Engaging fathers through nutrition behavior communication change did not increase child dietary diversity in a cluster randomized control trial in rural Ethiopia

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Abstract

Background: Augmenting maternal nutrition behavior change communication (BCC) activities with food vouchers or through greater engagement of fathers may play improve IYCF practices, but their impact is unknown.

Objective: We assess whether, in addition to the provision of maternal BCC, adding paternal BCC, a food voucher, or both a food voucher and paternal BCC improved child diet diversity.

Methods: We implemented a cluster randomized control trial in 92 Ethiopian villages, allocated to four treatment and one control group: (1) Maternal BCC only; (2) Maternal BCC and paternal BCC; (3) Maternal BCC and food vouchers; (4) Maternal BCC, food vouchers, and paternal BCC; and C, control. The trial lasted 16 weeks. Primary outcomes were parental IYCF nutrition knowledge, child Dietary Diversity Score and a household Food Consumption Score. Impacts were assessed using generalized estimating equations.

Results: Maternal BCC increased maternal knowledge of optimal IYCF practices and paternal BCC increases paternal knowledge of optimal IYCF practices. Paternal knowledge also increased when only mothers were exposed to nutrition BCC. All treatment arms had a statistically significant impact on children's dietary diversity scores. Effect sizes range from 10.0% (M&V&P) to 13.2% (M), to 21.2% (M&P) to 23.2% (M&V). Adding vouchers to maternal BCC produced a larger effect than maternal BCC alone but the difference was not statistically significant (P=0.18). Adding paternal BCC to the maternal BCC treatment did not lead to a larger increase in child diet diversity. Adding paternal BCC to the maternal BCC and voucher treatment did not lead to a larger increase in child diet diversity; we reject the null (P=0.03) that these had equal effects.

Conclusion: Increased paternal involvement does not necessarily translate into improvements in child feeding outcomes. Caution should be used when considering how to engage fathers in actions that affect child nutrition outcomes.

Keywords: Child dietary diversity; Behavior Change Communication; Food Vouchers; Paternal involvement; Ethiopia.

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Abbreviations

Average Standardized Treatment Effect	ASTE
Behavior Change Communication	BCC
Child dietary diversity score	CDDS
Control	C
Height-for-age Z scores	HAZ
Infant and Young Child Feeding	IYCF
Maternal BCC only	M
Maternal BCC and food vouchers	M&V
Maternal BCC, food vouchers and paternal BCC	M&V&P
Maternal BCC and paternal BCC	M&P
Weight-for-Height Z scores	WHZ

Abstract

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Results: Maternal BCC increased maternal knowledge of optimal IYCF practices and paternal BCC increases paternal knowledge of optimal IYCF practices. Paternal knowledge also increased when only mothers were exposed to nutrition BCC. All treatment arms had a statistically significant impact on children's dietary diversity scores. Effect sizes range from 10.0% (M&V&P) to 13.2% (M), to 21.2% (M&P) to 23.2% (M&V). Adding vouchers to maternal BCC produced a larger effect than maternal BCC alone but the difference was not statistically significant (P=0.18). Adding paternal BCC to the maternal BCC treatment did not lead to a larger increase in child diet diversity. Adding paternal BCC to the maternal BCC and voucher treatment did not lead to a larger increase in child diet diversity; we reject the null (P=0.03) that these had equal effects.

Conclusion: Increased paternal involvement does not necessarily translate into improvements in child feeding outcomes. Caution should be used when considering how to engage fathers in actions that affect child nutrition outcomes.

Key words: Child dietary diversity; Behavior Change Communication; Food Vouchers; Paternal involvement; Ethiopia

Introduction

Globally, 149 million children under the age of five are stunted (height-for-age Z score < -2).[1] Stunting is linked to short- and long-term life outcomes, affecting morbidity, cognitive function, schooling, and labor market outcomes.[2,3] In Ethiopia, the focus of this study, the prevalence of stunting in children under the age of five was 38% in 2016.[4] In Ethiopia, stunting increases sharply around age five months when complementary foods are first introduced and increases until 24 months of age (Supplementary Figure 1).[4] An important cause of stunting during this period is sub-optimal Infant and Young Child Feeding (IYCF) practices, in terms of both the quantity and nutrient quality of food fed to children.[5–7]

Multiple factors contribute to sub-optimal IYCF practices including limited availability and affordability for food and a lack of knowledge regarding appropriate complementary foods to feed young children.[8,9] Nutrition Behavioral Change Communication (BCC) is seen as a means of addressing limited knowledge about appropriate IYCF. It has been shown to improve infant and young child feeding knowledge and practices as well as complementary feeding practices,[10–12] caloric intake,[13] height,[13,14] and weight.[12,15] However, while nutrition education improves IYCF and child nutrition status, nutrition education stand-alone programs often have modest impacts.[16]

There are several reasons why these impacts may be modest. Nutrition BCC programs usually target only mothers even though paternal involvement in children's diet can potentially affect feeding practices. Limited paternal understanding or engagement with IYCF may limit mothers' ability to improve complementary feeding practices because fathers often determine the purchases of nutritious but expensive food items. There were few associational studies concerning paternal involvement and IYCF practices, and the results were mixed. Several studies have shown a positive relationship between paternal IYCF knowledge and improved feeding practices[17]. However, there are also studies that show potential downside of fathers' involvement mainly through increased male dominance in decision-making thereby decreasing women's autonomy.[18] Despite the mixed results on impacts of father engagement on child feeding practices, there are, to the best of our knowledge no intervention studies that causally assess the impact of paternal involvement in IYCF practices.

