.

These results confer important policy implications. First, for programs aiming to improve suboptimal health behaviors, it is crucial not only to identify the key constraints, but also to understand the underlying relationship between the constraints. If the key constraints are complementary, an effective program will require a multifaceted approach that relaxes multiple constraints simultaneously. In our case, we demonstrate the complementary nature of information and transfers, and highlight the importance of adding an effective educational component to many existing transfers in the developing world.

Second, for social protection or nutrition programs aiming to reduce child undernutrition, it may be best to target infant and young children in the critical age range of 6 to 18 months, including those who are not undernourished, as *BCC+Voucher* is particularly effective in preventing stunting from occurring in this age range rather than reversing it.

Lastly, we underscore the importance of considering the sustainability of development interventions when assessing their impacts. This entails weighing not only the long-term effects on the treated, but also the potential spillover effects on the untreated. Our results show that education programs like BCC could bring about sustainable positive impacts in the society through knowledge spillovers.

# References


Alderman, H., Gentilini, U., & Yemtsov, R. (2018). *The 1.5 billion people question: Food, vouhcers, or cash transfers?* World Bank.

Bandiera, O., Burgess, R., Das, N., Gulesci, S., Rasul, I., & Sulaiman, M. (2017). Labor markets and poverty in village economies. *The Quarterly Journal of Economics*, *132*(2), 811–870.

Banerjee, A., Duflo, E., Goldberg, N., Karlan, D., Osei, R., Pariente, W., . . . Udry, C. (2015). A multifaceted program causes lasting progress for the very poor: Evidence from six countries. *Science*, *348*(6236).

Beaudry, M., Dufour, R., & Marcoux, S. (1995). Relation between infant feeding and infections during the first 6 months of life. *Journal of Pediatrics*, *126*, 191–97.

Bhutta, Z., Das, J., Rizvi, A., Gaffey, M., Walker, N., Horton, S., . . . Black, R. (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? *The Lancet*, *382*(9890), 452–477.

Bilal, S., Dinant, G., Blanco, R., Crutzen, R., Mulugeta, A., & Spigt, M. (2013). The influence of father's child feeding knowledge and practices on children's dietary diversity: A study in urban and rural districts of northern ethiopia. *Maternal* & *Child Nutrition*, *12*, 473–83.

Black, E., Allen, H., Bhutta, A., Caulfield, E., de Onis, M., Ezzati, M., . . . Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: Global and regional exposures and health consequences. *The Lancet*, *371*(9608), 243–260.

Black, R., Victora, C., Walker, S., Bhutta, Z., Christian, P., de Onis, M., . . . the Maternal and Child Nutrition Study Group. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*, *382*, 427–51.

Cameron, C., Gelbach, J., & Miller, D. (2008). Bootstrap-based improvements for inference with clustered errors. *Review of Ecnomics and Statistics*, *90*(3), 414–427.

Christensen, G. & Miguel, E. (2018). Transparency, reproducibility, and the credibility of economics research. *Journal of Economic Literature*, *56*(3), 920–980.

Cole, S. & Fernando, E. (2018). 'mobile'izing agricultural advice: Technology adoption, diffusion and sustainability. *Harvard Business School Working Paper*.

Cunningham, A., Jelliffe, D., & Jelliffe, E. (1991). Breastfeeding and health in the 1980s: A global epidmiologic review. *Journal of Pediatrics*, *118*, 659–66.

Del Boca, D., Flinn, C., & Wiswall, M. (2014). Household choices and child development. *Review of Economic Studies*, *81*(1), 137–185.

der Merwe, L. V., Moore, S., Fulford, A., Halliday, K., Drammeh, S. S., & Young, S. (2013). Long-chain pufa supplementation in rural african infants: A randomized controlled rial of effects on gut interity, growth, and cognitive development. *Amreican Journal of Clinical Nutrition*, *97*, 45–57.

Dewey, K., Heinig, M., & Nommsen-Rivers, L. (1995). Differences in morbidity between breastfed and formula fed infants. *Journal of Pediatrics*, *126*, 696–702.

Ethiopia DHS. (2016). Ethiopia dhs. Retrieved from https://dhsprogram.com/what-we-do/survey/survey-display-478.cfm

Finkelstein, A., Taubman, S., Wright, B., Bernstein, M., Gruber, J., Newhouse, J., ... The Oregon Health Study Group. (2012). The oregon health insurance experiment: Evidence from the first year. *Quarterly Journal of Economics*, *127*, 1057–1106.

Fisher, R. (1966). *The design of experiments* (8th ed.). MacMillan.

Fiszbein, A., Kanbur, R., & Yemtsov, R. (2014). Social protection and poverty reduction: Global patterns and some targets. *World Development*, *61*, 166–77.

Fitzsimons, E., Malde, B., Mesnard, A., & Vera-Hernandez, M. (2016). Nutrition, information and household behavior: Experimental evidence from malawi. *Journal of Development Economics*, *122*, 113–126.

Gronau, R. (1986). Home production: A survey. In *Handbook of labor economics* (Vol. 1, *273-304*). Amsterdam.

Han, Y., Hoddinott, J., Kim, H. B., & Park, S. (2017). Promoting healthy eating among poor children: The roles of information, affordability, accessibility, gender, and peers on child-feeding in ethiopia. *AEA RCT Registry*.

Headey, D., Chiu, A., & Kadiyala, S. (2012). Agriculture's role in the indian enigma: Help or hindrance to the malnutrition crisis? *Food Security*, *4*, 87–102.

Hidrobo, M., Hoddinott, J., Peterman, A., Margolies, A., & Moreira, V. (2014). Cash, food, or vouchers? evidence from a randomized experiment in northern ecuador. *Journal of Development Economics*, *107*, 144–156.

Hoddinott, J., Ahmed, A., Karachiwalla, N., & Roy, S. (2018). Nutrition behaviour change communication causes sustained effects on iycn knowledge in two cluster-randomised trials in bangladesh. *Maternal & Child Nutrition*, *14*(1).

Hoddinott, J., Ahmed, I., Ahmed, A., & Roy, S. (2017). Behavior change communication activities improve infant and young child nutrition knowledge and practice of neighboring non-participants in a cluster-randomized trial in rural bangladesh. *PLoS One*, *12*(6), e0179866.

Hoddinott, J., Behrman, J., Maluccio, J., Melgar, P., Quisumbing, A., Ramirez-Zea, M., & Martorell, R. (2013). Adult consequences of growth failure in early childhood. *The American Journal of Clinical Nutrition*, ajcn–064584.

Jayachandran, S. & Pande, R. (2017). Why are indian children so short? the role of birth order and son preference. *American Economic Review*, *107*(9), 2600–2629.

Jones, G., Steketee, W., Black, E., Bhutta, A., Morris, S., & Bellagio Child Survival Study Group. (2003). How many child deaths can we prevent this year? *The Lancet*, *362*(9377), 65–71.

Kling, J., Liebman, J., & Katz, L. (2007). Experimental analysis of neighborhood effects. *Econometrica*, *75*, 83–119.

Kremer, M. & Miguel, E. (2007). The illusion of sustainability. *Quarterly Journal of Economics*, *112*(3), 1007–1065.

Luby, S., Rahman, M., Arnold, B., Unicomb, L., Ashraf, S., & Winch, P. (2018). Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural bangladesh: A cluster randomised controlled trial. *Lancet Global Health*, *6*, e302–15.

Manley, J., Gitter, S., & Slavchevska, V. (2013). How effective are cash transfers at improving nutritional status? *World Development*, *48*, 133–155.

McDonald, C., Olofin, I., & Flaxman, S. (2013). The effect of multiple anthropometric deficits on child mortality: Meta-analysis of individual data in 10 prospective studies from developing countries. *American Journal of Clinical Nutrition*, *97*, 896–901.

McIntosh, C. & Zeitlin, A. (2018). Benchmarking a child nutrition program against cash: Experimental evidence from rwanda. *Working Paper*.

MEASURE Evaluation. (2018). Behavior change communication–measure evaluation. Retrieved from https://www.measureevaluation.org

MOA. (2014). *Productive safety net programme phase iv programme implementation manual*. Addis Ababa: Ministry of Agriculture (MOA).

Muller, O., Garenne, M., Reitmaier, P., Zweeden, A. B. V., Kouyate, B., & Becher, H. (2003). Effect of zinc supplementation on growth in west african children: A randomized double-blind placebo-controlled trial in rural burkina faso. *International Journal of Epidemiology*, *32*, 1098–102.

Murray, C. & Lopez, A. (1996). *The global burden of disease: A comprehensive assessment of mortality and disability from diseases, injury and risk factors in 1990 and projected to 2020*. Harvard School of Public Health.

Nube, M. (2009). The asian enigma: Predisposition for low adult bmi among people of south asian descent. *Public Health Nutrition*, *12*, 507–516.

Null, C., Stewart, C., Pickering, A., Dentz, H., Arnold, B., & Arnold, C. (2018). Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural kenya: A cluster-randomised controlled trial. *Lancet Global Health*, *6*, e316–29.

Olney, K., Pedehombga, A., Ruel, M., & Dillon, A. (2015). A 2-year integrated agriculture and nutrition and health behavior change communication program targeted to women in burkina faso reduces anemia, wasting, diarrhea in children 3-12.9 months of age at baseline: A cluster-randomized controlled trial. *The Journal of Nutrition*, *145*(6), 1317–1324.

Organization, W. H. (1995). *Physical status: The use and interpretation of anthropometry* (WHO technical report series No. 854). Geneva, Switzerland: World Health Organization.

Paes-Sousa, R., Pacheco Santos, L., & Shisue Miazaki, E. (2011). Effects of a conditional cash transfer programme on child nutrition in brazil. *Bulletin of the World Health Organization*, *89*, 496–503.

Paul, K., Muti, M., Khalfan, S., Humphrey, J., Caffarella, R., & Stoltzfus, R. (2011). Beyond food insecurity: How context can improve complementary feeding interventions. *Food Nutrition Bulletin*, *32*(3), 244–53.

Reinbott, A., Schelling, A., Kuchenbecker, J., Jeremias, T., Russell, I., Kevanna, O., ... Jordan, I. (2016). Nutrition education linked to agricultural interventions improved child dietary diversity in rural cambodia. *British Journal of Nutrition*, *116*, 1457–1468.

Rivera, R., Maulding, M., & Eicher-Miller, H. (2019). Effect of supplemental nutrition assistance program-education (snap-ed) on food security and dietary outcomes. *Nutrition Reviews*, *May 2019*.

Rosenbaum, P. (2002). *Observational studies*. Springer.

Rosenzweig, M. & Schultze, T. (1983). Estimating a household production function: Heterogeneity, the demand for health inputs, and their efects on birth wieght. *Journal of Political Economy*, *91*(5), 723–746.

Ruel, M., Alderman, H., & Maternal and Child Nutrition Study Group. (2013). Nutrition-sensitive interventions and programmes: How can they help to accelerate progress in improving maternal and child nutrition? *The Lancet*, *382*(9891), 536–551.

Schroff, M., Griffiths, P., Adair, L., Suchindran, C., & Bentley, M. (2009). Maternal autonomy is inversely related to child stunting in andhra pradesh, india. *Maternal and Child Nutrition*, *5*(1), 64–74.

Schwarzenberg, S., Georgieff, M., & AAP Committee on Nutrition. (2018). Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. *Pediatrics*, *141*(2), e20173716.

Skoufias, E., di Maro, V., Gonzales-Cossio, T., & Ramirez, S. (2011). Food quality, calories and household income. *Applied Economics*, *43*, 4331–4342.

Small, D., Ten Have, T., & Rosenbaum, P. (2008). Randomization inference in a group–randomized trial of treatments for depression: Covariate adjustment, noncompliance, and quantile effects. *Journal of the American Statistical Association*, *103*(481), 271–279.

Smith, L. & Haddad, L. (2002). How potent is economic growth in reducing undernutrition? what are the pathways of impact? new cross-country evidence. *Economic Development and Cultural Change*, *51*, 55–76.

Thrive, A. .. (2018). Retrieved from https://www.aliveandthrive.org

UNICEF. (2018). Unicef country profiles: Ethiopia. Retrieved from https://data.unicef.org/country/eth/#

Weismann, D., Bassett, L., & Hoddinott, J. (2009). Validation of the world food programme's food consumption score and alternative indicators for household food security. *IFPRI Discussion Paper*, *00870*.

WFP. (2008). *Food consumption analysis: Calculation and use of the food consumption score in food security analysis*. Rome: World Food Programme.

WHO. (2010). *Assessing infant and young child feeding practices. part 2: Measurement.* Geneva: WHO Press.

WHO. (2014). *Who methods and data sources for global burden of disease estimates 2000–2011*. Department of Health Statistics and Information Systems, WHO.

WHO. (2018). Who country profiles: Ethiopia. Retrieved from https://www.who.int/countries/eth/en/

World Bank. (2006). *Repositioning nutrition as central to development: A strategy for large-scale action*. Washington DC: The World Bank.

World Bank. (2017). World development indicators. Retrieved from http://data.worldbank.org

You, D., Hug, L., & Ejdemyr, S. (2015). Global, regional, and national levels and trends in under-five mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the un inter-agency group for child mortality estimation. *Lancet*, *386*, 2275–86.

Zongrone, A., Menon, P., Pelto, G., Habicht, J.-P., Rasmussen, K., Constas, M., … Stoltzfus, R. (2018). The pathways from a behavior change communication intervention to infant and young child feeding in bangladesh are mediated and potentiated by maternal self-efficacy. *The Journal of Nutrition*, *148*(2), 259–266.