A second reason is that the foods emphasized as part of nutrition BCC, particularly animal source foods, are often expensive relative to staple foods.[5] One way of resolving this concern is to provide cash transfers alongside the BCC.[19] A second approach, often used in humanitarian settings is to provide a food voucher, allowing the holder to redeem the voucher for a specified set of foods. Relative to an in-kind payment, food vouchers are seen as a means of providing beneficiaries with some choice in how their transfer can be used at lower cost.[20] There are a small number of studies that assess the impact of food vouchers on child diet and anthropometry.[21,22] However, to the best of our knowledge, there are no studies that assess whether combining nutrition BCC with food vouchers leads to larger improvements in child diets compared to nutrition BCC alone.

Therefore, the primary objectives of this study were to assess the effect of maternal and paternal nutrition behavior change communication (BCC) programs on nutrition knowledge and IYCF practices and assessed whether the effects of BCC were altered by providing a food voucher.

Methods

Study design and participants

This study is a community-based, clustered randomized controlled trial. It was conducted in the Ejere district located in the Oromia region of central Ethiopia, 52 km west of Addis Ababa. Ejere covers an area of 300 km^2 and consists of three urban and 27 rural kebeles (ward). The population of the Ejere district in 2015 was 112,111; 5% of the population were children between 4-20 months of age. Supplementary Figure 2 shows the location of the study site relative to Addis Ababa.

In 2016, we conducted a census of the 22,000 households living in the Ejere district to identify eligible participants for the trial (see Supplementary Figure 3 for the study timeline). For inclusion in our study, women had to be permanent residents of the study cluster, have at least one child aged 4-20 months, and have consented to participate. Men were eligible if they lived with a participating woman for more than nine months in the last 12 months. For illiterate participants, enumerators read the consent form. Children's ages were calculated based on mother's recall of the birth date and a local events calendar was used to estimate child age when a mother had difficulty recalling the child's birth date.

The baseline survey was implemented from April to August 2017 before the start of the intervention, and the follow-up period was immediately after the completion of the BCC interventions (December 2017 to March 2018). Baseline and follow-up surveys were conducted using tablet PC at health posts where village gatherings are commonly held. Households were not aware of other intervention arms. We conducted the baseline survey prior to participants' group allocation, and we visited participants again and received a consent specific to the group allocation. Treatment was not blinded. There were no major changes to methods after trial commencement. Ethical approval for the study was obtained from the institutional review board at Cornell University (USA, 1612006823), the Oromia state IRB (Ethiopia, BEIO/AHBHN/1-8/2670), and Myungsung Medical College (Ethiopia).

Statistical analysis

We calculated means and standard deviations to describe our data and outcomes. We used F tests to test for balance across treatment and control arms. We used generalized estimating equations that accounted for within cluster correlation and contained four dummy variables representing the maternal BCC (M) compared to control, maternal & paternal BCC (M&P) compared to control, maternal BCC plus food vouchers (M&V) compared to control, and maternal & paternal BCC plus food voucher (M &V&P) compared to control, adjusting for pre-specified covariates and baseline outcomes.

$$y_{ijk1} = \beta_0 + \beta_1 M_{jk} + \beta_2 (M\&P)_{jk} + \beta_3 (M\&V)_{jk} + \beta_4 (M\&V\&P)_{jk} + \beta_5 y_{ijk0} + \beta_6 X_{ijk0} + \eta_k + \epsilon_{ijk}$$

where y_{ijk1} is the outcome of interest for household *i* from village *j* in ward *k* at follow-up including mothers' nutritional knowledge score and nutrition indicators such as CDDS. M_{jk} are dummy variables equal to 1 if the respondent was living in the M_{jk}, $(M\&P)_{jk}$, $(M\&V)_{jk}$, or the $(M\&V\&P)_{jk}$ treatment villages, respectively, at baseline and zero otherwise. Hence, β_1, β_2, β_3, and β_4 represent the intent-to-treatment estimators. y_{ijk0} is the outcome of interest at baseline. X_{ijk0} is a control vector of baseline household *i*'s characteristics (mother's age, eligible child's age, marital status, birth order, household size, ethnicity) and socioeconomic status (years of maternal schooling, maternal employment status, paternal schooling, paternal employment status, household asset) was used as control covariates. Where there was more than one child under the age of two years, the age of the youngest child was used. η_k is ward fixed effects, and ϵ_{ijk} is an error term clustered at the village level. For main outcomes, we also present results without the control vector as well as the results using the first-difference specification. We construct F tests to test hypotheses that treatment arms have equal effects on the outcomes we consider.

As robustness checks, to address the issue of small number of clusters, we use the wild-cluster bootstrap[23] and randomization inference methods to obtain valid inference.[24] In order to account for multiple hypotheses testing,[25] we group child-feeding practice outcome measures into a domain and take an average standardized treatment effect (ASTE) for several outcome variables.[26,27]

We performed robustness checks for primary outcomes results by running three different regression models (Supplementary Table 2)-controlling for 1) area variables only, 2) area and the baseline value of the dependent variable, 3) with area, baseline of the dependent variable, and other baseline characteristics. We find that the results are robust, and the point estimates and their degree of statistical significance remain similar across the three specifications. Stata 14.2 was used for data analysis.

Randomization and Masking

All villages in Ejere were eligible for inclusion. We randomly selected three rural kebeles (equivalent to a ward) and all three urban kebeles within the Ejere district to include both urban and rural localities. Within the six selected kebeles, 90 villages (also called garees) were identified by Kebele leaders. We randomly assigned garees into the following treatment and control groups in a 1:3 (treatment: control) ratio: M, maternal BCC only; M&P, maternal BCC and paternal BCC; M&V, maternal BCC and food vouchers; M &V&P, maternal BCC and paternal BCC and food vouchers; and C, control (Figure 1). Randomization was conducted for each of the six kebeles separately. The cluster design facilitated delivery of the different treatment arms. Further, spatial separation of garees reduced the likelihood of contamination of the control group. All participants received a nominal financial payment for participating in the survey. If a child was identified as being severely wasted, (s)he was referred to the local health post.

Randomization was computer generated using Stata version 14.2.[28] Survey enumerators were masked to group allocation by conducting baseline survey prior to group allocation and conducting follow-up without knowing the participant's group assignment. To reduce social desirability bias by fathers, we assessed fathers' behavior by asking mothers to report fathers' behavior.

Intervention

The intervention was guided by a Theory of Change that linked maternal and paternal BCC, and food vouchers, to changes in household decision making about food (and the resources available to acquire food) and ultimately to improvements in child diet diversity, see Supplementary Figure 4. The maternal BCC program lasted for 16 weeks. Seven to fourteen participants from the same garee (village) formed one BCC group and met with a trained facilitator (hired through Africa Future Foundation (AFF), a collaborating NGO) at the nearest health posts once a week for an hour. Maternal BCC included messages about appropriate types, diversity, quantity, preparation, and storage of complementary foods (Supplementary Figure 5). An image-oriented booklet containing a summary of optimal IYCF practices and action plans was distributed to all participants. Role-play and food demonstration sessions were also included.

Formative research suggested that fathers' attendance would decline significantly if the BCC sessions went on for an extended period of time. The paternal BCC program lasted for 12 weeks. Seven to fourteen participants from the same garee (village) formed one BCC group and met at the nearest health office once a week for an hour. The Paternal BCC program included messages about diet diversity, consequences of malnutrition during the first two years, fathers' role in childcare, shared division of household labor, and gender equal intra-household decision (Supplementary Figure 5).

Food vouchers worth 200 ETB (approximately 10 USD) were transferred monthly to each household for the duration of four months. In the case of female headed households, they were given to the female head. In the case of male headed households, they were randomly assigned to either the household head or the mother of the child. Transferors verbally stated that the purpose of the vouchers were to enable households to consume healthier foods and that the vouchers were nontransferable, while making it clear that nothing was required of participants to receive the voucher and no rules or regulations were tied to the receipt of the transfers (Supplementary Figure 6).

Outcomes

The primary outcomes of interest are measures of parental IYCF nutrition knowledge, CDDS and a measure of household food security, the Food Consumption Score. Mother and fathers' IYCF knowledge were assessed using a separate survey module that contained 34 and 27 questions, respectively, on topics covered during BCC program (see Supplementary Figures 7 and 8). We report the proportion of questions they correctly answered by taking the total number of correct responses and dividing it by the number of questions asked. When multiplied by 100, this gives a percentage score. To calculate CDDS, we used a survey module that contained questions on 40 food items or food groups that are consumed by children in the study area and age group. The food items were grouped into seven food groups, and CDDS was calculated by summing the number of food groups the child consumed in the past 24 hours.

Other measures of IYCF practices include minimum dietary diversity, minimum meal frequency, and minimum acceptable diet standards.[29] Minimum meal frequency is the proportion of children who consumed minimum number of meals recommended for the age, and minimum dietary diversity is the proportion of children who received food from four or more food groups. Minimum acceptable diet was calculated by combining minimum dietary diversity and minimum feeding frequency adjusting for child's age.

We also constructed a food consumption score, a household level food security measure that captures diet quality in terms of both energy and diet diversity.[30] Data for the GCS came from a seven-day recall module on foods consumed by the household.

As an intermediary outcome, mothers and fathers were asked about their perceived decision-making autonomy surrounding food purchases. Building on formative field research, fathers and mothers were asked (separately) to place their decision-making autonomy on a scale that ranged from zero (fathers make decisions with no input from mothers) to ten (mothers make decisions regarding food purchases with no input from fathers).

Lastly, we measured child anthropometry. Child's height, weight, and MUAC were collected three times in units of cm, kg, and cm, respectively. Height-for-age Z scores (HAZ), weight-for-height Z scores (WHZ), stunting, and wasting were calculated for analysis using WHO child growth standards.[31]

There were no changes to trial outcomes after the trial commenced.