# Figures and Tables

Figure 1: Study Design

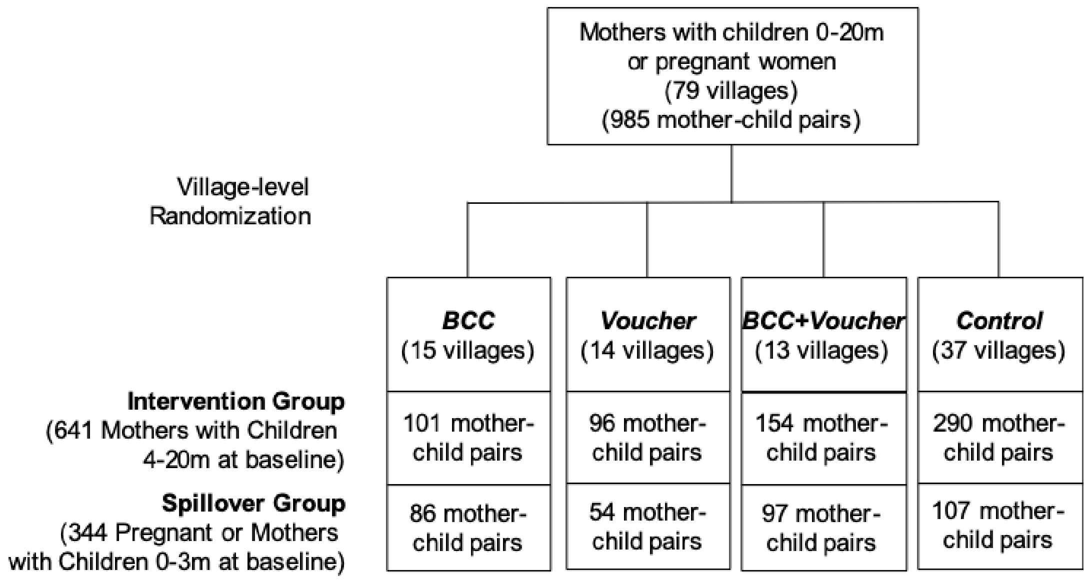
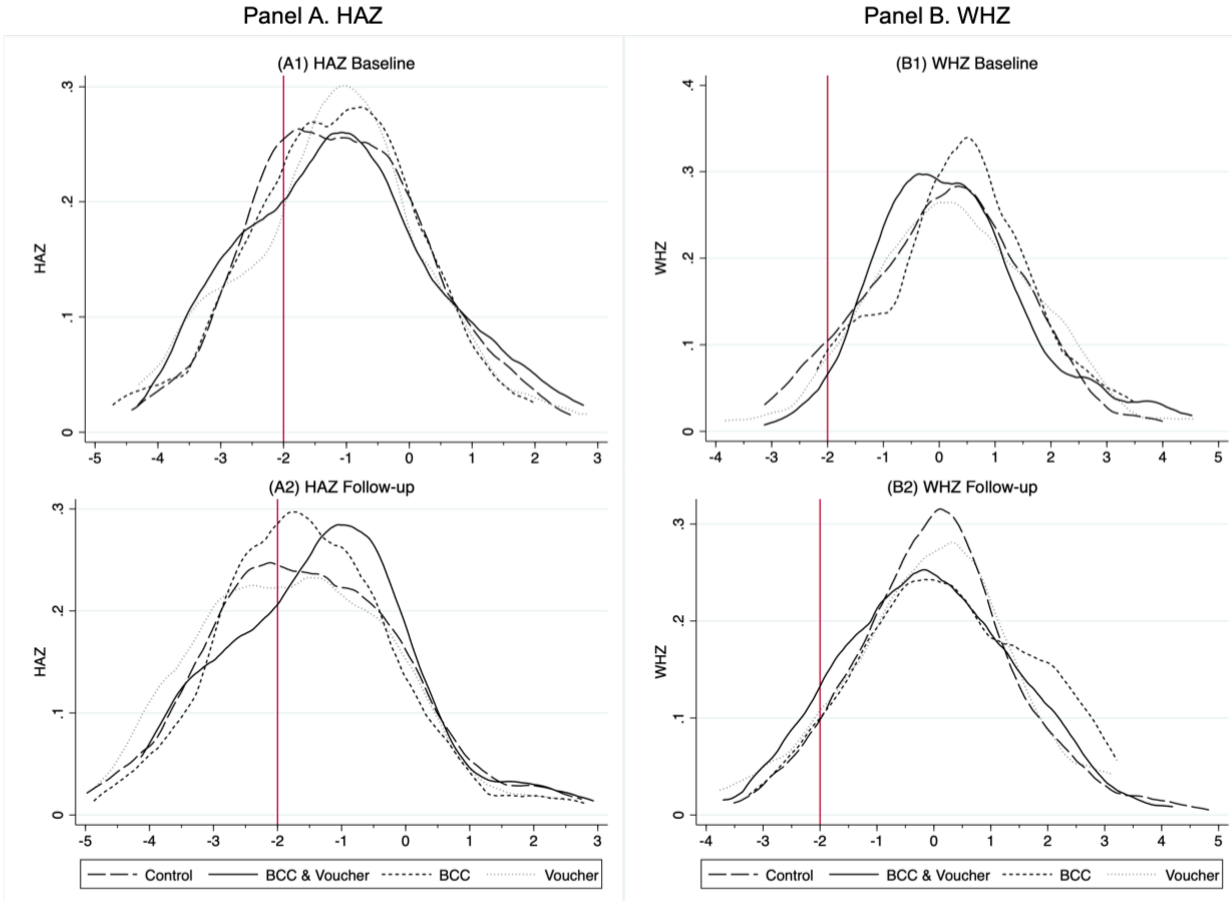


Figure 2: Distribution of Height-for-age $Z$ Score (HAZ) at Baseline and Follow-up




Note: This figure presents kernel density graph of height-for-age $Z$ scores of eligible children at baseline (Panel A) and at follow-up (Panel B), and weight-for-height Z scores of eligible children at baseline (Panel C) and at follow-up (Panel D). The red vertical line represents -2 SD, below which means stunted growth, and indicator for chronic undernutrition for HAZ and acute undernutrition for WHZ.

Table 1: Baseline Mean Characteristics by Intervention Groups

| | N | Mean | | Mean differences | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | All | Control | B-C | V-C | BV-C | B-V | B-BV | V-BV |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A. Mother characteristics* | | | | | | | | | |
| Mother age (years) | 639 | 28.279 | 28.191 | -0.656 | -0.028 | 0.777 | -0.684 | -1.433 | 0.749 |
| Mother is Oromo | 641 | 0.766 | 0.766 | -0.013 | 0.005 | 0.007 | -0.018 | -0.020 | -0.002 |
| Mother is Orthodox Christian | 641 | 0.844 | 0.852 | 0.010 | 0.002 | -0.040 | 0.007 | 0.050 | 0.042 |
| Mother is married | 640 | 0.769 | 0.779 | -0.046 | -0.049 | 0.020 | 0.004 | -0.066 | -0.070 |
| Mother has work | 641 | 0.565 | 0.545 | 0.049 | 0.039 | 0.027 | 0.011 | 0.023 | 0.012 |
| Mother able to read | 640 | 0.494 | 0.469 | 0.085 | 0.052 | 0.015 | 0.034 | 0.071 | 0.037 |
| Mother able to write | 640 | 0.484 | 0.455 | 0.089 | 0.055 | 0.028 | 0.034 | 0.061 | 0.027 |
| Mother years of schooling | 641 | 4.251 | 3.945 | 0.748 | -0.216 | 0.919 | 0.964 | -0.171 | -1.134 |
| Mother IYCF knowledge score | 641 | 21.480 | 21.445 | 0.050 | -0.132 | 0.198 | 0.183 | -0.148 | -0.330 |
| *Panel B. Child characteristics* | | | | | | | | | |
| Eligible child age (months) | 641 | 12.495 | 12.310 | 1.115 | -0.029 | 0.053 | 1.144 | 1.062 | -0.082 |
| Child dietary diversity score | 641 | 2.362 | 2.438 | 0.027 | -0.219 | -0.198 | 0.247 | 0.225 | -0.022 |
| Minimum acceptable diet | 634 | 0.128 | 0.116 | 0.072 | 0.001 | 0.001 | 0.071 | 0.071 | 0.000 |
| Height-for-age Z score | 594 | -1.085 | -1.051 | -0.132 | -0.005 | -0.045 | -0.127 | -0.087 | 0.040 |
| Stunting | 594 | 0.266 | 0.255 | 0.018 | -0.021 | 0.048 | 0.039 | -0.030 | -0.069 |
| *Panel C. Household characteristics* | | | | | | | | | |
| Female household head | 641 | 0.139 | 0.134 | 0.024 | 0.001 | 0.002 | 0.023 | 0.022 | -0.001 |
| Household size | 641 | 4.541 | 4.500 | -0.094 | 0.198 | 0.110 | -0.292 | -0.204 | 0.088 |
| Number of children | 641 | 2.351 | 2.321 | -0.103 | 0.127 | 0.114 | -0.230 | -0.217 | 0.013 |
| Asset index | 641 | -0.012 | -0.051 | 0.178 | -0.054 | 0.077 | 0.232 | 0.101 | -0.131 |
| Rural | 641 | 0.446 | 0.507 | -0.022 | -0.069 | -0.195*** | 0.048 | 0.173** | 0.126* |
| Total weekly food expenditure, per capita | 641 | 131.550 | 130.783 | 12.653 | -9.367 | 0.734 | 22.020 | 11.919 | -10.101 |
| Household food consumption score | 641 | 43.195 | 43.303 | -1.076 | 0.144 | 0.164 | -1.220 | -1.240 | -0.020 |
| *Panel D. Attrition* | | | | | | | | | |
| Follow-up Survey Attrition Rates | 641 | 0.084 | 0.093 | 0.006 | -0.041 | -0.015 | 0.047 | 0.021 | -0.026 |
| Anthropometry Attrition Rates | 641 | 0.189 | 0.172 | 0.045 | -0.037 | 0.061 | 0.082 | -0.016 | -0.098* |

Note: Table 1 reports mean of selected baseline variables. B represents those who were offered the BCC program only. V represents those who were offered the voucher program only. BV represents those who were offered both the BCC and the voucher programs. Columns 1-3 show the number of observations and a summary of the whole sample and the control group. Columns 4-9 report mean differences and significance levels from t-test of mean differences between study groups. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. B=BCC, V=Voucher, BV=BCC+Voucher.

Table 2: Effects on BCC Attendance and Mother IYCF Knowledge

| | BCC Attendance rate | Mother IYCF knowledge score (standardized) |
|---|---|---|
| | (1) | (2) |
| BCC (B) | 0.729*** | 0.477*** |
| | (0.025) | (0.097) |
| | [0.000] | [0.000] |
| | {0.000} | {0.000} |
| Voucher (V) | -0.002 | 0.070 |
| | (0.005) | (0.134) |
| | [0.609] | [0.607] |
| | {0.996} | {0.657} |
| BCC & Voucher (BV) | 0.752*** | 0.419*** |
| | (0.012) | (0.096) |
| | [0.000] | [0.000] |
| | {0.000} | {0.040} |
| Observations | 637 | 584 |
| R-squared | 0.884 | 0.129 |
| Control group mean | 0.000 | -0.166 |
| P-value: B=V | 0.000 | 0.006 |
| P-value: B=BV | 0.431 | 0.601 |
| P-value: V=BV | 0.000 | 0.024 |
| P-value: B+V=BV | 0.397 | 0.482 |

Note: This table reports results on BCC attendance rate and mothers' IYCF knowledge score (standardized). Column 1 uses administrative data collected during intervention and compares BCC attendance rates with the control group where the control and the voucher group's attendance rates are zero. All estimations include a standard set of control variables. Column 2 additionally controls for the baseline outcome. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3: Effects on Voucher Redemption
(During Intervention)

| | Average weekly total voucher exp. | Average voucher redemption per week by food group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Meat and fish | Milk and milk products | Eggs | Vitamin A-rich fruits & veg. | Other fruits and veg. | Nuts and legumes | Starchy staples | Oil and fats | Sugar, drinks, and spices |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Voucher (V) | 44.431*** | 0.139 | 0.079* | 1.325*** | 1.243*** | 6.136*** | 1.890*** | 17.917*** | 12.259*** | 3.390*** |
| | (1.343) | (0.103) | (0.041) | (0.315) | (0.148) | (0.476) | (0.554) | (0.963) | (1.176) | (0.303) |
| | [0.000] | [0.189] | [0.047] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| | {0.000} | {0.018} | {0.003} | {0.000} | {0.000} | {0.000} | {0.000} | {0.000} | {0.000} | {0.000} |
| BCC & Voucher (BV) | 44.049*** | 0.026 | 0.132** | 0.963*** | 1.479*** | 7.900*** | 1.258*** | 16.318*** | 12.258*** | 3.645*** |
| | (0.897) | (0.023) | (0.063) | (0.194) | (0.132) | (0.446) | (0.533) | (0.888) | (0.794) | (0.247) |
| | [0.000] | [0.247] | [0.019] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| | {0.000} | {0.483} | {0.022} | {0.003} | {0.000} | {0.000} | {0.012} | {0.000} | {0.000} | {0.000} |
| Observations | 524 | 524 | 524 | 524 | 524 | 524 | 524 | 524 | 524 | 524 |
| R-squared | 0.922 | 0.041 | 0.028 | 0.211 | 0.377 | 0.615 | 0.195 | 0.667 | 0.626 | 0.418 |
| P-value: V=BV | 0.815 | 0.272 | 0.452 | 0.327 | 0.229 | 0.008 | 0.404 | 0.207 | 1.000 | 0.501 |