Sample size

The sample size (ie, the number of clusters and households) was calculated based on the minimum detectable difference of child dietary diversity score and fathers' knowledge score, the two primary outcomes. We estimated a mean detectable difference of 2.48 points in fathers' knowledge score, assuming a standard deviation (SD) of 4.12 and an intra-cluster correlation (ICC) coefficient of 0.1. We used the pilot study results to estimate mean and SD for fathers' knowledge score. A minimum detectable difference of 0.6 food group for CDDS was calculated assuming SD of 1.07 and an ICC coefficient of 0.073. DHS Ethiopia 2012 data was used to estimate the mean, SD, and ICC coefficient for CDDS. All calculations were set at 95% confidence levels, 90% power and assumed 10% attrition.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

778 eligible women were enrolled from 90 clusters (Figure 1). 651 of these women had husbands or partners, and 509 partners were enrolled in this study. We excluded those who do not live with spouses from the sample, and conducted an intent-to-treat analysis, including all mothers who have partners.

An agrarian semi-subsistence economy, the majority of the rural population in Ejere were poor, and the urban population were a mix of agrarian and wage employees. Table 1 reports baseline characteristics. A mean household size of 4.7 people, the mean age of the eligible mother, father, and child was 28 years, 34 years, and 14 months old, respectively. The WHO standard IYCF indicators showed inadequate IYCF practices, consuming only 2.7 out of 7 food groups the previous day.

We assessed balance at baseline across treatment and the control arms in terms of both outcomes and control variables used in our analysis (Table 1). The sample is balanced between the treatment and the control groups. At endline, attrition for our samples of mothers, fathers and children was 7.4%, 7.5%, and 15.7% respectively. Attrition was balanced across the treatment and control groups.

First Stage Outcomes: BCC Attendance

To assess whether mothers and fathers attended the BCC sessions, and whether this differed by treatment arm, we estimated the proportion of sessions attended as a function of treatment status and the control variables described above. Converting the parameter estimates reported in Table 2, treatment arms that included maternal BCC led to women attending between 73.3 and 77.5 percent of the mothers' BCC sessions that were conducted. Treatment arms with paternal BCC led to fathers attending between 65.0 and 68.0 percent of the fathers' BCC sessions that were offered. There was no statistically significant difference in mothers or father attendance by treatment arm.

Primary Outcomes: IYCF knowledge, Child Diet Diversity, and Household Food Consumption Score

We assessed the impact of the BCC treatments on IYCF knowledge (Table 3). Mother's IYCF knowledge significantly increased in all treatment groups compared to control, increasing the proportion of questions correctly answered by 0.042 to 0.068 , the equivalent of 4.2 to 6.8 percentage points. Treatment arms that provided BCC to fathers increased the proportion of questions they correctly answered by 0.083-0.084 or 8.3-8.4 percentage points. Table 3 also shows that fathers' IYCF knowledge increased in treatment arms where their wives received BCC but they did not (these are the Maternal BCC and Maternal BCC & Food Voucher groups), increasing the proportion of questions correctly answered by 0.037 and 0.048. For women's IYCF knowledge, we do not reject the null that these impacts are equal across treatment arms. For men's IYCF knowledge, we do reject the null that the effects are equal for the *M&V* and the *M&V&P* treatment arms. The results are robust to changes in model specification and to adjusting the prob values used in the tests of equality of coefficients to account for the small number of clusters in our study, see Supplementary Table 1.

We next assessed the impact of these treatment arms on children's diet quality as measured by the CDDS. Panels A and B of Figure 2 present descriptive statistics of CDDS at baseline and follow-up survey, respectively. There was a change in the CDDS distribution in the *M&P*, and *M&V* groups relative to the control group, with the overall CDDS distribution shifting rightward. It also shows a smaller shift in the CDDS distribution in the *M* and *M&V&P* groups relative to the *M&P*, and *M&V* treatment groups.

Table 3 shows that the maternal BCC treatment increased CDDS score by 0.43 food groups, equivalent to a 13.2% increase compared to the control group. When maternal BCC was combined with either paternal BCC or food voucher, the increase is larger, 0.68 and 0.74 food groups, in the *M&P* and *M&V* groups respectively. This is equivalent to a 21.0% and 23.1%

increase compared to the control group. The increase in CDDS in the *M&V&P* group is 0.32 food groups. We reject the null hypothesis that the impacts of *M&V* and *M&V&P* are equal.

We next assessed the impact of these treatment arms on household diet as measured by the Food Consumption Score. Table 3 shows that household food consumption score (FCS) significantly increased in *M*, *M&V*, and *M&V&P* groups, compared to control, increasing the FCS by 7.2 and 6.1, and 4.8 points, respectively. This is equivalent to a 13.5%, 11.4%, and 9.1% increase compared to the control group.

Table 4 reports the impact on specific food groups consumed by children in the previous 24 hours. The *M&V* arm had a statistically significant effect on all food groups emphasized during the BCC sessions. It increased the proportion of children who consumed dairy products, meat, eggs and Vitamin A rich fruits and vegetables by 0.14, 0.13, 0.22 and 0.098 respectively. Three treatment arms increased consumption of dairy products – *M, M&V*, and *M&P*– but *M&V&P* did not. *M&V* and *M&P* had statistically significant effects on the likelihood that children consumed eggs and Vitamin A rich fruits and vegetables, but the other treatment arms did not. We reject the null that the impacts of *M&V* and *M&V&P* are equal for consumption of dairy products, meat, and eggs. There was no impact on two food groups that were not emphasized in the BCC sessions – grains, roots and tubers, and other fruit and vegetables. *M, M&V* and *M&P* increased consumption of legumes and nuts. Supplementary Table 2 shows that tests of equality of coefficient are robust to corrections for small numbers of clusters. Supplementary Table 2 shows that when we calculate average standardized treatment effects (ASTE) of the food groups that were emphasized during the BCC program, we find similar patterns.

Secondary Outcomes

In our supplementary results, we consider additional IYCF indicators (Supplementary Table 3). We find that the proportion of children who meet the minimum diet diversity standard increased by 20.9, 20.4, and 13.9 percentage points in the *M&V, M&P* groups, and *M&V&P* treatment groups respectively. We find similar patterns in minimum meal frequency and minimum acceptable diet standards. We do not reject the null hypothesis of equal treatment effects; this finding is robust to corrections for small numbers of clusters.

We assessed how the different treatment arms affected household food expenditure (Supplementary Table 4). Consistent with our findings on the impacts on CDDS, we find that the *M&V* treatment increased expenditures on foods emphasized during the BCC training (Meat and fish; Vitamin A rich Foods; Dairy products; Eggs). The *M&V&P* had no impact on expenditures on these food groups. We reject the null hypothesis that the impacts of *M&V* and *M&V&P* were equal for expenditures on meat and fish, vitamin A rich foods and dairy products. These findings are robust to corrections for small numbers of clusters. When we calculate average standardized treatment effects (ASTE) of the food groups that were emphasized during the BCC program, we find similar patterns. Maternal BCC increased expenditures on meat and fish; maternal and paternal BCC increased expenditures on vitamin A rich foods but no other food groups were impacted by these two treatment arms.

Lastly, we assessed whether any treatment arms affected children's anthropometric status. Supplementary Figure 9 shows how child HAZ and WHZ evolved over time for the different treatment groups. Supplementary Table 5 does not show consistent, statistically significant impacts on either HAZ or WHZ for any of the treatments we consider.

Mechanisms

We assess how treatments affected mothers' perception of intra-household decisions (Table 5), scaled from zero (food purchase decisions are made solely by fathers) to 10 (food purchase decisions are made solely by mothers). Treatment arms that only include BCC (*M* and *M&P*) have no effect on maternal decision-making autonomy. However, maternal autonomy is reduced when either vouchers or vouchers and paternal BCC were provided, by 0.23, and 0.24 points respectively, a reduction equivalent to a three percent drop. Focusing on the effects of the *M&P&V* treatment on individual food groups consumed by children in the day prior to the endline interview, Table 5 shows that all point estimates are negative. Two (dairy products and eggs) are statistically significant at the five percent level, reducing maternal decision-making autonomy for these foods by 0.52 and 0.34 points respectively (equivalent to a 7.0 and 4.3 percent reductions relative to the control group). The ASTE results show similar effects (Supplementary Table 6).

Discussion

Reducing chronic undernutrition in children 0-24mo is of intrinsic and instrumental value. Intrinsic because good nutrition is an important outcome right. It is of instrumental value because chronic undernutrition in children in this age group results in impaired brain development, low levels of education, and poor health and labor market attainment in adulthood.[32,33] It is increasingly well understood that the multiple factors contribute to poor nutritional status in early life and thus, interventions that address multidimensional and interrelated causes of undernutrition may be more effective. We contribute to knowledge by assessing the impact of a community-based cluster randomized intervention in Ethiopia that included maternal nutrition

BCC, both maternal and paternal nutrition BCC, maternal nutrition BCC and food vouchers, and both maternal and paternal nutrition BCC together with food vouchers.

We highlight the following findings. Maternal BCC increased maternal knowledge of optimal IYCF practices (these are the impacts seen in the *M, M&P, M&V, and M&P&V* treatment arms) and paternal BCC increased paternal knowledge of optimal IYCF practices (treatment arms *M&P and M&P&V*). But paternal knowledge also increased when only mothers were exposed to nutrition BCC (treatment arms *M* and *M&V)*, suggesting that information provided to mothers is shared with their husbands.

All treatment arms had a statistically significant impact on children's dietary diversity scores. Effect sizes range from 10.0% (*M&V&P*) to 13.2% (*M*), to 21.2% (*M&P*) to 23.2% (*M&V*). Adding vouchers to maternal BCC produced a larger effect than maternal BCC alone; however, the difference in impacts was not statistically significant (P=0.18). Adding paternal BCC to the maternal BCC treatment did not lead to a larger increase in child diet diversity. Adding paternal BCC to the maternal BCC and voucher treatment arm did not lead to a larger increase in child diet diversity; the impact (in percentage terms) is half that of maternal BCC and vouchers alone and we reject the null that the impacts of *M&V* and *M&V&P* are equal.