Note: This table reports effects on voucher redemption using administrative data collected during the intervention. The results compare the $BCC + Voucher$ group and the $Voucher$ group with the control group which has zero voucher spending. All estimations include a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last row reports p-value from an F-test of coefficient equality between $Voucher$ and $BCC + Voucher$ groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 4: Effects on Child Diet Quality

| | CDDS | Minimum acceptable diet | Minimum dietary diversity | Minimum meal frequency | Standardized treatment effect |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| BCC (B) | 0.332* | 0.085** | 0.046 | 0.071 | 0.044** |
| | (0.172) | (0.035) | (0.053) | (0.074) | (0.019) |
| | [0.083] | [0.038] | [0.407] | [0.387] | |
| | {0.056} | {0.095} | {0.306} | {0.461} | |
| Voucher (V) | 0.005 | -0.002 | -0.036 | 0.043 | -0.004 |
| | (0.185) | (0.030) | (0.051) | (0.061) | (0.018) |
| | [0.978] | [0.950] | [0.516] | [0.478] | |
| | {0.820} | {0.872} | {0.817} | {0.930} | |
| BCC & Voucher | 0.589*** | 0.153*** | 0.167*** | 0.146** | 0.090*** |
| (BV) | (0.167) | (0.030) | (0.047) | (0.068) | (0.018) |
| | [0.015] | [0.001] | [0.015] | [0.067] | |
| | {0.014} | {0.002} | {0.014} | {0.168} | |
| Observations | 583 | 537 | 583 | 440 | 2,143 |
| R-squared | 0.121 | 0.122 | 0.123 | 0.067 | 0.079 |
| Control group mean | 3.073 | 0.124 | 0.328 | 0.565 | 0.000 |
| P-value: B=V | 0.117 | 0.025 | 0.149 | 0.712 | 0.021 |
| P-value: B=BV | 0.186 | 0.088 | 0.038 | 0.403 | 0.031 |
| P-value: V=BV | 0.006 | 0.000 | 0.001 | 0.159 | 0.000 |
| P-value: B+V=BV | 0.353 | 0.180 | 0.057 | 0.774 | 0.084 |

Note: This table reports results on child dietary diversity score (CDDS), minimum acceptable diet standard, minimum dietary diversity, and minimum meal frequency, collected after intervention completion (see section 4.2 for outcome definition). Column 5 reports standardized treatment effect across all outcomes in columns 1-4. All estimations include the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5: Effects on Child Food Consumption

| | Whether child ate in the last 24 hours: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Meat | Milk | Eggs | Vitamin A-rich fruits & veg. | Std'ized treat-ment effect | Other fruits & veg. | Nuts & legumes | Starchy staples |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| BCC (B) | 0.135*** | 0.083* | 0.078 | -0.001 | 0.043** | -0.019 | 0.075 | -0.023 |
| | (0.051) | (0.046) | (0.063) | (0.055) | (0.018) | (0.059) | (0.056) | (0.017) |
| | [0.030] | [0.102] | [0.296] | [0.988] | | [0.797] | [0.182] | [0.218] |
| | {0.001} | {0.160} | {0.150} | {0.974} | | {0.742} | {0.249} | {0.123} |
| Voucher (V) | 0.137*** | -0.032 | -0.019 | -0.062 | 0.006 | -0.038 | 0.022 | -0.003 |
| | (0.037) | (0.046) | (0.070) | (0.041) | (0.016) | (0.053) | (0.069) | (0.013) |
| | [0.003] | [0.513] | [0.791] | [0.145] | | [0.506] | [0.775] | [0.881] |
| | {0.000} | {0.583} | {0.767} | {0.278} | | {0.506} | {0.749} | {0.876} |
| BCC & Voucher | 0.123*** | 0.092** | 0.183*** | 0.096** | 0.070*** | 0.007 | 0.074 | 0.005 |
| (BV) | (0.023) | (0.043) | (0.052) | (0.048) | (0.016) | (0.044) | (0.046) | (0.009) |
| | [0.000] | [0.058] | [0.014] | [0.100] | | [0.884] | [0.149] | [0.680] |
| | {0.000} | {0.147} | {0.005} | {0.095} | | {0.903} | {0.244} | {0.713} |
| Observations | 583 | 583 | 583 | 583 | 2,332 | 583 | 583 | 583 |
| R-squared | 0.107 | 0.091 | 0.095 | 0.059 | 0.059 | 0.042 | 0.047 | 0.037 |
| Control mean | 0.119 | 0.275 | 0.286 | 0.226 | 0.000 | 0.805 | 0.368 | 0.992 |
| P-value: B=V | 0.981 | 0.029 | 0.242 | 0.296 | 0.074 | 0.769 | 0.467 | 0.248 |
| P-value: B=BV | 0.813 | 0.852 | 0.139 | 0.128 | 0.191 | 0.687 | 0.995 | 0.123 |
| P-value: V=BV | 0.735 | 0.016 | 0.013 | 0.003 | 0.001 | 0.414 | 0.444 | 0.563 |
| P-value: B+V=BV | 0.023 | 0.549 | 0.233 | 0.038 | 0.414 | 0.452 | 0.806 | 0.187 |

Note: This table reports results on child food consumption by food group. Each outcome indicates whether the child ate any food from the food group in the last 24 hours, collected after intervention completion. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Effects on Child Physical Growth

| | Stunted<br>(1) | HAZ<br>(2) | Wasted<br>(3) | WHZ<br>(4) |
|---|---|---|---|---|
| BCC (B) | 0.092 | -0.069 | -0.034 | 0.325** |
| | (0.069) | (0.166) | (0.036) | (0.154) |
| | [0.210] | [0.684] | [0.372] | [0.038] |
| | {0.116} | {0.700} | {0.371} | {0.074} |
| Voucher (V) | 0.066 | -0.216 | 0.005 | -0.084 |
| | (0.059) | (0.131) | (0.035) | (0.149) |
| | [0.322] | [0.130] | [0.889] | [0.589] |
| | {0.245} | {0.181} | {0.885} | {0.650} |
| BCC & Voucher (BV) | -0.101** | 0.173 | 0.003 | -0.041 |
| | (0.045) | (0.143) | (0.035) | (0.166) |
| | [0.079] | [0.315] | [0.944] | [0.833] |
| | {0.083} | {0.336} | {0.943} | {0.824} |
| Observations | 462 | 462 | 474 | 474 |
| R-squared | 0.008 | 0.367 | 0.087 | 0.121 |
| Control group mean | 0.410 | -1.521 | 0.078 | 0.048 |
| P-value: B=V | 0.758 | 0.408 | 0.395 | 0.016 |
| P-value: B=BV | 0.006 | 0.145 | 0.384 | 0.037 |
| P-value: V=BV | 0.015 | 0.010 | 0.955 | 0.813 |
| P-value: B+V=BV | 0.006 | 0.028 | 0.563 | 0.230 |

Note: This table reports results on stunting prevalence, height-for-age Z scores (HAZ), wasting prevalence, and weight-for-height Z scores (WHZ), collected after intervention completion (see section 4.2 for outcome definition). All estimations include baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 7: Sustainability of the BCC Intervention: Spillover Effects

| | (1) | (2) | (3) |
|---|---|---|---|
| Network information source: | Spillover group mother listed BCC participant as friend | BCC participant listed spillover group mother as friend | Pooled effect |
| Dependent variable: | Mother IYCF knowledge score (standardized) | | |
| Panel A. | | | |
| Have BCC-eligible friends | 0.259* | 0.372* | 0.263* |
| | (0.155) | (0.222) | (0.143) |
| Observations | 275 | 275 | 550 |
| R-squared | 0.119 | 0.121 | 0.119 |
| Panel B. | | | |
| Have BCC-eligible friends in top 2 | 0.371*** | 0.152 | 0.268* |
| | (0.141) | (0.267) | (0.151) |
| Observations | 275 | 275 | 550 |
| R-squared | 0.116 | 0.118 | 0.205 |
| Panel C. | | | |
| Proportion of BCC-eligible friends | 0.534 | 0.265 | 0.289 |
| BCC | (0.415) | (0.221) | (0.205) |
| Observations | 275 | 275 | 550 |
| R-squared | 0.116 | 0.118 | 0.205 |
| Panel D. | | | |
| Lives in BCC village and have | 0.353** | 0.320 | 0.295* |
| BCC-eligible friends | (0.153) | (0.228) | (0.150) |
| Observations | 275 | 275 | 550 |
| R-squared | 0.123 | 0.119 | 0.120 |

Note: This table reports results on the whether the spillover group mother has any friend who is eligible for the BCC treatment (Panel A), whether she has friends who are eligible for the BCC treatment in the top 2 closest friends (Panel B), the proportion of BCC-eligible friends she has (Panel C), and whether lives in BCC village and has BCC-eligible friends (Panel D) defined by: the spillover group mothers' networks (Column 1) and BCC-participating mothers' networks (Column 2). The last column shows pooled effects of columns 1 and 2 with robust standard errors clustered at the village and individual levels. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses for columns 1-4. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

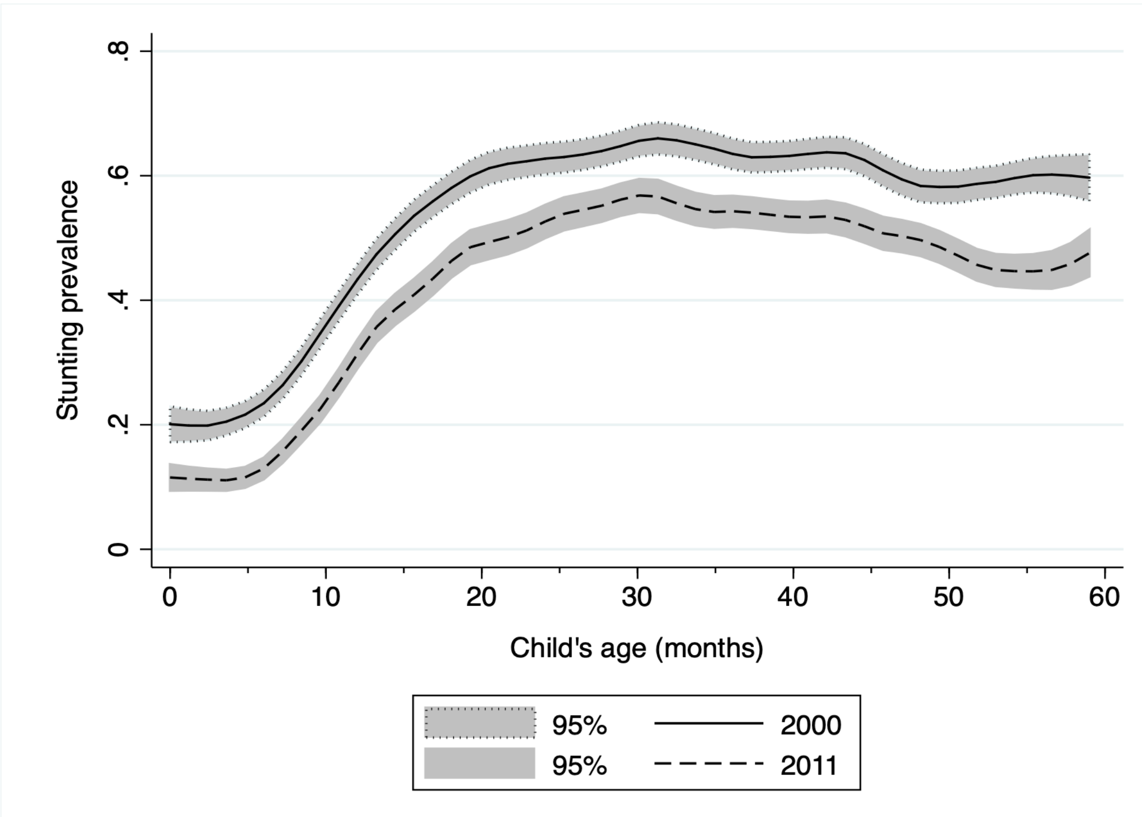
Table 8: *BCC + Voucher* Cost-effectiveness Analysis

| | Amount (USD) | Amount per household (USD) | % of Total |
|---|---|---|---|
| Panel A. BCC | | | |
| Personnel | 1,110 | 7 | 9.5% |
| Community workers | 640 | 4 | 5.5% |
| Personnel transportation | 419 | 3 | 3.6% |
| Training materials | 614 | 4 | 5.2% |
| Other program costs | 281 | 2 | 2.4% |
| BCC subtotal | 3,063 | 20 | 26.2% |
| | | | |
| Panel B. Voucher | | | |
| Transfer amount | 5,544 | 36 | 47.3% |
| Personnel | 430 | 3 | 3.7% |
| Personnel transportation | 479 | 3 | 4.1% |
| Community workers | 274 | 2 | 2.3% |
| Voucher subtotal | 6,727 | 44 | 57.4% |
| | | | |
| Panel C. Beneficiary cost | | | |
| Transportation | 887 | 6 | 7.6% |
| Time | 1,035 | 7 | 8.8% |
| Beneficiary cost subtotal | 1,922 | 12 | 16.4% |
| | | | |
| TOTAL | 11,712 | 76 | |
| Total cost per household | | US$ 76 | |
| Decrease in prevalence of stunting | | 10.1% | |
| Cases of stunting averted | | 16 | |
| Cost per case of stunting averted | | US$ 753 | |
| DALY averted | | 44 | |
| Cost per DALY averted | | US$ 265 | |

# Appendices

## Appendix A Figures and Tables

Figure A1: Stunting Prevalence by Child Age in Ethiopia




Source: Local polynomial smoothing predictions with 95% confidence intervals estimated using the DHS data (Ethiopia DHS, 2000, 2011).

Figure A2: Map of Ejere District

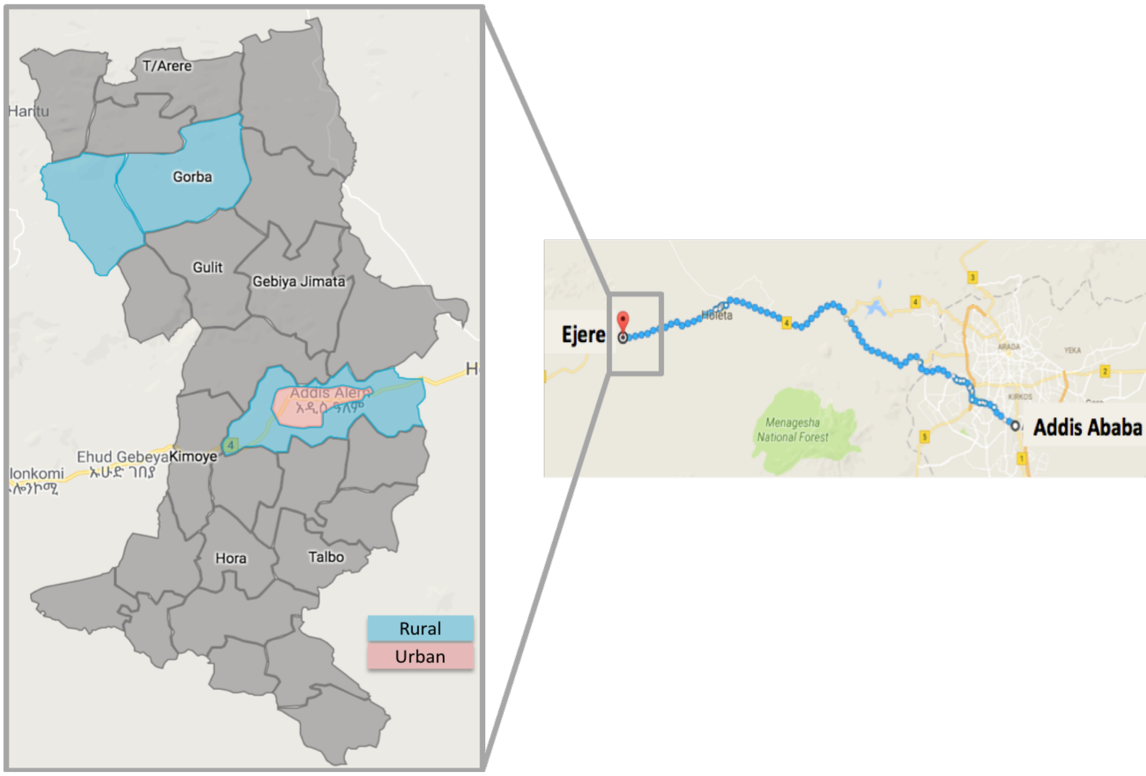
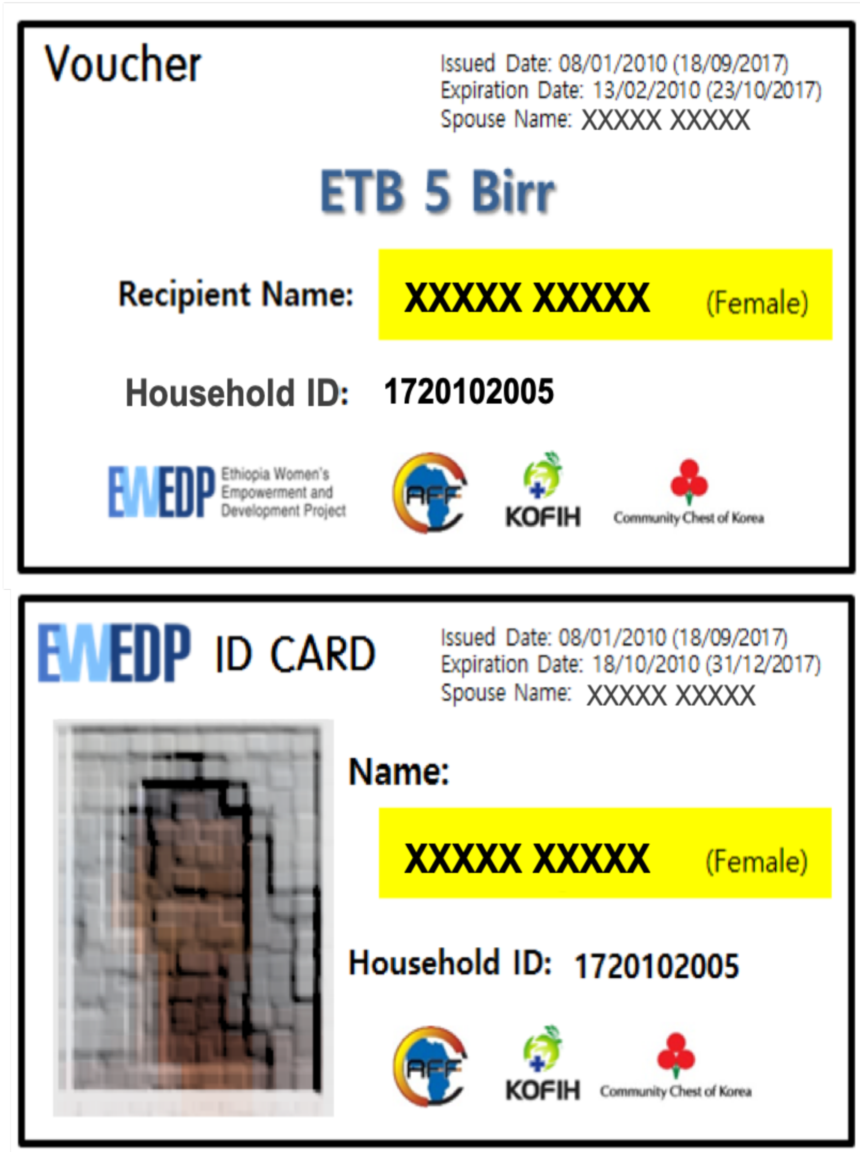


Figure A3: Sample Voucher and Household ID




Note: This figure shows sample voucher and household ID provided to the $Voucher$ and $BCC+Voucher$ households. Each voucher and the household ID state the recipient name, unique household ID, and spouse name which are cross-checked for verification in voucher transactions. They also list the issued date and expiration date in Ethiopian calendar, with dates in Gregorian calendar in parentheses. Before distribution, these vouchers and ID cards were printed and stamped in blue with an official AFF mark to prevent duplication.

Figure A4: Study Timeline

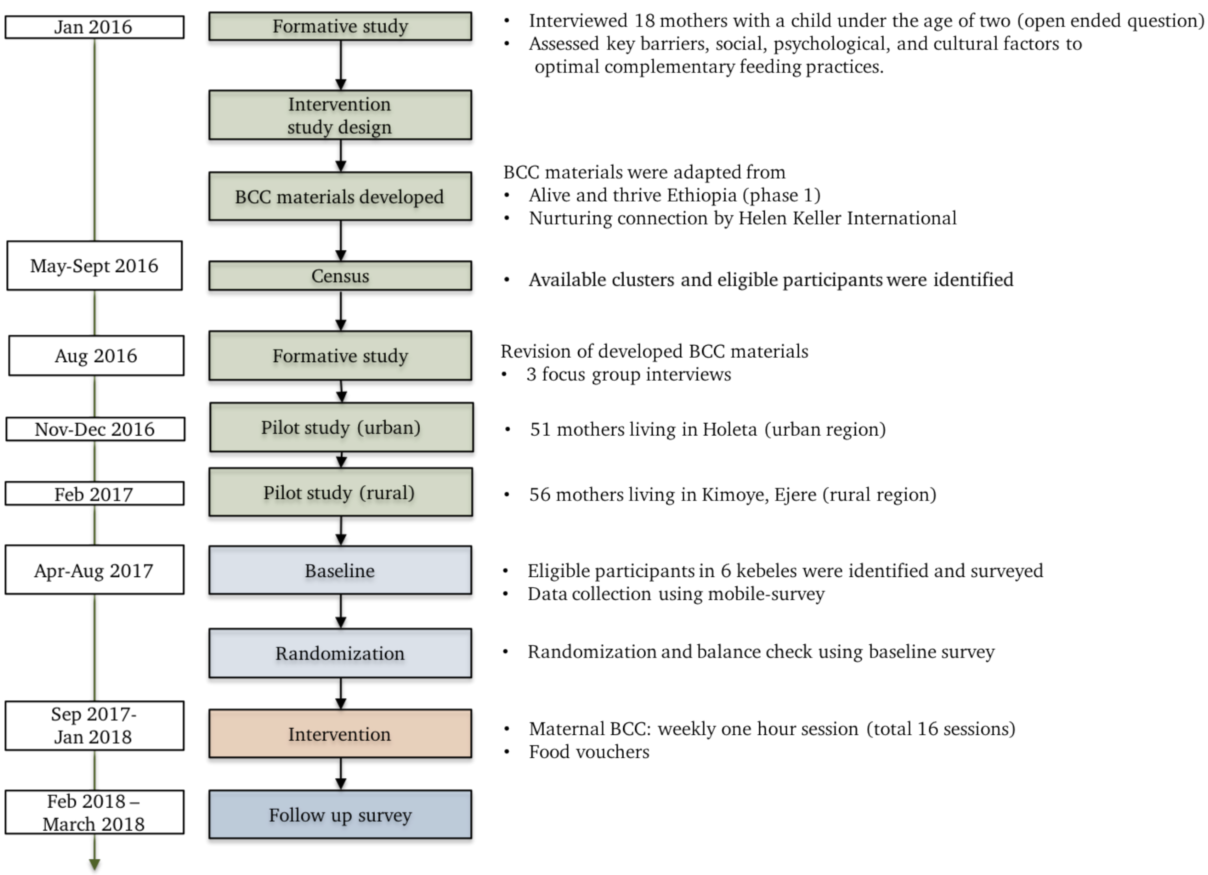
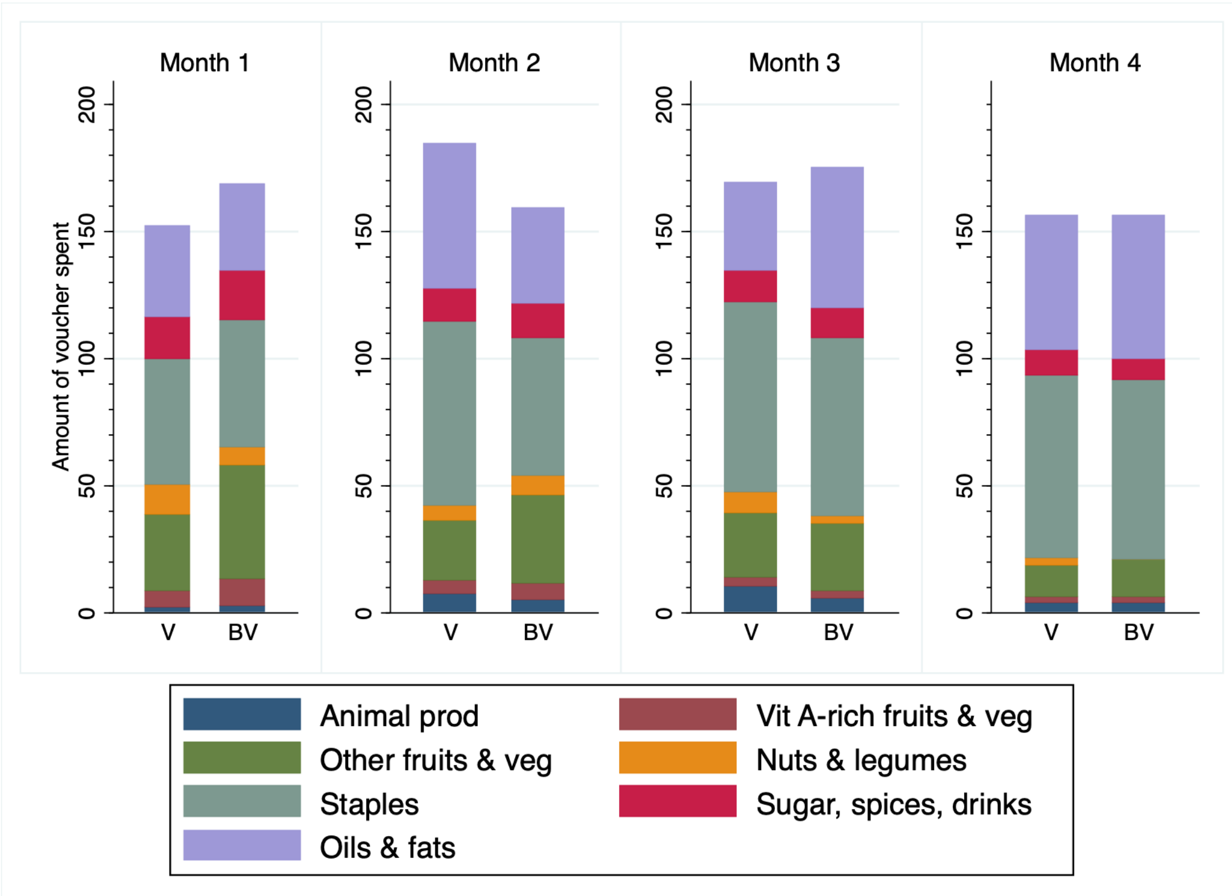


Figure A5: Voucher Redemption Patterns Over Time (During Intervention)

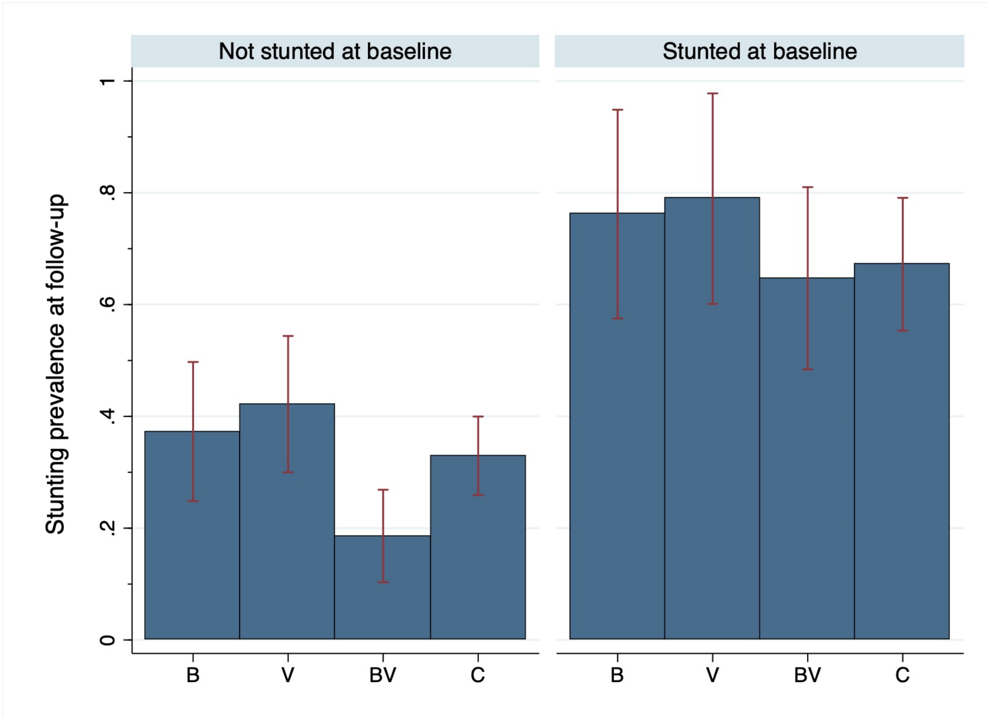

Note: This figure shows total amount of vouchers spent per week over time on average across both *BCC* and *BCC* + *Voucher* groups, using voucher purchase administrative data. The horizontal axis ranges from week 1 to 16. Bars are grouped in 4 weeks, indicating each month.