In the treatment arms where child diet quality improves, these improvements are driven by a greater likelihood that the child consumed dairy products, meat and eggs – foods emphasized during the nutrition BCC sessions. The effect sizes are large relative to the control group. For example, *M&V* increases whether eggs were consumed the previous day by 22.5 percentage points, an 83 percent increase relative to the control group. *M&V* also increases whether meat was consumed the previous day by 13.8 percentage points, a 125 percent increase relative to the control group. However, the treatment arm that included both adding paternal

BCC and maternal BCC did not lead to a statistically significant increase in the likelihood of consumption of BCC-emphasized foods. Adding paternal BCC to the maternal BCC and voucher treatment lowered impacts on the consumption of these foods relative to maternal BCC and vouchers alone. We reject the null of equality of impacts of *M&V* and *M&V&P* for dairy products, meat, and eggs. Across all child diet outcomes that we consider, we find no evidence that adding paternal BCC led to larger improvements in child diet outcomes.

One explanation for the smaller impacts of the *M&V&P* is this. The food voucher represented an unexpected windfall to the household, appearing at the same time as fathers in the paternal BCC treatment arm were encouraged to become more involved in child feeding practices resulting in a reduction in maternal autonomy in decision-making in the sphere of child feeding. The benefits to improved child feeding practices associated with increased maternal knowledge (the *M* treatment) and with the presence of the voucher (the *V* treatment) were offset by the reduction in maternal autonomy in decision-making. Even though paternal BCC increased paternal knowledge of optimal IYCF practices, it appears that this was insufficient to persuade fathers that when additional resources were made available (the voucher), that they should be spent on nutrient-rich, but expensive, foods to be consumed by young children. What is unclear is why this occurred – were fathers unpersuaded by the information provided in the nutrition BCC sessions or did they simply not attend enough sessions. Further, because in nearly all cases we cannot reject that impacts the null that impacts on maternal decision-making are equal across treatment arms, we emphasize we regard this as a suggestive, not definitive explanation.

Our study has strengths. The cluster-randomized design allows us to make causal interpretations of the results we obtain. The collection of baseline measures before randomization allows us to assess the extent of differential uptake (specifically whether uptake occurred and whether it differed by treatment arm). Masking survey enumerators to group allocation also reduced potential bias. Our study was adequately powered to detect our primary outcomes. A broad range of participants were enrolled. The sample was diverse in age, years of education, marital status, and employment status. This trial population included both urban and rural residents. The cluster design reduced the likelihood of spillovers to the control group.

Our study has limitations. IYCF practices were assessed through self-reported outcome measures which pose a risk for social desirability bias. If such bias exists, and if it differs across treatment arms, this will confound our comparisons of treatments. The measurement of CDDS is based on child's consumption in the past 24 hours. This may not be sensitive enough to capture the changes in IYCF practices in settings where baseline CDDS and consumption of certain food groups, such as meat, is low. Average paternal BCC attendance was relatively low, 63%.

A number of studies in low-income country settings have documented the effect of fathers' involvement on maternal and child health outcomes, showing a positive relationship in settings where men have considerable control over women's access to economic resources.[17,34] However, there can be a downside to increased paternal engagement where this results in a diminution of women's decision-making power; put differently increased male involvement may result in men usurping what was formerly women's territory.[18,35] A better understanding of these intra-household decision-making dynamics, and how they relate to IYCF represents an important area for future research. With that noted, these findings provide cautionary evidence that increased paternal involvement does not necessarily translate into improvements in child feeding outcomes.

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Data Sharing

Individual participant data that underlie the results reported in this article collected during the trial will be available immediately after publication with no end date after de-identification. Data will be available to those who wishes to access the data and study protocol, statistical analysis plan, and analytic code will be shared. Data are available indefinitely at (link to be included)

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Table 1: Maternal, paternal, child, and household characteristics at baseline, by treatment arm