Figure A6: Voucher Redemption Patterns Over Time by Treatment and Food Group (During Intervention)



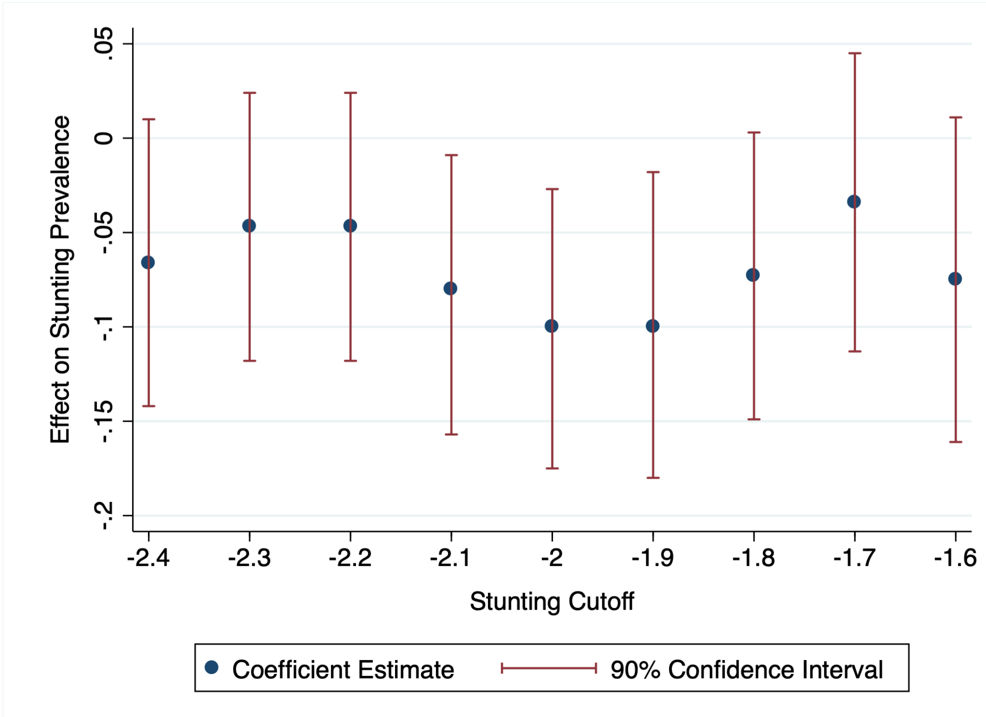

Note: This figure shows monthly voucher expenditures by food group and by treatment groups from month 1 (weeks 1-4) to month 4 (weeks 13-16), using voucher purchase administrative data. V=Voucher, BV=BCC+Voucher.

Figure A7: Stunting Prevalence at Follow-up by Stunting Status at Baseline



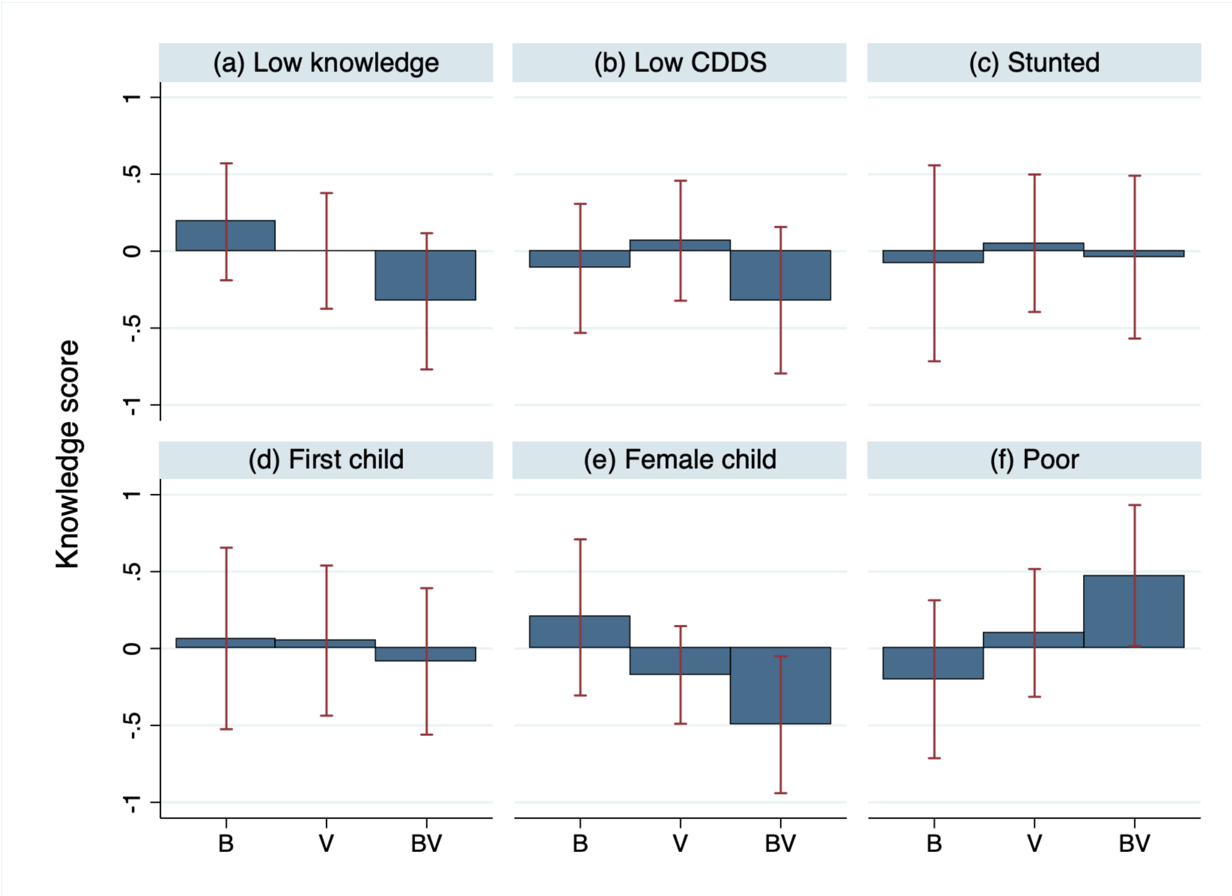

Note: The bar graphs represent mean stunting prevalence at follow-up by study arm conditional on whether stunted at baseline. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher, C=Control.

Figure A8: Effects of $BCC + Voucher$ on Stunting Prevalence by various Cutoffs



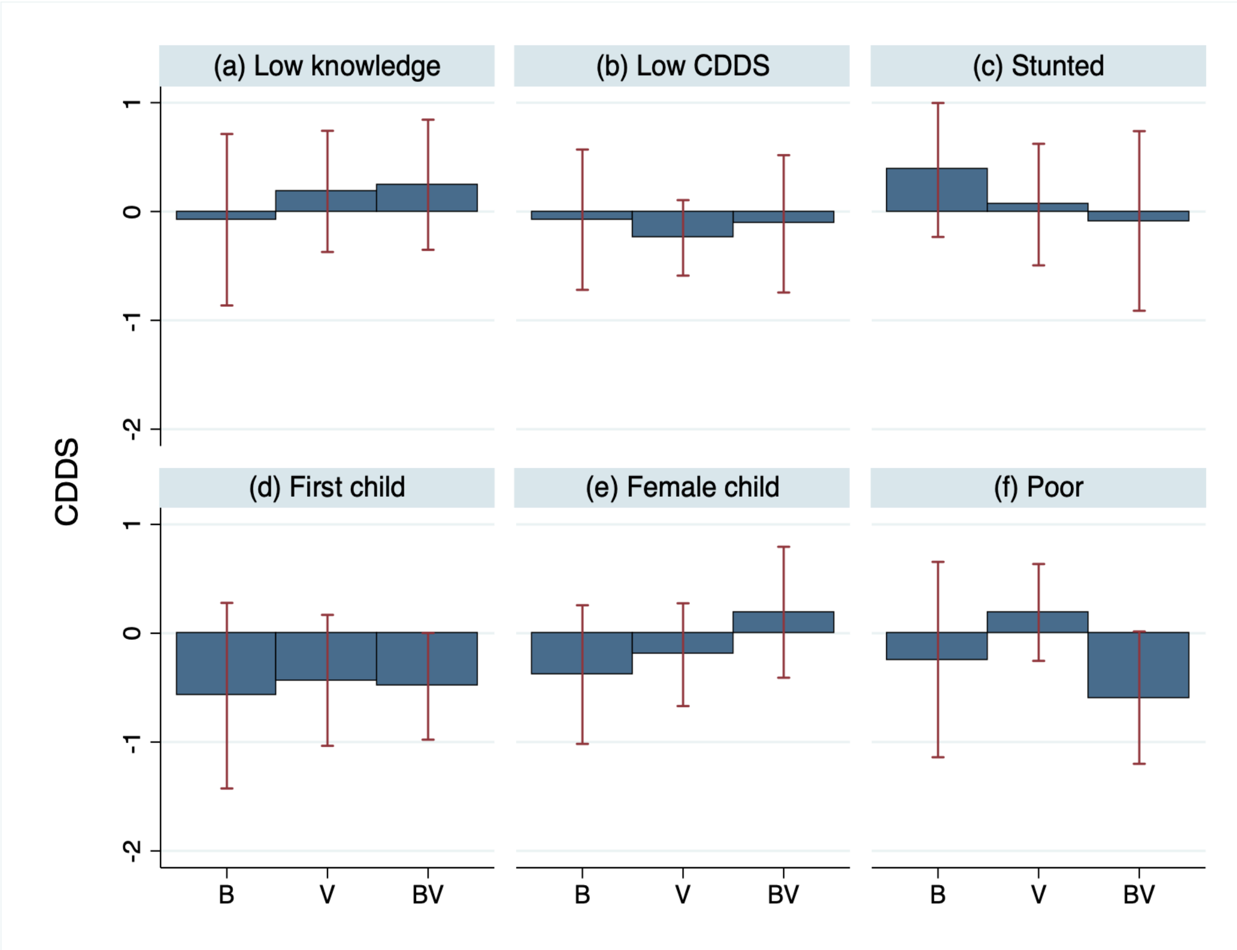

Note: This figure presents the effects of $BCC + Voucher$ on stunting prevalence (vertical axis), varying the stunting cutoff between -2.4 and -1.6 in increments of 0.1 (horizontal axis). The blue dots represent the coefficient estimate and the red vertical lines are the 90% confidence intervals.

Figure A9: Heterogeneous Effects on Knowledge



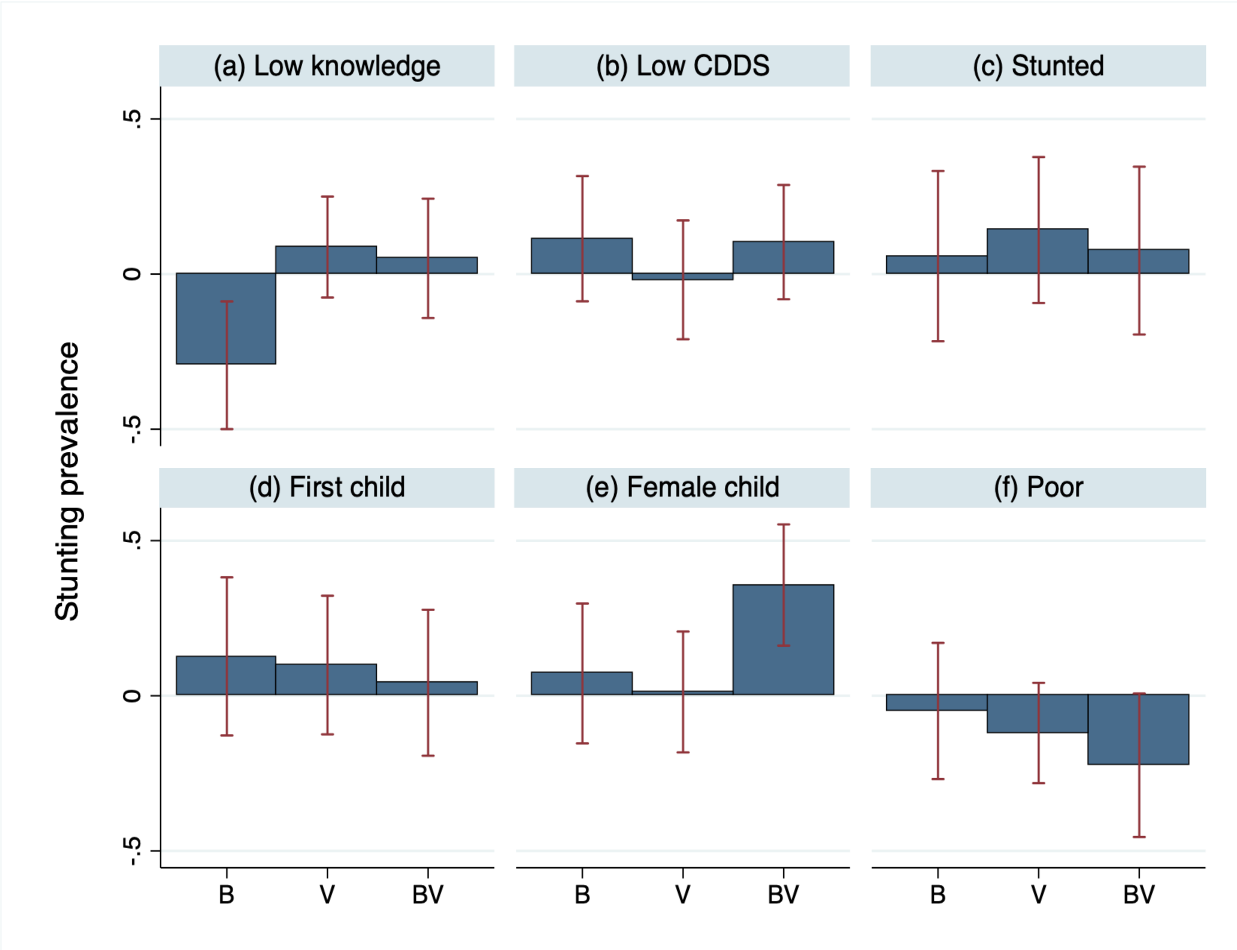

Note: This figure shows heterogeneous treatment effects on mothers' nutritional knowledge score (standardized) by a set of baseline outcomes which include: (a) whether knowledge score lower than the median, (b) whether child dietary diversity score (CDDS) 2 or less food groups, (c) whether child stunted at baseline, (d) whether first child (new mother), (e) whether female child, and (f) whether asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Figure A10: Heterogeneous Effects on CDDS




Note: This figure shows heterogeneous treatment effects on child dietary diversity score (CDDS) by a set of baseline outcomes which include: (a) whether knowledge score lower than the median, (b) whether child dietary diversity score (CDDS) 2 or less food groups, (c) whether child stunted at baseline, (d) whether first child (new mother), (e) whether female child, and (f) whether asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Figure A11: Heterogeneous Effects on Stunting Prevalence




Note: This figure shows heterogeneous treatment effects on stunting prevalence by a set of baseline outcomes which include: (a) whether knowledge score lower than the median, (b) whether child dietary diversity score (CDDS) 2 or less food groups, (c) whether child stunted at baseline, (d) whether first child (new mother), (e) whether female child, and (f) whether asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Table A1: Effects on BCC Attendance and Mother IYCF Knowledge by Topic

| | IYCF Topics: | | | | | |
|---|---|---|---|---|---|---|
| | Animal source foods | Vitamin A-rich fruits & veg. | Malnutrition & care | Feeding quantity, frequency, thickness | Age of intro-duction | Hygiene |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A. Attendance rate by topic** | | | | | | |
| BCC (B) | 0.691*** | 0.611*** | 0.729*** | 0.761*** | 0.652*** | 0.951*** |
| | (0.031) | (0.046) | (0.062) | (0.030) | (0.024) | (0.021) |
| Voucher (V) | -0.001 | -0.001 | -0.005 | -0.002 | -0.000 | -0.001 |
| | (0.004) | (0.008) | (0.010) | (0.007) | (0.004) | (0.008) |
| BCC & Voucher (BV) | 0.726*** | 0.683*** | 0.694*** | 0.765*** | 0.782*** | 0.793*** |
| | (0.030) | (0.055) | (0.027) | (0.017) | (0.020) | (0.035) |
| Observations | 637 | 637 | 637 | 637 | 637 | 637 |
| R-squared | 0.820 | 0.731 | 0.738 | 0.865 | 0.818 | 0.825 |
| P-value: B=BV | 0.420 | 0.317 | 0.606 | 0.912 | 0.000 | 0.000 |
| **Panel B. Knowledge score by topic** | | | | | | |
| BCC (B) | 0.358*** | 0.385*** | 0.353*** | 0.198** | 0.312*** | 0.038 |
| | (0.134) | (0.085) | (0.118) | (0.091) | (0.096) | (0.154) |
| | [0.033] | [0.001] | [0.011] | [0.036] | [0.004] | [0.800] |
| | {0.024} | {0.001} | {0.005} | {0.140} | {0.021} | {0.766} |
| Voucher (V) | 0.028 | 0.096 | 0.096 | 0.013 | 0.012 | 0.015 |
| | (0.124) | (0.104) | (0.160) | (0.113) | (0.096) | (0.118) |
| | [0.827] | [0.406] | [0.588] | [0.900] | [0.904] | [0.911] |
| | {0.860} | {0.466} | {0.459} | {0.930} | {0.931} | {0.900} |
| BCC & Voucher (BV) | 0.282** | 0.308*** | 0.343*** | 0.256*** | 0.211** | 0.051 |
| | (0.109) | (0.091) | (0.081) | (0.084) | (0.091) | (0.102) |
| | [0.015] | [0.004] | [0.000] | [0.002] | [0.046] | [0.643] |
| | {0.058} | {0.020} | {0.003} | {0.091} | {0.132} | {0.644} |
| Observations | 584 | 584 | 584 | 584 | 584 | 584 |
| R-squared | 0.080 | 0.074 | 0.083 | 0.072 | 0.108 | 0.071 |
| P-value: B=V | 0.034 | 0.010 | 0.166 | 0.110 | 0.002 | 0.890 |
| P-value: B=BV | 0.608 | 0.430 | 0.937 | 0.565 | 0.277 | 0.944 |
| P-value: V=BV | 0.076 | 0.060 | 0.137 | 0.044 | 0.041 | 0.796 |

Note: This table reports results on BCC attendance rate and mothers' IYCF knowledge score (standardized) by IYCF topic. Panel A uses administrative data and compares BCC attendance rates with the control group where the control and the voucher group's attendance rates are set to zero. Panel B uses survey data on mothers' IYCF knowledge. All estimations control for a standard set of control variables. Panel B additionally controls for the baseline outcome. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A2: Effects on Other Child Diet Quality Measures

| | Number of times breastfed yesterday | Number of times ate solid or semi-solid food yesterday | Timely intro. of complementary food score (standardized) | Perceived relative diet quality |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| BCC (B) | 0.359** | 0.126 | 0.144** | 0.037 |
| | (0.172) | (0.218) | (0.064) | (0.027) |
| | [0.057] | [0.546] | [0.048] | [0.197] |
| | {0.090} | {0.555} | {0.061} | {0.267} |
| Voucher (V) | 0.249 | 0.303** | -0.035 | 0.052** |
| | (0.177) | (0.145) | (0.084) | (0.025) |
| | [0.188] | [0.055] | [0.709] | [0.046] |
| | {0.244} | {0.127} | {0.697} | {0.115} |
| BCC & Voucher (BV) | 0.004 | 0.495** | 0.134** | 0.077*** |
| | (0.178) | (0.189) | (0.061) | (0.023) |
| | [0.988] | [0.023] | [0.072] | [0.003] |
| | {0.985} | {0.026} | {0.069} | {0.025} |
| Observations | 490 | 580 | 572 | 584 |
| R-squared | 0.146 | 0.062 | 0.043 | 0.053 |
| Control group mean | 5.272 | 2.678 | 0.153 | 0.905 |
| P-value: B=V | 0.594 | 0.376 | 0.064 | 0.544 |
| P-value: B=BV | 0.097 | 0.142 | 0.890 | 0.119 |
| P-value: V=BV | 0.196 | 0.304 | 0.079 | 0.262 |
| P-value: B+V=BV | 0.023 | 0.825 | 0.822 | 0.735 |

Note: This table reports results on number of times breastfed yesterday, number of times ate solid or semi-solid food yesterday, standardized score on timely introduction of complementary foods, and mothers' perception of their children's relative dietary quantity and quality. All estimations include the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

## Table A3: Effects on Household Food Consumption

| | FCS | Whether household ate in the last week: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Meat & poultry | Milk & milk prod. | Eggs | Vitamin A-rich fruits & veg. | Std'ized treat-ment effect | Nuts & legumes | Other fruits & veg. | Staples | Oils & fats | Sugar & spices |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| BCC (B) | 5.446*** | 0.147** | -0.049 | 0.005 | -0.049 | 0.028* | -0.036* | -0.013 | 0.013* | 0.016* | -0.004 |
| | (1.672) | (0.070) | (0.050) | (0.064) | (0.050) | (0.015) | (0.019) | (0.015) | (0.007) | (0.009) | (0.012) |
| | [0.002] | [0.074] | [0.379] | [0.956] | [0.379] | | [0.083] | [0.469] | [0.088] | [0.078] | [0.729] |
| | {0.009} | {0.036} | {0.061} | {0.947} | {0.455} | | {0.330} | {0.125} | {0.174} | {0.280} | {0.597} |
| Voucher (V) | 1.750 | 0.070 | 0.020 | -0.002 | 0.020 | 0.023* | -0.003 | -0.019 | -0.006 | 0.003 | -0.007 |
| | (2.154) | (0.067) | (0.056) | (0.064) | (0.056) | (0.013) | (0.027) | (0.011) | (0.016) | (0.010) | (0.011) |
| | [0.470] | [0.335] | [0.735] | [0.981] | [0.735] | | [0.923] | [0.170] | [0.757] | [0.814] | [0.729] |
| | {0.398} | {0.318} | {0.067} | {0.974} | {0.739} | | {0.116} | {0.897} | {0.659} | {0.860} | {0.370} |
| BCC & Voucher (BV) | 5.658*** | 0.149** | 0.187*** | 0.213*** | 0.187*** | 0.071*** | 0.011 | -0.014 | 0.005 | 0.003 | 0.003 |
| | (1.632) | (0.060) | (0.059) | (0.050) | (0.059) | (0.014) | (0.026) | (0.011) | (0.011) | (0.013) | (0.004) |
| | [0.007] | [0.030] | [0.002] | [0.002] | [0.002] | | [0.696] | [0.222] | [0.674] | [0.815] | [0.411] |
| | {0.009} | {0.051} | {0.068} | {0.005} | {0.010} | | {0.217} | {0.635} | {0.644} | {0.834} | {0.334} |
| Observations | 583 | 583 | 583 | 583 | 583 | 2,915 | 583 | 583 | 583 | 583 | 583 |
| R-squared | 0.218 | 0.201 | 0.245 | 0.203 | 0.245 | 0.157 | 0.061 | 0.064 | 0.055 | 0.047 | 0.051 |
| Control group mean | 53.425 | 0.360 | 0.234 | 0.345 | 0.402 | 0.000 | 0.061 | 0.992 | 0.985 | 0.985 | 1.000 |
| P-value: B=V | 0.107 | 0.377 | 0.255 | 0.929 | 0.255 | 0.757 | 0.218 | 0.714 | 0.197 | 0.151 | 0.865 |
| P-value: B=BV | 0.906 | 0.971 | 0.000 | 0.002 | 0.000 | 0.006 | 0.094 | 0.932 | 0.421 | 0.249 | 0.467 |
| P-value: V=BV | 0.096 | 0.300 | 0.007 | 0.001 | 0.007 | 0.001 | 0.689 | 0.737 | 0.519 | 0.965 | 0.377 |
| P-value: B+V=BV | 0.594 | 0.494 | 0.007 | 0.018 | 0.007 | 0.289 | 0.222 | 0.430 | 0.887 | 0.254 | 0.397 |

Note: This table reports results on household food consumption score (FCS) and household food consumption by food group. Outcomes in Columns 2-11 indicate whether the household ate any food item from the food group. Column 6 reports standardized treatment effect across outcomes in Columns 2-5. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

## Table A4: Effects on Household Expenditures

| | Total food expenditure | Amount spent per capita in the last week: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Meat and fish | Milk and milk products | Eggs | Vitamin A-rich fruits & veg. | Std'ized treatment effect | Other fruits & veg. | Nuts and legumes | Starchy staples | Oils and fats | Sugars, drinks, spices |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| BCC (B) | 13.324 | 9.662** | -0.858 | -0.170 | 0.194 | 0.018 | 1.866* | 3.473*** | 0.988 | -0.297 | -1.379 |
| | (10.675) | (4.212) | (1.226) | (0.242) | (0.253) | (0.015) | (1.025) | (1.259) | (6.151) | (1.152) | (2.707) |
| | [0.293] | [0.044] | [0.537] | [0.502] | [0.503] | | [0.112] | [0.026] | [0.888] | [0.850] | [0.620] |
| | {0.253} | {0.023} | {0.548} | {0.538} | {0.782} | | {0.029} | {0.060} | {0.866} | {0.770} | {0.665} |
| Voucher (V) | 14.690 | 12.669** | 0.176 | 0.176 | -0.205 | 0.025 | 0.281 | 0.171 | -2.408 | 1.196 | 2.230 |
| | (12.226) | (5.118) | (1.846) | (0.407) | (0.221) | (0.021) | (0.645) | (1.106) | (6.713) | (1.483) | (2.358) |
| | [0.268] | [0.024] | [0.931] | [0.740] | [0.370] | | [0.681] | [0.895] | [0.746] | [0.475] | [0.344] |
| | {0.293} | {0.005} | {0.910} | {0.515} | {0.781} | | {0.857} | {0.917} | {0.715} | {0.321} | {0.462} |
| BCC & Voucher | 14.848 | 7.494** | 1.418 | 0.651* | 0.987*** | 0.068*** | 1.039* | 0.325 | -2.386 | 1.040 | 3.643** |
| (BV) | (10.303) | (3.652) | (1.329) | (0.331) | (0.267) | (0.018) | (0.612) | (1.106) | (6.768) | (0.939) | (1.662) |
| | [0.187] | [0.085] | [0.313] | [0.081] | [0.006] | | [0.102] | [0.777] | [0.758] | [0.347] | [0.029] |
| | {0.329} | {0.099} | {0.346} | {0.122} | {0.528} | | {0.226} | {0.874} | {0.620} | {0.933} | {0.224} |
| Observations | 583 | 583 | 583 | 583 | 583 | 2,332 | 583 | 583 | 583 | 583 | 583 |
| R-squared | 0.232 | 0.100 | 0.111 | 0.103 | 0.155 | 0.079 | 0.255 | 0.100 | 0.172 | 0.062 | 0.126 |
| Control group mean | 81.312 | 13.053 | 4.320 | 0.964 | 0.772 | 0.000 | 6.611 | 3.012 | 30.942 | 5.819 | 15.820 |
| P-value: B=V | 0.920 | 0.618 | 0.608 | 0.420 | 0.145 | 0.766 | 0.125 | 0.032 | 0.617 | 0.391 | 0.230 |
| P-value: B=BV | 0.900 | 0.636 | 0.119 | 0.016 | 0.009 | 0.006 | 0.462 | 0.035 | 0.624 | 0.329 | 0.066 |
| P-value: V=BV | 0.990 | 0.345 | 0.537 | 0.277 | 0.000 | 0.055 | 0.347 | 0.910 | 0.997 | 0.921 | 0.554 |
| P-value: B+V=BV | 0.440 | 0.030 | 0.360 | 0.184 | 0.008 | 0.324 | 0.428 | 0.071 | 0.915 | 0.944 | 0.459 |

Note: This table reports results on weekly household food expenditures in total and by food group. Each outcome indicates the amount spent by household in the last week per capita in Ethiopian Birr. Column 6 reports standardized treatment effect across outcomes in Columns 2-5. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5: Effects on Child Physical Growth by Stunting Status at Baseline

| | Stunted | HAZ | Wasted | WHZ |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Panel A. Not stunted at baseline** | | | | |
| BCC (B) | 0.063 | 0.044 | -0.040 | 0.344 |
| | (0.071) | (0.202) | (0.031) | (0.214) |
| | [0.383] | [0.844] | [0.191] | [0.111] |
| | {0.374} | {0.824} | {0.219} | {0.049} |
| Voucher (V) | 0.044 | -0.191 | 0.062 | -0.276 |
| | (0.075) | (0.177) | (0.038) | (0.167) |
| | [0.626] | [0.319] | [0.164] | [0.101] |
| | {0.556} | {0.332} | {0.211} | {0.241} |
| BCC & Voucher (BV) | -0.114* | 0.280 | 0.059* | -0.135 |
| | (0.061) | (0.172) | (0.033) | (0.197) |
| | [0.142] | [0.176] | [0.091] | [0.512] |
| | {0.127} | {0.186} | {0.224} | {0.819} |
| Observations | 341 | 341 | 337 | 337 |
| R-squared | 0.151 | 0.311 | 0.090 | 0.146 |
| Control group mean | 0.291 | -1.208 | 0.057 | 0.136 |
| **Panel B. Stunted at baseline** | | | | |
| BCC (B) | 0.306* | -0.499 | -0.117 | 0.735 |
| | (0.172) | (0.352) | (0.096) | (0.512) |
| | [0.107] | [0.174] | [0.265] | [0.224] |
| | {0.043} | {0.146} | {0.166} | {0.056} |
| Voucher (V) | 0.211 | -0.435 | -0.186** | 0.565 |
| | (0.164) | (0.289) | (0.088) | (0.430) |
| | [0.277] | [0.125] | [0.044] | [0.198] |
| | {0.136} | {0.193} | {0.061} | {0.126} |
| BCC & Voucher (BV) | -0.028 | -0.156 | -0.163 | 0.267 |
| | (0.107) | (0.255) | (0.109) | (0.492) |
| | [0.799] | [0.508] | [0.143] | [0.616] |
| | {0.800} | {0.616} | {0.071} | {0.410} |
| Observations | 121 | 121 | 118 | 118 |
| R-squared | 0.259 | 0.304 | 0.301 | 0.278 |
| Control group mean | 0.706 | -2.286 | 0.118 | -0.116 |

Note: This table reports results on stunting prevalence, height-for-age $Z$ scores (HAZ), wasting prevalence, and weight-for-height $Z$ scores (WHZ) collected after intervention completion. Panel A reports results for children not stunted at baseline and Panel B for those stunted at baseline. All estimations include baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A6: Effects on Child Diet Quality by Stunting Status at Baseline

| | CDDS | MAD | MDD | MMF | STE |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A. Not stunted at baseline** | | | | | |
| BCC (B) | 0.248 | 0.079 | 0.028 | 0.104 | 0.044 |
| | (0.208) | (0.052) | (0.068) | (0.095) | (0.027) |
| | [0.265] | [0.152] | [0.677] | [0.327] | |
| | {0.872} | {0.314} | {0.819} | {0.523} | |
| Voucher (V) | 0.044 | -0.027 | -0.036 | 0.040 | -0.005 |
| | (0.220) | (0.042) | (0.070) | (0.090) | (0.027) |
| | [0.844] | [0.535] | [0.635] | [0.674] | |
| | {0.912} | {0.892} | {0.720} | {0.732} | |
| BCC & Voucher (BV) | 0.557*** | 0.148*** | 0.133* | 0.163** | 0.090*** |
| | (0.199) | (0.050) | (0.070) | (0.075) | (0.027) |
| | [0.058] | [0.023] | [0.180] | [0.050] | |
| | {0.088} | {0.093} | {0.310} | {0.078} | |
| Observations | 396 | 361 | 396 | 291 | 1,444 |
| R-squared | 0.146 | 0.039 | 0.128 | 0.077 | 0.090 |
| Control group mean | 3.153 | 0.127 | 0.352 | 0.545 | 0.000 |
| **Panel B. Stunted at baseline** | | | | | |
| BCC (B) | 0.944*** | 0.153** | 0.237*** | 0.064 | 0.120*** |
| | (0.278) | (0.074) | (0.080) | (0.143) | (0.033) |
| | [0.005] | [0.089] | [0.014] | [0.655] | |
| | {0.093} | {0.116} | {0.293} | {0.838} | |
| Voucher (V) | 0.290 | 0.093 | 0.157 | -0.086 | 0.044 |
| | (0.387) | (0.083) | (0.117) | (0.159) | (0.040) |
| | [0.526] | [0.294] | [0.194] | [0.614] | |
| | {0.739} | {0.753} | {0.862} | {0.921} | |
| BCC & Voucher (BV) | 0.593* | 0.157** | 0.266*** | 0.104 | 0.119*** |
| | (0.315) | (0.072) | (0.094) | (0.112) | (0.035) |
| | [0.092] | [0.055] | [0.016] | [0.368] | |
| | {0.100} | {0.065} | {0.035} | {0.407} | |
| Observations | 144 | 136 | 144 | 118 | 542 |
| R-squared | 0.197 | 0.222 | 0.216 | 0.226 | 0.128 |
| Control group mean | 2.746 | 0.105 | 0.220 | 0.615 | 0.000 |

Note: This table reports results on child dietary diversity score (CDDS), minimum acceptable diet (MAD), minimum dietary diversity (MDD), and minimum meal frequency (MMF) collected after intervention completion. Column 5 reports standardized treatment effect (STE) across all outcomes in columns 1-4. Panel A reports results for children not stunted at baseline and Panel B for those stunted at baseline. All estimations include baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

# Appendix B Proofs

## Proof of Conceptual Model

Building on the literature using a child health production function (Del Boca et al. 2014; Fitzsimons et al. 2016; Gronau 1986; Rosenzweig and Schultze 1983), we conceptualize that households are concerned about adult consumption ($X$), and about their children's health ($H$) which is a function of nutritional input ($C$) and knowledge ($K$). For simplicity, we assume that each household has one adult and one child. The household maximizes the following welfare function by choosing $C$ and $X$ simultaneously:

$$\max_{X,C} \; U(A,H) = A(X) + H(C,K)$$
$$s.t.: \; X + pC \leq Y$$

where $U(.,.)$ captures the utility from adult consumption utility ($A$) and child health ($H$). $X$ is adult consumption, $C$ is child nutritional input, $K$ is nutritional knowledge, $p$ is the price of child nutrition input relative to adult consumption, and $Y$ is income. The function $A(.)$ represents the adult consumption utility function and $H(.,.)$ represents the child health production function. We assume that $A(X)$ is increasing in $X$ and concave, and $H(C,K)$ is increasing in $C$ and $K$.

### Case 1: General Child Health Production Function

Assume that the adult consumption utility and the child health production function are Cobb-Douglas: $A(X) = \gamma \ln X$ and $H(C,K) = \alpha \ln C + \beta \ln K$ where $\alpha, \beta, \gamma > 0$ and $\alpha + \beta < 1$. The optimization problem is:

$$\max_{X,C} \; \gamma \ln X + \alpha \ln C + \beta \ln K$$
$$s.t.: \; X + pC \leq Y$$

where $K$, $p$, and $Y$ are given. As the objective function is increasing in each argument, the budget constraint will be binding at the optimum. We use the budget constraint to solve for

$X$ and substitute in the objective function to obtain:

$$\max_{C} \ \gamma \ln (Y - pC) + \alpha \ln C + \beta \ln K$$

The first-order condition is:

$$\frac{-\gamma p}{Y - pC} + \frac{\alpha}{C} = 0 \tag{B1}$$

Rearranging B1 to solve for $C$, we have:

$$C^* = \frac{\alpha Y}{p(\alpha + \gamma)} \tag{B2}$$

To examine changes in $H$ given changes in $Y$ and $K$, we plug equation B2 into the health production function:

$$H^* = \alpha \ln \left( \frac{\alpha Y}{p(\alpha + \gamma)} \right) + \beta \ln K$$

Taking partial derivates of $H^*$ with respect to $Y$ and $K$:

$$\frac{\partial H}{\partial Y} = \frac{\alpha}{Y} > 0 \tag{B3}$$

$$\frac{\partial H}{\partial K} = \frac{\beta}{K} > 0 \tag{B4}$$

which show that marginal child health returns to income and knowledge are both positive. It follows that $H^0 < H^V \lesseqgtr H^B < H^{BV}$, where $H^0$, $H^V$, $H^B$, and $H^{BV}$ denote child health status given no change (control), given increase in income ($Voucher$), given increase in knowledge ($BCC$), and given increase in both ($BCC + Voucher$), respectively.

**Case 2: (Near) Perfect Complements Child Health Production Function**

To illustrate a simplified case in which the marginal returns to an input is constrained by the other input, we assume a perfect complement relationship between nutritional input and knowledge. This is represented by $H(C, K) = min\{\alpha C, \beta K\}$, with $\alpha, \beta > 0$. We can therefore rewrite the optimization problem as:

$$\max_{X,C} \ A(X) + min\{\alpha C, \beta K\}$$

$$s.t. : \ X + pC \leq Y$$

where $K$, $p$, and $Y$ are given. The optimal bundle for perfect complements satisfy $\alpha C = \beta K$, i.e., optimal bundles are located at the kinks of the indifference curves. This means that starting at one of the kinks, using more of $X$ or more of $K$ does not increase child health. As $K$ is exogenous, the constraint for $H(C, K)$ is $C = \frac{Y-X}{p}$ which is obtained by rearranging the budget constraint, represented by the green vertical line in Figure B1. Using the intersection of the line $\alpha C = \beta K$ with the budget constraint, we can find the solution to the optimization problem as follows:

$$C^* = \frac{\beta}{\alpha} K \tag{B5}$$

$$X^* = Y - \frac{\beta}{\alpha} K p \tag{B6}$$

Based on this set-up, we will examine the following three scenarios: 1) changes in child health given increase in income, 2) changes in child health given increase in knowledge, and 3) changes in child health given increase in both income and knowledge. We show the three scenarios graphically, as the kinked child health function cannot be differentiated. $C_0$, $K_0$, $X_0$, and $Y_0$ denote control group values of child nutritional input, nutritional knowledge, adult consumption, and income, respectively.

Figure B2 illustrates the first scenario. Given increase in income, while it is possible to increase $C$, it is not utility-maximizing to do so as it does not result in any increase in child health given $K_0$. This is represented by $\frac{\partial C}{\partial Y} = 0$. Thus, given increase in income with knowledge remaining constant, the child nutritional input remains the same at $C_0 = \frac{\beta}{\alpha} K_0$ and child health remains unchanged: $H^V = min\{\alpha C_0, \beta K_0\} = H^0$ (Figure B2).

Given increase in knowledge, the changes in the consumption bundle are such that $\frac{\partial C}{\partial K} = \frac{\beta}{\alpha} > 0$ and $\frac{\partial X}{\partial K} = -\frac{\beta}{\alpha} p < 0$. Thus, the increase in $K$ leads to increase in $C$ and decrease in $X$ consumption. In the case of unconstrained households such that $Y \geq X^* + pC^*$, they can afford $C^*$. However, in the case of constrained households, $Y < X^* + pC^*$, they cannot afford $C^*$—i.e., they do not have enough income to practice their knowledge. Hence, the increase in $C$ is limited, which in turn constrains knowledge (Figure B3). To reflect the study setting, we assume that households are constrained by income. This results in some improvements in child health but not to the full extent of the knowledge increase:

$H^B = min\{C_1, K_1\} \geq H^0$ where $C_1 < \frac{\beta}{\alpha}K_1$ (Figure B3).[1]

Lastly, given increase in both income and knowledge, households are now fully able to afford the increase in knowledge, leading to further increase in $C$ (Figure B4). Reflecting the study setting, we assume that amount of the income increase (voucher transfers) is sufficient for purchasing optimal child nutritional inputs: $Y \geq X^* + pC^*$. This leads to further improvements in child health: $H^{BV} = min\{C_1, K_1\} > H^B \geq H^0$ where $C_1 = \frac{\beta}{\alpha}K_1$ (Figure B4). In summary, we obtain that $H^0 = H^V \leq H^B < H^{BV}$.

In conclusion, the above two cases of child health production functions that assume different relationships between $C$ and $K$ allow us to establish the following proposition:

**Proposition.** If $C$ and $K$ are imperfect complements, then $H^0 < H^V \lesseqgtr H^B < H^{BV}$. However, if $C$ and $K$ are (near) perfect complements, then $H^0 \backsimeq H^V \leq H^B < H^{BV}$.

[1] $H^V = H^B$ would hold in an extreme case of income constraint, $Y \leq \bar{X} + p\bar{C}$, where $\bar{X}$ and $\bar{C}$ represent subsistence level household consumption and child nutritional inputs.

Figure B1. Child Health Function (No change)

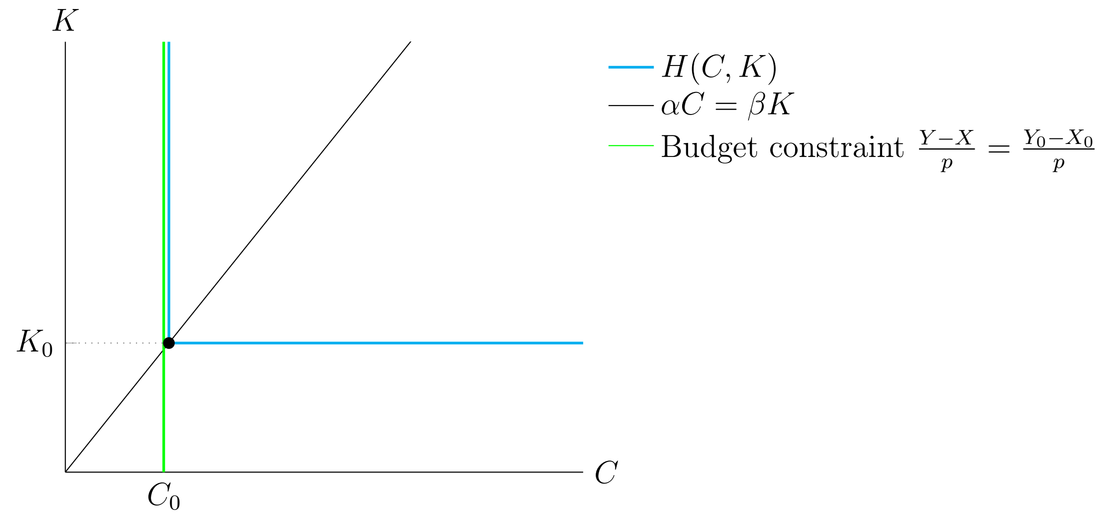



Figure B2. Voucher ($Y_0 \rightarrow$Y$_1$)

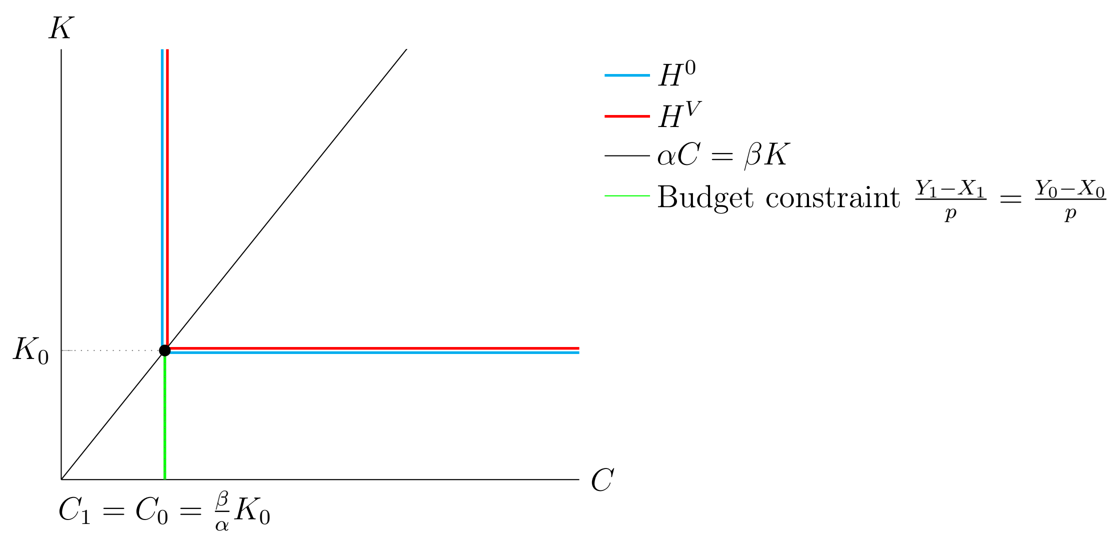


Figure B3. BCC ($K_0$ →K$_1$)

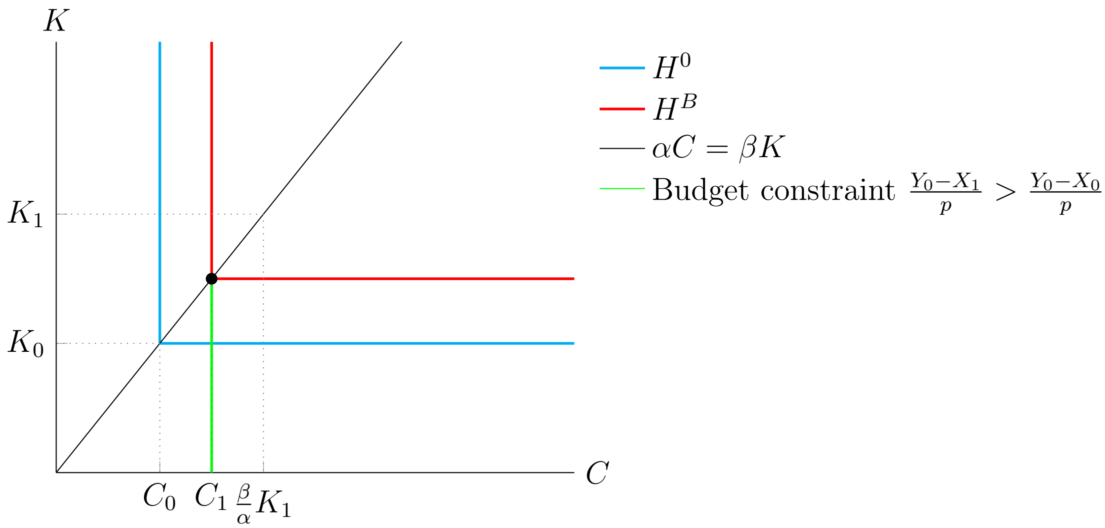
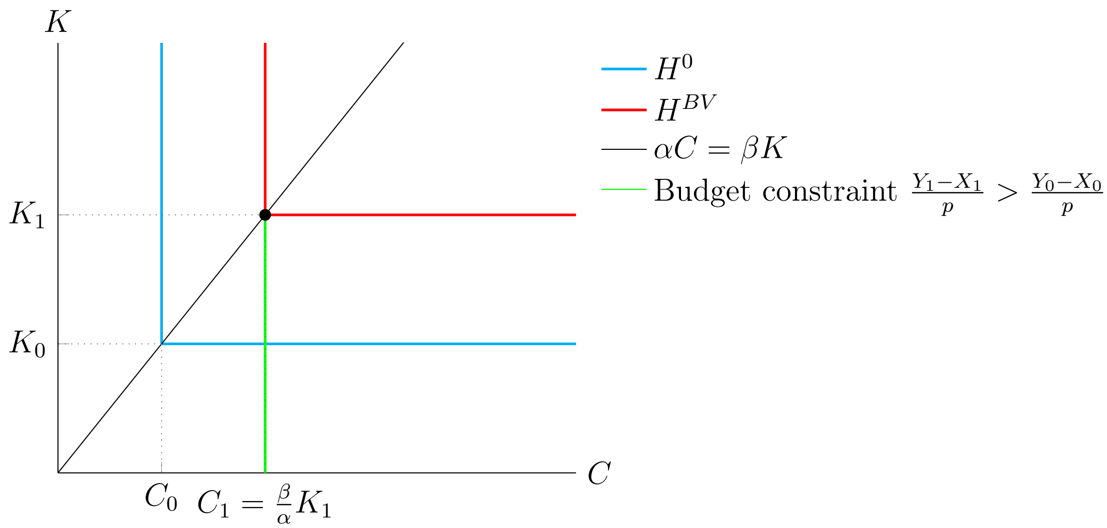



Figure B4. BCC & Vouchers ($Y_0$ →Y$_1$ & $K_0$ →K$_1$)



# Appendix C Mother IYCF BCC Curriculum

| Week | Contents | Week | Contents |
|---|---|---|---|
| 1 | Introduction | 9 | A: Frequency & amount of complementary food<br>B: Eating schedule & discussion |
| 2 | Dietary diversity and weekly diet schedule | 10 | Recipe and cooking demonstration |
| 3 | When to start complementary feeding | 11 | Responsive feeding |
| 4 | Thickness & consistency of complementary food | 12 | Feeding during illness |
| 5 | Role play & discussion | 13 | Role play & discussion |
| 6 | Food variety-iron, proteins from meat | 14 | Hygienic preparation & storage of food |
| 7 | A: Enrichment of complementary food<br>B: Household food processing strategy | 15 | Group discussion & review |
| 8 | Role play & discussion | 16 | Testimonials & ceremony |

# Appendix D Mother IYCF Knowledge Questionnaires

| 1. At what age should a baby first start to receive foods (such as porridge) in addition to breast milk?<br>99=Don't know 88=cannot remember | ________month |
|---|---|

| | 2. Please tell me if the following statement is true or false. If you don't know, say don't know. | | | |
|---|---|---|---|---|
| | Statements | True | False | Don't know |
| a | If a child does not eat enough iron, brain development will be delayed. | X | | |
| b | If a child does not eat enough iron, children will become anemic. | X | | |
| c | Vegetables and fruits are the best source of iron. | | X | |
| d | Zinc helps to prevent illness such as diarrhea. | X | | |
| e | Meat is the food that is rich in iron. | X | | |
| f | Meat is not a good source of zinc. | | X | |
| g | If a child does not eat enough vitamin A rich food, child will have low resistance to illness. | X | | |
| h | If a child does not eat enough vitamin A rich food, child will have eye disease. | X | | |
| i | Eggs are rich in protein that is essential for healthy growth of child. | X | | |
| j | Adding small amount of oil/butter will give extra energy for child's growth. | X | | |
| k | Orange colored fruits and vegetables are rich in vitamin A. | X | | |

| | 3. Please tell me if the following statement is true or false. If you don't know, say don't know. | | | |
|---|---|---|---|---|
| | Statements | True | False | Don't know |
| a | After 6 months of age, feeding only breast milk is adequate to meet the child's needs. | | X | |
| b | The consequence of malnutrition is more serious for a three-years-old child than for a child who is one year old. | | X | |
| c | It is not possible to reverse the effects of malnutrition that happens in the first 2 years of life. | X | | |
| d | At 7 months of age, babies are not ready to digest foods other than soft gruel. | | X | |
| e | At 9 months, babies are not ready to digest eggs. | | X | |
| f | An adult person needs to feed a young child rather than having an older brother/sister feed the young child. | X | | |
| g | At 7 months babies are not ready to digest thick porridge. Only thin porridge should be given. | | X | |
| h | At 7 months babies do not need fruits in their diet. | | X | |
| i | In addition to normal feeding, children should be fed often—whenever they are hungry. | X | | |
| j | Children should be fed snacks between the meals. | X | | |
| k | Children should be fed animal foods such as egg and meat as often as possible. | X | | |

| 4. For a child 12 up to 24 months of age, how much complementary food should be given per day?<br>1=3 full coffee cups of food (porridge) and one snack, 2=2 full coffee cups of food (porridge) and three snacks,<br>3=4 full coffee cups of food (porridge) and 1 to 2 snacks, 99=don't know | Answer: 3 |
|---|---|

| 5. The quality of complementary food can be improved by [Multiple responses possible) [Do not read the options]<br>1=Replacing water used to make porridge with milk, 2=Adding a small amount of oil or butter to porridge,<br>3=Adding mashed vegetables and animal products such as meat and fish<br>4=None of the above, 96=Other, specify, 99=I don't know | Answer: |
|---|---|

| | 6. Please tell me if the following statement is true or false. If you don't know, say don't know. | | | |
|---|---|---|---|---|
| | Statements | True | False | Don't know |
| a | When a child is sick, child doesn't have appetite, so there is no need to give solid food. Child will eat when they recover from illness. | | X | |
| b | Cooking large amount of foods to consume for a longer period of time is not a problem. | | X | |
| c | Using clean water for cooking is important. | X | | |
| d | Mixing different types of cereals and legumes to make porridge powder will increase child's nutritional status. | X | | |
| e | It is no problem for child to share foods from the family plate. | | X | |
| f | If child refuse to eat, parents should force the child to eat more. | | X | |
| g | Parents should help the child to eat. | X | | |
| h | Child's older siblings should be responsible for feeding the child. | | X | |

| | |
|---|---|
| 7. Please look at these two pictures of porridges. Which one do you think should be given to a young child at 10 months of age?<br>*(Show the images/pictures of thick and watery/thin porridges and tick one of the options here below depending on the respondent answer.)*<br>1=Thin watery porridge, 2=Thick porridge, 99=Don't know<br>**Support material: porridges**<br>1.  2.  | 2 |

| | |
|---|---|
| 8. Do you know any ways to encourage young children to eat?<br>*[Ask open question]* *[Multiple answers possible]* *[Do not read the options]*<br>1=Giving them attention during meals, talk to them, make meal times happy times<br>2=Clap hands<br>3=Make funny faces/play/laugh<br>4=Demonstrate opening your own mouth very wide/modelling how to eat<br>5=Say encouraging words<br>6=Draw the child's attention<br>96=Other, specify 99=Don't know | |