	M	M &V	M&P	M&V&P	C	P value of joint test of equality across arms
Mother (N)	72	120	69	103	227	
Father (N)	58	97	50	90	173	
Maternal BCC attendance	0.72 (0.19)	0.75 (0.22)	0.75 (0.19)	0.77 (0.2)	N/A	0.54
Paternal BCC attendance	N/A	N/A	0.66 (0.17)	0.65 (0.23)	N/A	0.90
Mother attrition	0.08 (0.28)	0.06 (0.25)	0.09 (0.28)	0.08 (0.27)	0.06 (0.24)	0.80
Father attrition	0.04 (0.21)	0.08 (0.27)	0.07 (0.26)	0.06 22 (0.24)	0.07 (0.27)	0.64
Child attrition	0.19 (0.4)	0.19 (0.39)	0.23 (0.42)	0.16 (0.37)	0.12 (0.33)	0.30
Panel A. Mother Characteristics						
IYCF Knowledge score	0.64 (0.14)	0.66 (0.12)	0.66 (0.14)	0.67 (0.1)	0.64 (0.12)	0.10
Married	0.87 (0.35)	0.92 (0.28)	0.86 (0.36)	0.86 (0.36)	0.89 (0.33)	0.80
Age	27.68 (5.64)	28.48 (5.7)	29 (6.79)	29.51 (7.33)	28.11 (6.35)	0.38
Number of school years	4.53 (5.44)	5 (6.3)	4.53 (6.23)	4.31 (5.15)	4.36 (5.42)	0.84
Currently work	0.5 (0.51)	0.56 (0.5)	0.54 (0.51)	0.52 (0.51)	0.55 (0.5)	0.98
Panel B. Father Characteristics						
IYCF Knowledge score	0.60 (0.15)	0.60 (0.12)	0.55 (0.17)	0.61 (0.15)	0.61 (0.15)	0.09
Age	33.98 (8.44)	33.72 (6.5)	34.37 (8.09)	35.34 (9.26)	34 (7.9)	0.56
Number of school years	7.16 (6.08)	6.47 (6.85)	6.44 (6.97)	6.36 (6.02)	6.47 (6.83)	0.59
Currently work	0.85 (0.37)	0.89 (0.33)	0.86 (0.36)	0.92 (0.29)	0.91 (0.3)	0.29
Panel C. Child Characteristics						
Eligible child's age	13.49 (4.96)*	12.08 (5.09)	12.8 (5.36)	12.66 (4.88)	12.04 (4.79)	0.19
Male	1.53 (0.51)	1.42 (0.5)	1.5 (0.51)	1.42 (0.5)	1.5 (0.51)	0.35
Eligible child's birth order	2.38 (1.46)	2.43 (1.45)	2.56 (1.36)	2.46 (1.55)	2.43 (1.46)	0.97
Panel D. Household						
Household size	4.6 (1.48)	4.71 (1.49)	4.83 (1.35)	4.67 (1.56)	4.67 (1.49)	0.82
Orthodox	0.84 (0.38)	0.84 (0.38)	0.83 (0.39)	0.93 (0.27)	0.85 (0.37)	0.41
Oromo	0.76 (0.44)	0.77 (0.43)	0.86 (0.36)	0.7 (0.47)	0.75 (0.44)	0.27
Rural	0.5 (0.51)	0.34 (0.48)	0.56 (0.51)	0.36 (0.49)	0.53 (0.51)	0.00
Has handwashing place	0.72 (0.46)	0.67 (0.48)	0.64 (0.49)	0.72 (0.46)	0.63 (0.49)	0.41
Total asset score	0.14 (1.88)	0.21 (1.66)	-0.13 (1.62)	0.21 (1.6)	0.12 (1.78)	0.79
Panel E. IYCF practices						
Child dietary diversity score	2.71 (1.72)	2.48 (1.59)	2.7 (1.81)	2.75 (1.66)	2.75 (1.61)	0.73
Minim acceptable diet	0.28 (0.46)	0.14 (0.34)	0.18 (0.39)	0.12 (0.33)	0.21 (0.41)	0.09
Minimum dietary diversity	0.36 (0.49)	0.24 (0.43)	0.28 (0.45)	0.3 (0.46)	0.34 (0.48)	0.50
Minimum meal frequency	0.61 (0.5)	0.57 (0.5)	0.58 (0.5)	0.5 (0.51)	0.52 (0.51)	0.59
Panel F. Anthropometry						
WHZ	0.33 (1.34)	0.17 (1.68)	0.26 (1.78)	-0.18 (1.49)	0.15 (1.61)	0.23
HAZ	-1.17 (1.28)	-1.11 (1.69)	-1.15 (1.95)	-0.97 (1.61)	-1.01 (1.84)	0.97

Notes: M: maternal BCC, M&P: maternal & paternal BCC, M&V: maternal BCC & voucher, M&V&P: maternal & paternal BCC & voucher. P values based on one-way ANOVA to jointly test the equality of means across all treatment and control groups.

Table 2: Impact of treatment arms on maternal and paternal attendance at BCC sessions

	Maternal attendance	**Paternal attendance**
Treatment arm		
Maternal BCC	0.733***	
	(0.022)	
Maternal BCC & Voucher	0.772***	
	(0.014)	
Maternal BCC & Paternal BCC	0.765***	0.680***
	(0.029)	(0.017)
Maternal BCC & Voucher & Paternal BCC	0.775***	0.650***
	(0.025)	(0.031)
Control group mean	0.00	0.00
Observations	591	468
R-squared	0.86	0.86
P values for tests of equality of coefficients between selected treatment groups		
P-value: M = M & V	0.37	
P-value: M = M & P	0.14	
P-value: M & V = M & V & P	0.21	

Notes: M: maternal BCC. M & P: maternal & paternal BCC. M & V: maternal BCC & voucher. M & P & V: maternal & paternal BCC & voucher. Estimates include ward fixed effects, and controls for baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively

Table 3: Impact of treatment arms on Maternal IYCF knowledge, Paternal IYCF knowledge, Child Dietary Diversity score and Household Food Consumption Score

	Maternal IYCF knowledge	Paternal IYCF knowledge	Child dietary diversity score	Household Food consumption score
Treatment arm				
Maternal BCC	0.049***	0.048**	0.425**	7.226***
	(0.012)	(0.023)	(0.200)	(1.949)
Maternal BCC & Voucher	0.044***	0.037*	0.744***	6.118***
	(0.014)	(0.019)	(0.177)	(1.620)
Maternal BCC & Paternal BCC	0.042**	0.084***	0.681***	3.052*
	(0.019)	(0.020)	(0.173)	(1.686)
Maternal BCC & Voucher & Paternal BCC	0.068***	0.083***	0.323*	4.868**
	(0.013)	(0.019)	(0.167)	(2.110)
Control group mean	0.69	0.62	3.21	53.69
Observations	591	468	591	591
R-squared	0.12	0.13	0.15	0.19
P values for tests of equality of coefficients between selected treatment groups				
P-value: M = M & V	0.76	0.65	0.18	0.61
P-value: M = M & P	0.75	0.18	0.28	0.06
P-value: M & V = M & V & P	0.09	0.02	0.03	0.60

Notes: Maternal and paternal IYCF knowledge is the fraction of correct answers to tests on the material covered in the BCC sessions. M: maternal BCC. M & P: maternal & paternal BCC. M & V: maternal BCC & voucher. M & V & P: maternal BCC, voucher and paternal BCC. Estimates include ward fixed effects, and controls for baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively

Table 4: Impact of treatment arms on specific food groups consumed by children in last 24 hours, by emphasis given in BCC

	BCC-emphasized food groups					Not emphasized		
	Dairy products	Meat	Eggs	Vitamin A rich fruits and vegetables		Grains, roots, and tubers	Legumes and nuts	Other fruits and vegetables
Treatment arm								
Maternal BCC	0.093*	0.111*	0.104	0.029		-0.018	0.117*	-0.017
	(0.053)	(0.057)	(0.069)	(0.076)		(0.018)	(0.067)	(0.060)
Maternal BCC & Voucher	0.144***	0.138***	0.225***	0.098*		0.007	0.083*	0.040
	(0.041)	(0.030)	(0.058)	(0.052)		(0.011)	(0.048)	(0.044)
Maternal BCC & Paternal BCC	0.173***	0.082**	0.172***	0.105*		-0.017	0.147**	0.019
	(0.057)	(0.041)	(0.062)	(0.054)		(0.022)	(0.058)	(0.044)
Maternal BCC & Voucher & Paternal BCC	0.052	0.074**	0.081*	0.078		-0.009	0.039	0.005
	(0.050)	(0.029)	(0.046)	(0.052)		(0.019)	(0.062)	(0.053)
Control group mean	0.42	0.12	0.28	0.23		1.00	0.37	0.82
Observations	591	591	591	591		591	591	591
R-squared	0.16	0.11	0.13	0.06		0.02	0.05	0.05
P values for tests of equality of coefficients between selected treatment groups								
P-value: M = M & V	0.37	0.67	0.14	0.41		0.25	0.62	0.39
P-value: M = M & P	0.25	0.66	0.42	0.39		0.99	0.69	0.57
P-value: M & V = M & V & P	0.08	0.08	0.02	0.72		0.39	0.49	0.50

Notes: M: maternal BCC. M & P: maternal & paternal BCC. M & V: maternal BCC & voucher. M & V & P: maternal BCC, voucher and paternal BCC. Estimates include ward fixed effects, and controls for baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively

Table 5: Impact of treatment arms on mother's perceived decision-making autonomy relating to food purchases, by emphasis given in BCC

		BCC-emphasized food groups					Not emphasized		
	All food groups combined	Dairy products	Meat	Eggs	Vit A rich fruits and vegetables		Grains, roots, and tubers	Legumes and nuts	Other fruits and vegetables
Treatment arm									
Maternal BCC	-0.147	0.013	-0.462*	-0.273	0.162		-0.079	-0.107	-0.200
	(0.146)	(0.231)	(0.260)	(0.214)	(0.163)		(0.196)	(0.223)	(0.183)
Maternal BCC & Voucher	-0.229**	-0.192	-0.009	-0.210	-0.344***		-0.369**	-0.177	-0.366**
	(0.113)	(0.211)	(0.205)	(0.160)	(0.121)		(0.177)	(0.149)	(0.149)
Maternal BCC & Paternal BCC	-0.133	-0.045	0.136	-0.462*	0.042		-0.466	0.135	-0.125
	(0.209)	(0.296)	(0.314)	(0.256)	(0.208)		(0.289)	(0.246)	(0.264)
Maternal BCC & Voucher & Paternal BCC	-0.239*	-0.522**	-0.078	-0.340**	-0.137		-0.321*	-0.168	-0.229
	(0.123)	(0.238)	(0.255)	(0.157)	(0.138)		(0.176)	(0.175)	(0.157)
Control group mean	7.03	7.43	3.27	7.81	7.99		7.25	7.71	7.77
Observations	590	573	583	589	590		588	572	590
R-squared	0.031	0.045	0.040	0.033	0.062		0.049	0.023	0.033
P values for tests of equality of coefficients between selected treatment groups									
P-value: M = M & V	0.58	0.34	0.10	0.78	0.003		0.20	0.75	0.41
P-value: M = M & P	0.95	0.86	0.11	0.55	0.63		0.24	0.42	0.81
P-value: M & V = M & V & P	0.93	0.07	0.77	0.40	0.13		0.80	0.96	0.42

Notes: Mother's perceived intra-household decision (score range 0-10, 10=mother decide alone). Variations in sample sizes occur because "I don't know" responses were coded as missing. The total food groups combined column shows an average score of 7 food groups combined. M: maternal BCC. M & P: maternal & paternal BCC. M & V: maternal BCC & voucher. M & V & P: maternal BCC, voucher and paternal BCC. All estimates include ward fixed effects, and controls for baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively