

ENGAGING FATHERS IN IMPROVING INFANT AND YOUNG CHILD
FEEDING (IYCF) PRACTICES TO IMPROVE CHILD DIET

A Dissertation

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

By

Yae Eun Han

May 2020

© 2020 Yae Eun Han

ENGAGING FATHERS IN IMPROVING INFANT AND YOUNG CHILD FEEDING
(IYCF) PRACTICES TO IMPROVE CHILD DIET

Yae Eun Han, Ph.D.

Cornell University 2020

An important cause of stunting is limited consumption of complementary foods. To improve complementary feeding practices, behavior change communication (BCC) activities are often used to provide education and counseling. However, most BCC programs commonly target only mothers when fathers have the potential to positively influence complementary feeding practices in settings where gender inequality and the low bargaining power of women are prevalent. The efficacy of paternal BCC program to increase paternal support on improved complementary feeding practices remains unknown.

This community-based, clustered randomized controlled trial that included women who had children between 4 and 20 months old, their children, and the partners of participating women who lived in the 92 *garees* (villages) between April and August 2017; the follow-up ended in March 2018. The trial included 779 women and 509 men who met the eligibility criteria. We randomly assigned the 92 *garees* into treatment and control groups in a 1:3 (treatment:control) ratio: T1, maternal BCC only ($n = 15$); T2, maternal BCC and paternal BCC ($n = 13$); T3, maternal BCC and food voucher ($n = 15$); T4, maternal BCC and paternal BCC and food voucher ($n = 13$); and C, control ($n = 36$). The primary outcomes were the fathers' knowledge and the children's dietary diversity scores.

Study 1 (Chapter 2) assessed the additional impact of the maternal and paternal BCC programs on complementary feeding practices compared to the maternal BCC program alone (T2 vs. T1). The main findings indicate the paternal BCC additionally increase father's IYCF

knowledge however, we do not see evidence of increased IYCF knowledge translating into improvement in IYCF practices as measured by CDDS and WHO standard IYCF indicators.

Study 2 (Chapter 3) assessed the additional impact of the maternal and paternal BCC programs on complementary feeding practices compared to the maternal BCC program alone when affordability constraints are reduced by receiving food voucher (T4 vs. T3). In this study, we compare all four treatment arms for better interpretation of the results. The main findings indicate the group that receive paternal BCC increase fathers' IYCF knowledge significantly compared to the control group. We also find that CDDS significantly improve among the maternal BCC, maternal and paternal BCC, and maternal BCC and voucher groups, compared to the control group. However, surprisingly, providing the paternal BCC and food voucher together in addition to the maternal BCC leads to a smaller increase in CDDS, and the effect is not statistically significant compared to the control group. We find that this effect is mainly driven by the households in which the husband is more actively involved in food purchases.

Study 3 (Chapter 4) assessed beliefs of the mothers and fathers in the BCC and control households by making intra-dyadic comparisons and characterizing the behavioral, normative, and control beliefs. The findings show greater differences in beliefs between the BCC and control mothers. Contrary to expectations, the beliefs of BCC and control fathers are similar overall. As a result, although intra-dyadic concordance between couples in the gender-equal direction is similar between the BCC and control households, more BCC households show discordance between gender-equal mothers and traditional fathers because more BCC mothers have shifted in the gender-equal direction. Finally, a qualitative investigation to explore possible explanations for the unexpected results in the trial show fathers tend to reduce the household budget for food purchases when they receive food vouchers.

BIOGRAPHICAL SKETCH

Yae Eun Han is a public health nutritionist working on social and behavioral challenges related to reducing chronic malnutrition during the critical first 1,000 days of life in resource limited settings. The focus of her PhD training is on nutrition and epidemiology. She conducts primary data collection as well as secondary data analysis. Specifically, she employs field experiments, develop survey instruments, and analyze both primary data and existing datasets. For example, she has implemented a large-scale randomized control trial (RCT) in Ethiopia as part of her PhD thesis. Yae Eun is also leading a primary data collection of biomarkers and 24-hour dietary intake modules and data analysis of long-term cohort studies in Malawi. Although her study mostly focuses on quantitative research, she also has the skills to conduct qualitative research that could be complementary to quantitative studies.

Yae Eun earned a M.Sci. degree in the Department of Chemistry at Imperial College London, UK in 2008. After finishing her degree, she worked at a chemical company for 4 years before entering the Ph.D. degree program in Nutritional Sciences at Cornell University to advance her training in the field of international nutrition research. Yae Eun was trained under the direction of Dr. John Hoddinott. For her dissertation studies conducted in Ethiopia, she managed much of the research process. She applied for funding, designed the interventions, trained survey supervisors, enumerators, and project facilitators, oversaw the implementation of household surveys, and supervised data-cleaning. In addition to developing and orchestrating field research, she conducted all of the analysis and wrote the manuscript.

Going forward, she plans to do research related to identifying causes of undernutrition and suboptimal health behaviors using field experiments and existing datasets.

To Hyuncheol

my love and best friend

and to my parents

who have given unconditional love and support

ACKNOWLEDGMENTS

I would like to express my deepest appreciation for Dr. John Hoddinott for his constant guidance, support, and his advice. Finishing this dissertation while raising two children would have been impossible without his unbelievable support and mentorship. I have learned so many things, which are integral in my career path. I also thank my committee members. I thank Dr. David Pelletier for opening my eyes to qualitative research and providing much feedback, support, and time. I also thank Dr. Pat Cassano and Dr. Rebecca Seguin for their supervisory roles and kind support for my research and academic accomplishments.

I want to thank my husband Hyuncheol who supports me with prayers, love, and encouragement. His love and selfless supports have helped me to enjoy the 6 years with humor. It would have been impossible to finish this dissertation without your support. I would like to thank my parents and in-laws, for the love, prayers, and endless support, especially taking care of Suon and Suryun.

I also want to thank Seollee Park, my co-author and friend. I am hugely indebted to your support, feedback, and patience. Thanks to the Africa Future Foundation, MyungSung Hospital, Korean fellows, and Ethiopian staff for their passion and determination to run this trial successfully.

Most of all, I thank and praise God, for His sincere love and guidance in each and every step I have taken and will take in my life.

TABLE OF CONTENTS

	<i>Page</i>
BIOGRAPHICAL SKETCH.....	v
ACKNOWLEDGEMENTS.....	vii
CHAPTER 1: <i>Introduction and overview</i>	1
CHAPTER 2: <i>Engaging fathers in improving infant and young child feeding (IYCF) practices does not improve child diet or anthropometric outcomes in a clustered randomized controlled trial in rural Ethiopia</i>	16
CHAPTER 3: <i>Engaging fathers in improving infant and young child feeding (IYCF) practices to improve child diet and anthropometric outcomes when households receive food vouchers: a clustered randomized controlled trial in Ethiopia</i>	56
CHAPTER 4: <i>Couples' responses to a behavior change communication to improve parenting and feeding practices for young children in Ethiopia: Concordance, beliefs in the father's role in childcare, shared decision-making, and shared division of household labor among couples: a qualitative investigation</i>	102
CHAPTER 5: <i>Conclusion</i>	146

LIST OF FIGURES

1.1 Consolidated Standards of Reporting Trials (CONSORT) diagram.....	8
1.2 Conceptual framework.....	9
2.1 Consolidated Standards of Reporting Trials (CONSORT) diagram.....	23
2.2 Behavior change communication curriculum.....	25
S2.1. Distribution of father’s knowledge and CDDS of control group at baseline and follow-up.....	42
S2.2. Distribution of weight-for-height Z score and height-for-age Z score of control group at baseline and follow-up.....	43
S2.3. Distribution of father’s knowledge and CDDS score by group assignment.....	44
S2.4. Distribution of weight-for-height Z score and height-for-age Z score by group assignment.....	45
S2.5. Map of Ejere district.....	46
S2.6. Study Timeline.....	47
S2.7. Paternal BCC attendance.....	52
3.1. Consolidated Standards of Reporting Trials (CONSORT) diagram.....	63
S3.1. Kernel density plots of fathers’ knowledge and child dietary diversity score.....	84
S3.2. Kernel density plots of child growth.....	85
S3.3. Paternal BCC program attendance.....	88

TABLE OF CONTENTS

2.1. Maternal, paternal, child, household, IYCF characteristics and anthropometry at baseline.....	30
2.2. Primary outcomes.....	31
2.3. Pre-specified IYCF indicators.	32
2.4. Child food consumption.....	34
2.5. Pre-specified intermediary outcomes.....	35
2.6. Child growth.....	36
S2.1. Robustness check for the primary outcomes.....	48
S2.2. Robustness check for the child growth outcomes.....	49
S2.3. Father’s IYCF knowledge.....	50
S2.4. Household decision on food purchases.....	51
S2.5. Maternal, paternal, child, household, IYCF, and anthropometry characteristics at baseline by paternal BCC attendance.....	53
S2.6. CONSORT 2010 checklist.....	54
3.1. Maternal, paternal, child, household, IYCF characteristics and anthropometry at baseline.....	70
3.2. Primary outcomes.....	72
3.3. Child food consumption.....	74
3.4. Mother perceived intra-household decision on food purchases.....	75
S3.1. Robustness check for the primary outcomes.....	86
S3.2. Robustness check for the child growth outcomes.....	87
S3.3. Treatment effects by fathers’ involvement in household food purchases.....	80
S3.4. Mother involvement vs. Father involvement on primary outcomes.....	90
S3.5. Mother involvement vs. Father involvement (intra-household food decision and child food consumption)	91
S3.6. Pre-specified outcomes- IYCF indicators.....	92
S3.7. Pre-specified outcomes- IYCF indicators (sample without control)	93
S3.8. pre-specified intermediary outcomes.....	94

S3.9. Pre-specified intermediary outcomes (sample without control)	95
S3.10. Child growth.....	96
S3.11. Child growth (sample without control)	97
S3.12. Mother perceived intra-household decision on food purchases (sample without control)	98
S3.13. Child food consumption (sample without control)	99
S3.14. CONSORT 2010 checklist.....	100
4.1. Key variables used to select participants.....	108
4.2. Participants’ characteristics.....	109
4.3. The difference between BCC mothers and control mothers.....	114
4.4. The difference between BCC fathers and control fathers.....	120
4.5. Gender-equal mother and father- comparing couples who are in BCC and control households.....	126
4.6. Concordance in gender-equal direction- comparing couples in BCC and control households.....	127
S4.1. Participants’ characteristics by rural and urban areas.....	138
S4.2. The difference between the BCC fathers and control fathers.....	139
S4.3. Correlations and reliability of constructs.....	140
S4.4. Intra-dyadic concordance in BCC households.....	141
S4.5. Intra-dyadic concordance in control households.....	142
S4.6. BCC curriculum.....	143

CHAPTER 1

Introduction and overview

OVERVIEW

This dissertation contains three research aims that studies social and behavioral aspects of nutrition and the linkages between nutrition and gender in resource limited settings, focusing on children under the age of two. Stunting, an indicator of chronic malnutrition in children under the age of two is linked to short- and long-term life outcomes, affecting morbidity, cognitive function, schooling, and wages ¹. While the prevalence of stunting is decreasing worldwide, the absolute number of the stunted population is growing in Africa ². In Ethiopia, the focus of this study, the prevalence of stunting in children under the age of five is 37% in 2019 ³. Poor nutritional status in early life reflects poor maternal nutrition, limited access to health care during pregnancy, and sub-optimal breastfeeding practices during the first six months of life ¹. During the period of 6-24 months, peak incidence of growth faltering occurs, and longitudinal studies indicate that if nutritional deficiencies are not treated by 2 years of age, health and cognitive consequences are likely to be irreversible. Important cause of malnutrition during this period is mainly due to limited consumption, in terms of both quantities and qualities ². Minimum dietary diversity standard, a measure of diet quality recommended by WHO, show only 12.6% of children aged 6-24 months met the standard in Ethiopia ⁴.

The findings from existing literature show that mothers lack of knowledge as one of the barriers to improved feeding practices. To address a lack of knowledge, behavior change communication (BCC), that uses a mix of interpersonal, group, and mass media channels to address a lack of knowledge is often used. BCC developed through interactive processes with individuals and societies has shown effectiveness in multiple settings in improving complementary feeding practices ⁵⁻⁷, caloric intake ⁸, length ^{6,8}, and weight ^{7,9} in children. However, results are mixed; for example, one study showed no difference in energy intake ⁹, while another study showed a significant improvement in height-for-age Z-score and weight-for-age Z-score ⁸.

However, most BCC programs target mothers when fathers also have the potential to positively influence complementary feeding practices. A common argument for mother-focused programs is that mothers take primary responsibility for feeding their children¹⁰ or are considered the primary caregiver¹¹. Previous association studies suggest paternal support has the potential to significantly improve complementary feeding practices, especially in developing country settings where gender inequality and the low bargaining power of women are prevalent. This is because fathers often determine the purchases of expensive food items that are nutritious but lacking in child's diet, and mothers need fathers' support with household chores to cook improved complementary food, which requires additional tasks and time^{12,13}. Looking at the studies concerning paternal involvement and maternal health show paternal involvement is positively associated with the following outcomes: increased maternal access to antenatal and postnatal services^{14,15}, discouragement of unhealthy maternal practices such as smoking^{16,17}, improved maternal mental health¹⁸⁻²⁰, increased likelihood of contraception usage^{21,22}, and rate of six months exclusive breastfeeding²³. On infant and young child feeding (IYCF), paternal knowledge, practice, and direct involvement in complementary feeding is positively associated with child dietary diversity^{24,25}. Furthermore, a quasi-experimental study conducted in western Kenya showed that targeting fathers and grandmothers as well as mothers improves family members' supportiveness²⁶.

Although there is limited evidence showing the causal impact of paternal support on complementary feeding practices, programs have begun to engage fathers. However, father-targeted programs are usually low intensity programs reaching fathers through broad awareness campaigns, mass media channels, or counseling programs at health centers. Furthermore, health-related programs that are open to both men and women are branded largely as programs for mothers, resulting in low participation of fathers. A few exceptions are programs that have begun to engage fathers in BCC programs. For example, the Soils, Food, and Healthy

Communities (SFHC) project in northern Malawi uses participatory methods involving intergenerational discussion groups to address issues related to gender inequality, cropping systems, and child growth. In Kenya, PATH developed a curriculum intended to improve paternal support in complementary feeding through group discussions in male-only groups.

Another major barrier to improved IYCF practices identified is financial constraint. There are significant differences in food consumption by income in Ethiopia, which indicates affordability constraints. A household's share of non-cereal expenditures increases with income, and in particular, expenditures on animal-source products rise with household income²⁷. The findings from the formative study in study area also show affordability constraints. Many mothers indicate that financial constraints prevent their households from purchasing more diverse foods. Preliminary baseline summary statistics from a sample of 982 observations show a mean child dietary diversity score (CDDS) of 2.32 among children 4-20 months at baseline. The main bottleneck seems to be coming from expensive food items such as meat, eggs, vitamin A-rich fruits and vegetables, and dairy products. When asked how they would allocate an additional 15% of monthly income, a staggering 89% of mothers responded they would spend it on food. Some of the respondent responded that the additional monthly income would help them purchase more expensive foods such as meat or vitamin A rich fruits.

To reduce financial constraint, cash transfer programs with or without activity or behavioral conditions attached have been used widely in many countries. Many conditional cash transfer (CCT) programs with conditionality on specific health-related behaviors, such as use of preventive services, immunization, and healthy behaviors, show that overall, CCT is effective in improving targeted behavior change²⁸. Although CCT programs are designed differently, a review of CCT programs on child nutritional status measured by height-for-age Z-score show that CCT programs have their greatest impacts on the youngest and the poorest children as well as on those exposed to the program for long durations²⁹. Similarly, food vouchers are used to

change particular behaviors or the consumption of particular goods³⁰. An RCT comparing cash, food vouchers, and food transfers shows that although all three modalities significantly improve the quantity and quality of people's foods, vouchers led to significantly larger increases in dietary diversity than the other two modalities and were the most cost-effective³¹.

However, almost all cash-based transfers target mothers as ample research on intra-household bargaining indicates resources under the mother's control have a stronger positive impact on a child's health and schooling than resources under the father's control. Because fathers are aware that the transfers are given to mothers, it is possible mothers won't be able to make independent decisions on purchases, even if they are the recipients of the transfers. Therefore, to increase the likelihood that transfers are used to purchase nutritious foods, and to ensure these foods are allocated to the child, educating both the mother and father on optimal complementary feeding practices and to increase the relative autonomy of mothers in food decision making is essential.

The results from the existing literature led to the following research question. Would increasing paternal nutrition knowledge improve complementary feeding practices by agreeing with mothers to allocate household resources in favor of child's diet? Furthermore, would increasing fathers' awareness on the importance of gender equal household dynamics change father's behavior within the household, creating supportive environment for the mothers to improve complementary feeding practices?

RESEARCH METHODS

Formative research

We conducted focus group interviews for mothers and fathers' group separately to understand intersection between gender and nutrition. The formative study we conducted in the study site also showed gender inequality and the low bargaining power of women is prevalent. Fathers generally see themselves as engaged in their children's care mostly through financial and resource support. While mothers are often overburdened with the dual responsibilities of childcare and time-intensive domestic work, fathers ascribe to a traditional gendered division of roles and responsibilities, making it difficult to share the domestic work. Furthermore, although father communicate with mother about household purchases, the decision-making power is largely unequal within the household, with men having the final say on how the resources are allocated, including nutrition and health-related expenses. Although women may make independent decisions about small purchases, men make the decisions on more expensive purchases that are lacking in child's diet.

Cluster randomized controlled trial

To answer the research question, we implemented a clustered randomized controlled trial in Ejere. 90 garees (villages) were identified and randomly assigned into treatment and control groups in a 1:3 (treatment: control) ratio: T1, maternal BCC only; T2, maternal BCC and paternal BCC; T3, maternal BCC and food voucher; T4, maternal BCC and paternal BCC and food voucher; and C, control. Ownership of the food vouchers for voucher receiving households were individually randomized within the household between men and women. For female headed households, the women were given ownership of the food voucher. As a result of the BCC and food voucher ownership randomizations, we have four treatment arms for voucher owned households; maternal BCC + mother voucher ownership (M-BCC & M-V),

maternal BCC + father voucher ownership (M-BCC & F-V), maternal and paternal BCC & mother voucher ownership (MP-BCC & M-V), and maternal and paternal BCC & father voucher ownership (MP-BCC & F-V). Detailed consort diagram of the trial is presented in Figure 1.

Maternal BCC program was delivered weekly and lasted for 16 weeks, and included messages directly related to IYCF knowledge. Paternal BCC program was delivered weekly and lasted for 12 weeks, and included not only IYCF related messages, but also delivered messages related to gender equal household dynamics. Food voucher worth 200 ETB (approximately 10 USD) were transferred monthly to households for the duration of 16 weeks.

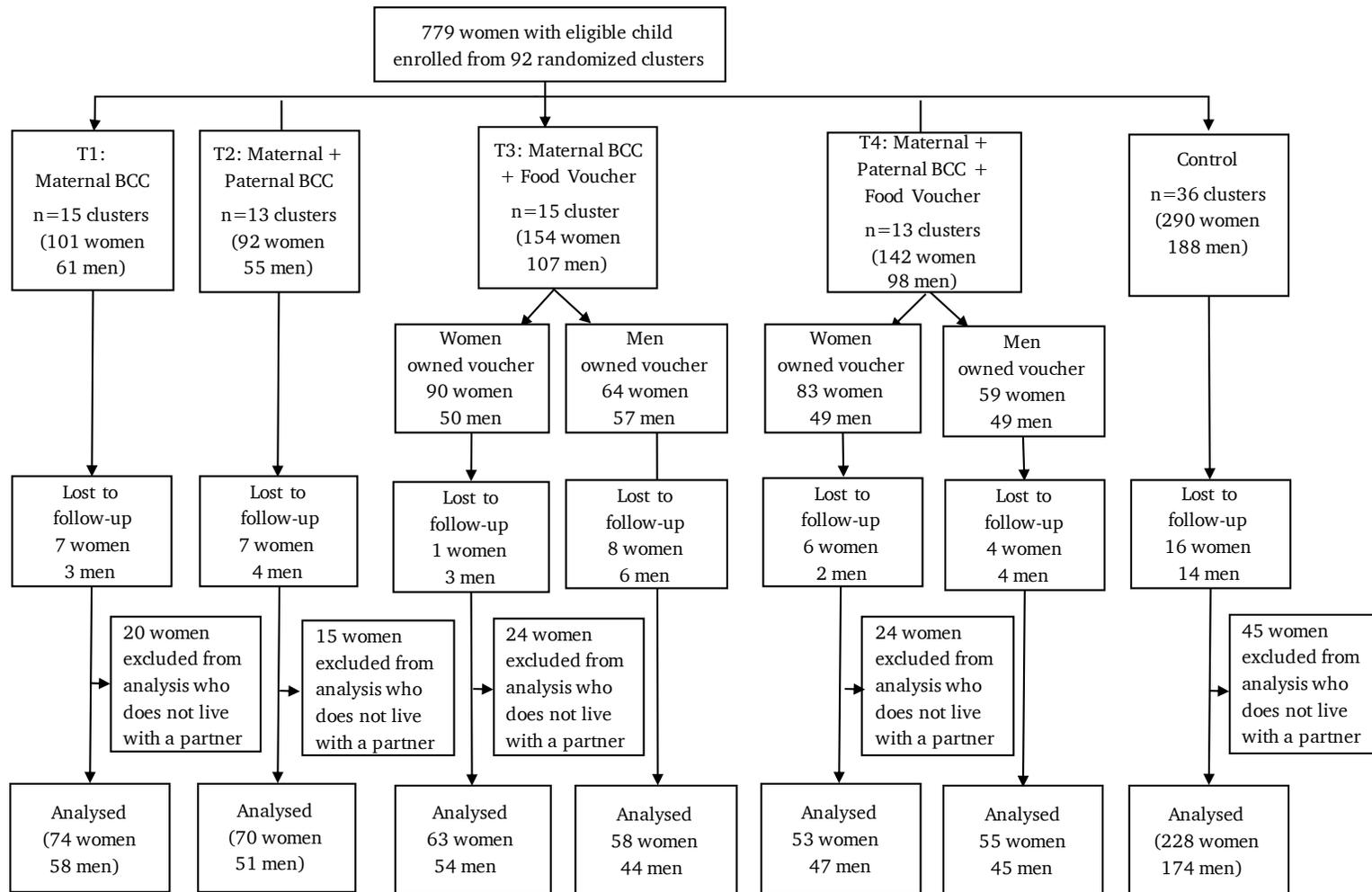


Figure 1.1. Consolidated Standards of Reporting Trials (CONSORT) diagram

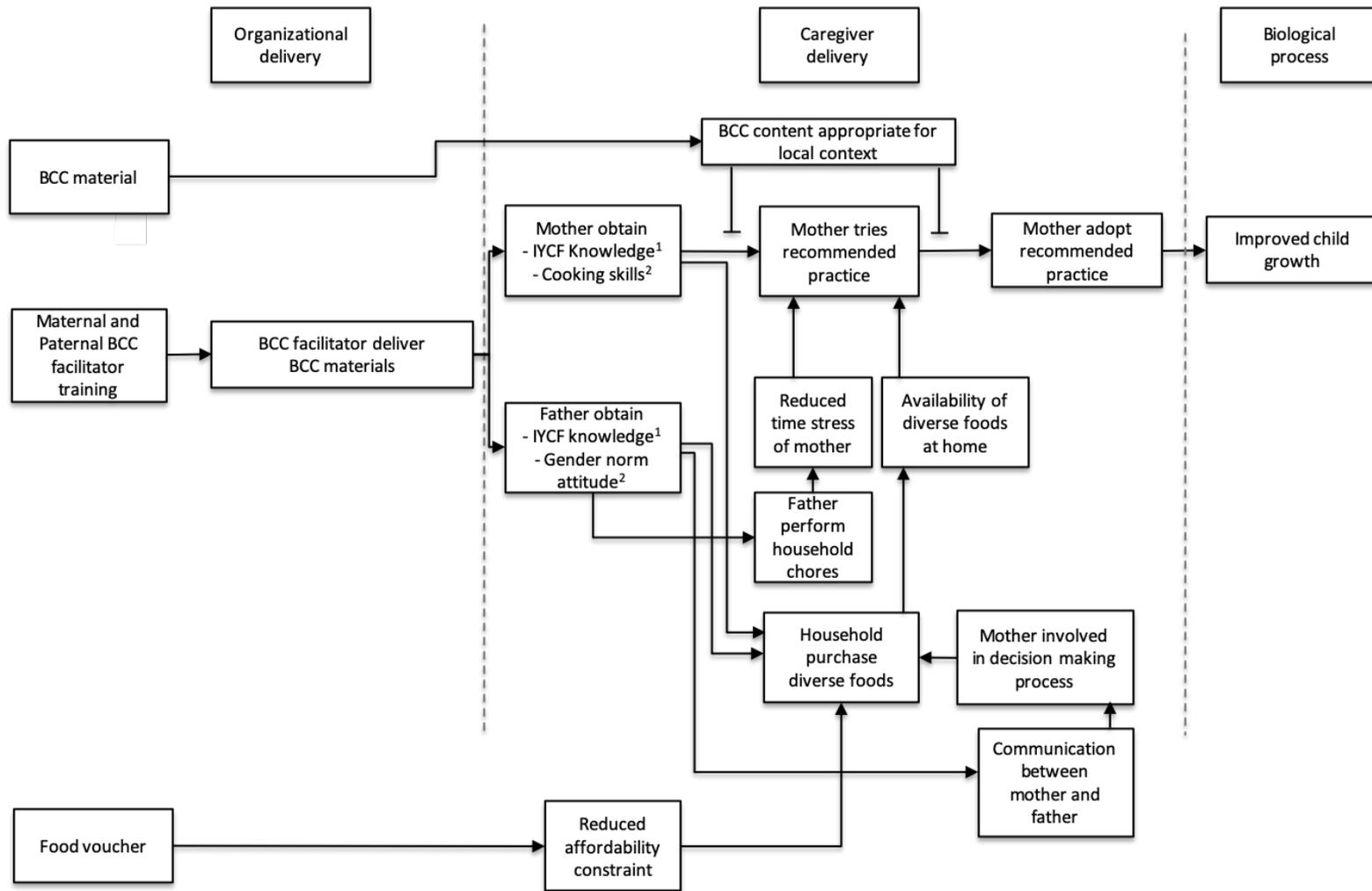


Figure 1.2. Conceptual framework

Qualitative research

Changing health behavior is complex, and behavior change communications have met with mixed success³². Although existing research provides support for facilitators and barriers to changes in mother's behavior in response to a BCC program³³, despite compelling calls for couple-level studies, most studies base their conclusions solely on mothers' self-report³⁴. By characterizing changes in beliefs as mothers and fathers enact new practices in response to BCC at a matched couple level may increase our understanding.

To answer the question, subsets of participants who participated in the RCT were recruited for individual interviews. We recruited fourteen households from the maternal and paternal BCC group and seven households from the control group. Mothers and fathers in each household were interviewed separately.

SUMMARY OF FINDINGS

Chapter 2

In chapter 2, by comparing two treatment groups- maternal BCC (T1) and maternal and paternal BCC (T2)- we test whether the paternal BCC program in addition to the maternal BCC program has additional impact on complementary practices compared to providing maternal BCC program alone. We hypothesized increase in fathers' IYCF knowledge, and changes in paternal behavior related to the shared division of time-intensive domestic work and joint decision-making will additionally improve IYCF practices.

We find paternal BCC has additional impact on father's IYCF knowledge however, we do not see evidence of increased IYCF knowledge translating into an improvement in IYCF practices as measured by CDDS and WHO standard IYCF indicators.

Chapter 3

In chapter 3, we compare four treatment groups-maternal BCC (T1), Maternal & paternal BCC (T2), maternal BCC and voucher (T3), and maternal & paternal BCC and voucher (T4). To better interpret the findings, we test the effects separately by the voucher ownership. We hypothesized increase in fathers' IYCF knowledge, and therefore fathers agreeing with mothers to use the food vouchers to purchase nutritious foods for the child in the maternal & paternal BCC and voucher group (T4) will show biggest improvement in IYCF practices compared to the other treatment groups.

We find the group that received paternal BCC increase fathers' IYCF knowledge significantly compared to the control group. We also find that CDDS significantly improve among the maternal BCC, maternal BCC and paternal BCC, and maternal BCC and voucher groups, compared with the control group, by 0.43, 0.65, and 0.74 food groups. However, surprisingly, providing the paternal BCC and food voucher together in addition to the maternal BCC lead to a smaller increase in CDDS, by 0.31 food group. The effect is not statistically significant compared with the control group. We find that this effect is mainly driven by the households in which the husband is more actively involved in food purchases.

Chapter 4

In chapter 4, we use interview-based qualitative approach to examine the maternal BCC and paternal BCC program, characterizing the behavioral, normative, and control beliefs of both mothers and fathers in BCC households compared to those in control households. I characterize mothers and fathers' beliefs on men's involvement in childcare, household chores, and household decision making. Furthermore, I assess an intra-dyadic comparison to explore how mothers and fathers within the same households share or do not share the same beliefs, and to understand whether the BCC may have altered this. Finally, we examine unexpected results in

the trial that show providing the paternal BCC and food voucher together in addition to the maternal BCC leading to a smaller increase in CDDS compared to providing the maternal BCC and food voucher without the paternal BCC.

We expected the BCC mothers to show more gender-equal tendencies than the control mothers, and BCC fathers to show gender-equal tendencies than the control fathers. As a result, we expected intra-dyadic concordance between couples to be more gender-equal in the BCC households and more traditional in the control households.

The findings show greater differences in beliefs between the BCC and control mothers. Contrary to expectations, the beliefs of BCC and control fathers are similar overall. As a result, although intra-dyadic concordance between couples in the gender-equal direction is similar between the BCC and control households, more BCC households show discordance between gender-equal mothers and traditional fathers because more BCC mothers have shifted in the gender-equal direction. Finally, a qualitative investigation to explore possible explanations for the unexpected results in the trial show fathers tend to reduce the household budget for food purchases when they receive food vouchers, possibly crowding out the effect of the food voucher.

REFERENCES

1. Black, R. E. *et al.* Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* **382**, 427–451 (2013).
2. de Onis, M., Blossner, M. & Borghi, E. Prevalence and trends of stunting among pre-school children, 1990-2020. *Public health nutrition* **15**, 142–148 (2012).
3. Ethiopia, D. Ethiopia Demographic and Health Survey 2016 [FR328]. 1–551 (2017).
4. Beyene, M., Worku, A. G. & Wassie, M. M. Dietary diversity, meal frequency and associated factors among infant and young children in Northwest Ethiopia: a cross-sectional study. *BMC public health* **15**, 1007 (2015).
5. Bhandari, N. *et al.* Use of multiple opportunities for improving feeding practices in under-twos within child health programmes. *Health Policy Plan* **20**, 328–336 (2005).
6. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *The Journal of nutrition* **130**, 1204–1211 (2000).
7. Zaman, S., Ashraf, R. N. & Martines, J. Training in complementary feeding counselling of healthcare workers and its influence on maternal behaviours and child growth: a cluster-randomized controlled trial in Lahore, Pakistan. *Journal of health, population, and nutrition* **26**, 210–222 (2008).
8. Bhandari, N., Mazumder, S., Bahl, R. & Martines, J. An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, *community and international nutrition* (2004).
9. Santos, I. *et al.* Nutrition counseling increases weight gain among Brazilian children. *The Journal of nutrition* **131**, 2866–2873 (2001).
10. Blissett, J., Meyer, C. & Haycraft, E. Maternal and paternal controlling feeding practices with male and female children. *Appetite* **47**, 212–219 (2006).
11. Patrick, H., Nicklas, T. A., Hughes, S. O. & Morales, M. The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. *Appetite* **44**, 243–249 (2005).
12. Engle, P. L., Menon, P. & Haddad, L. Care and Nutrition: Concepts and Measurement. *World Development* **27**, 1309–1337 (1999).
13. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *The Journal of nutrition* **130**, 1204–1211 (2000).
14. Redshaw, M. & Henderson, J. Fathers' engagement in pregnancy and childbirth: evidence from a national survey. *BMC pregnancy and childbirth* **13**, 70 (2013).

15. Schaffer, M. A. & Lia-Hoagberg, B. Effects of social support on prenatal care and health behaviors of low-income women. *J Obstet Gynecol Neonatal Nurs* **26**, 433–440 (1997).
16. Martin, L. T., McNamara, M. J., Milot, A. S., Halle, T. & Hair, E. C. The effects of father involvement during pregnancy on receipt of prenatal care and maternal smoking. *Maternal and child health journal* **11**, 595–602 (2007).
17. Kiernan, K. & Pickett, K. E. Marital status disparities in maternal smoking during pregnancy, breastfeeding and maternal depression. *Social science & medicine (1982)* **63**, 335–346 (2006).
18. Bielinski-Blattmann, D., Lemola, S., Jaussi, C., Stadlmayr, W. & Grob, A. Postpartum depressive symptoms in the first 17 months after childbirth: the impact of an emotionally supportive partnership. *International journal of public health* **54**, 333–339 (2009).
19. O'Hara, M. W. Social support, life events, and depression during pregnancy and the puerperium. *Arch. Gen. Psychiatry* **43**, 569–573 (1986).
20. Gremigni, P., Mariani, L., Marracino, V., Tranquilli, A. L. & Turi, A. Partner support and postpartum depressive symptoms. *J Psychosom Obstet Gynaecol* **32**, 135–140 (2011).
21. Mekonnen, W. & Worku, A. Determinants of low family planning use and high unmet need in Butajira District, South Central Ethiopia. *Reprod Health* **8**, 37 (2011).
22. Yue, K., O'Donnell, C. & Sparks, P. L. The effect of spousal communication on contraceptive use in Central Terai, Nepal. *Patient Educ Couns* **81**, 402–408 (2010).
23. Susin, L. R. O. & Giugliani, E. R. J. Inclusion of Fathers in an Intervention to Promote Breastfeeding: Impact on Breastfeeding Rates. *Journal of human lactation : official journal of International Lactation Consultant Association* **24**, 386–392 (2008).
24. Gebremedhin, S. *et al.* Predictors of dietary diversity in children ages 6 to 23 mo in largely food-insecure area of South Wollo, Ethiopia. *Nutrition (Burbank, Los Angeles County, Calif.)* **33**, 163–168 (2017).
25. Bilal, S. *et al.* Fathers' Perception, Practice, and Challenges in Young Child Care and Feeding in Ethiopia. *Food and nutrition bulletin* (2016). doi:10.1177/0379572116654027
26. Mukuria, A. G., Martin, S. L., Egondi, T., Bingham, A. & Thuita, F. M. Role of Social Support in Improving Infant Feeding Practices in Western Kenya: A Quasi-Experimental Study. *Global health, science and practice* **4**, 55–72 (2016).

27. Bilal, S. M. *et al.* 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, 2013. *Maternal & child nutrition* **12**, 473–483 (2014).
28. Ranganathan, M. & Lagarde, M. Promoting healthy behaviours and improving health outcomes in low and middle income countries: A review of the impact of conditional cash transfer programmes. *Preventive medicine* **55**, S95–S105 (2012).
29. Manley, J., Gitter, S. & Slavchevska, V. How Effective are Cash Transfers at Improving Nutritional Status? *World Development* **48**, 133–155 (2013).
30. Currie, J. & Gahvari, F. Transfers in Cash and In-Kind: Theory Meets the Data. *Journal of Economic Literature* **46**, 333–383 (2008).
31. Hidrobo, M., Hoddinott, J., Peterman, A., Margolies, A. & Moreira, V. Cash, food, or vouchers? Evidence from a randomized experiment in northern Ecuador. *Journal of Development Economics* **107**, 144–156 (2014).
32. Bentley, M. E., of, H. W. T. J.2011. Responsive feeding and child undernutrition in low-and middle-income countries. *academic.oup.com*
doi:10.3945/jn.110.130005", "keywords":["consultation", "diet", "caregivers", "child", 'd
eveloping
33. Affleck, W. & Pelto, G. Caregivers' responses to an intervention to improve young child feeding behaviors in rural Bangladesh: A mixed method study of the facilitators and barriers to change. *Social science & medicine (1982)* **75**, 651–658 (2012).
34. Bankole, A. Desired Fertility and Fertility Behaviour among the Yoruba of Nigeria: A Study of Couple Preferences and Subsequent Fertility. *Population Studies* **49**, 317–328 (2010).

CHAPTER 2

Engaging fathers in improving infant and young child feeding (IYCF) practices does not improve child diet or anthropometric outcomes in a clustered randomized controlled trial in rural Ethiopia

ABSTRACT

Context: An important cause of stunting is limited consumption of complementary foods, in terms of both quantities and nutrients. The efficacy of paternal BCC program that aims to increase paternal support on improved complementary feeding practices remains unknown.

Objective: To determine the efficacy of maternal and paternal BCC program compared to maternal BCC program.

Design, Setting, Participants: This community-based, clustered randomized controlled trial that included women who had children between 4 and 20 months old, their children, and the partners of participating women who lived in the 92 *garees* (villages) between April and August 2017; the follow-up ended in March 2018. The trial included 779 women and 509 men who met the eligibility criteria.

Intervention: We randomly assigned the 92 *garees* into treatment and control groups in a 1:3 (treatment:control) ratio: T1, maternal BCC only ($n = 15$); T2, maternal BCC and paternal BCC ($n = 13$); T3, maternal BCC and food voucher ($n = 15$); T4, maternal BCC and paternal BCC and food voucher ($n = 13$); and C, control ($n = 36$). The primary outcome were fathers' knowledge and child dietary diversity score.

Results: Among 779 women and 509 men who participated, 93% and 93.6% completed the trial, respectively. During treatment, mean attendance for maternal BCC and paternal BCC was 73% and 66%, respectively. Father's IYCF knowledge increased by 5 percentage point when BCC was provided to both mothers and fathers compared to when BCC was provided to mothers only. The additional impact is statistically significant at the 5% level. Child dietary diversity score (CDDS) improves for maternal BCC only group and maternal and paternal BCC group by 0.38 and 0.70 food group, respectively. However, the additional impact of the paternal BCC on CDDS is not statistically significant at the 5% level. We see no differential impact on child anthropometry.

Conclusion: Nutrition BCC program that targets both fathers and mothers have greater impact on father's IYCF knowledge compared to nutrition BCC program that targets mothers only. However, we do not see father's IYCF knowledge translating into improved diet.

Trial Registration: The study is registered with ClinicalTrials.gov, number NCT03229629.

Funding: This trial was supported by Africa Future Foundation, Korea Foundation for International Healthcare (KOFIH), Seoul Women's Hospital, and Dr. Taehoon Kim.

INTRODUCTION

Globally, 171 million children under the age of five are stunted (height-for-age Z score < -2), 35% of which live in Africa ¹. Stunting, an indicator of chronic malnutrition, is linked to short- and long-term life outcomes, affecting morbidity, cognitive function, schooling, and wages ^{2,3}. While the prevalence of stunting is decreasing worldwide, the absolute number of the stunted population is growing in Africa ¹. In Ethiopia, the focus of this study, the prevalence of stunting in children under the age of five was 38% in 2016 ⁴. It is widely understood that poor nutritional status in early life reflects poor maternal nutrition and limited access to health care during pregnancy and sub-optimal breastfeeding practices during the first six months of life ¹. During the period 6-24 months, another critical period for child growth, an important cause of stunting is limited consumption of complementary foods, in terms of both quantities and nutrients ¹.

Multiple factors contribute to sub-optimal complementary food consumption, including low household resources, limited availability and unaffordability ^{5,6}. Incorrect knowledge and attitudes about appropriate foods to feed to children 6-24 months also plays a role. Nutrition education is seen as a means of addressing this constraint and has been shown to improve infant and young child feeding knowledge and practices in multiple settings such as improving complementary feeding practices ⁷⁻⁹, caloric intake ¹⁰, length ^{10,11}, and weight ^{9,12}. However, most nutrition education programs address only knowledge

constraint to improved IYCF and nutrition outcomes. Behavior change communication (BCC), that uses multiple communication channels including group education, individual counselling, and mass media has been shown to be effective in developing positive behavior.

Another important constraint to improved IYCF practices is lack of paternal support. A number of qualitative and association studies have pointed to the constraining effects of limited paternal engagement^{13,14}. A lack of paternal support may affect mothers' ability to improve complementary feeding practices either because fathers often determine the purchases of nutritious but expensive food items that are absent from a child's diet or because while mothers are often overburdened with the dual responsibilities of childcare and time-intensive domestic work, fathers ascribe to a traditional gendered division of roles and responsibilities, making it difficult to share the domestic work. Without paternal support with household chores, mother will have difficulties cooking improved complementary food, which requires additional tasks and time^{11,15}.

A number of studies have shown a positive relationship between paternal involvement and maternal health¹⁶⁻²⁴ and there are several association studies that have shown positive correlation between paternal knowledge and improved feeding practice^{13,14}. However, to the best of our knowledge, there are no intervention studies that assess the impact of engaging fathers in nutrition BCC in order to improve complementary feeding practices. We implement a cluster randomized controlled trial to assess whether adding paternal nutrition BCC to a maternal nutrition BCC program has a larger impact on complementary feeding practices compared to a maternal nutrition BCC program alone.

Evidence before this study

In low-income countries, child stunting is highly prevalent, and sub-optimal complementary feeding practices is one of the most significant causes of stunting. Most programs target mothers when paternal support has the potential to improve complementary feeding practices, especially in developing country settings where gender inequality and the

low bargaining power of women are prevalent. We searched PubMed with the following search term: (growth) AND (infant OR child) AND (complementary feeding OR IYCF) AND (father OR male OR gender). There were few associational studies concerning paternal involvement and complementary feeding practices, but to our knowledge there are no randomized controlled study to determine the causal impact of paternal influence on complementary feeding practices. Existing association studies conducted in Ethiopia show that fathers' direct involvement in complementary feeding is positively associated with child dietary diversity and that multiple dimensions of fathers' knowledge and practices are positively associated with children's minimum dietary diversity^{13,14}. A quasi-experimental study conducted in western Kenya showed that targeting fathers and grandmothers improved family members' supportiveness for complementary feeding practices²⁵.

Added value of this study

To the best of our knowledge, this is the first randomized trial to investigate the additional impact of a paternal BCC program on improved complementary feeding practices relative to a maternal BCC program only. This study was implemented in both rural and urban African settings. The maternal BCC program was adapted from a well-documented, successful behavior change communication, intervention, Alive and Thrive Ethiopia²⁶. Paternal BCC program was adapted from Nurturing Connections developed by Helen Keller International²⁷.

Provision of both maternal and paternal BCC increases father's knowledge of IYCF by a greater magnitude relative to maternal BCC only. We found that the provision of both maternal and paternal BCC improves child dietary diversity score (CDDS) by 0.65 food groups and increases the likelihood they meet minimum diet diversity by 19 percentage points. However, we cannot reject the null hypothesis that the additional impact of paternal BCC on child diets differs from the impact of the provision of maternal BCC. We see no differential impact on child anthropometry.

METHODS

Study design and participants

This study is a community-based, clustered randomized controlled trial conducted from April 2017 until March 2018. To minimize contamination by spill-over of knowledge, we used a clustered randomized controlled trial as our study design. The study was conducted in Ejere district located in the Oromia region of central Ethiopia, 52km west of Addis Ababa. Ejere covers an area of 300km² and consists of 3 urban and 27 rural kebeles (ward). The total population of the Ejere district in 2015 was 112,111; 5% of children were between 4-20 months of age. BCC facilitators and enumerators were hired through Africa Future Foundation (AFF), a collaborating NGO.

The census data of 22,000 households living in Ejere district was collected in collaboration with AFF during 2016 was used to identify eligible participants. The summary of study timeline is presented in figure 2. Key household characteristics such as the youngest child's age, the mother's age, and spouse information collected in the census were used to identify eligible participants. Enumerators made household visits to invite eligible mothers to participate in the study. For inclusion in our study, women had to be permanent resident of the study cluster and have children between 4-20 months and consented to participate. For illiterate mothers, enumerators read the consent form and received signature if they were willing to participate. Men were eligible if they lived with the participating women more than nine months in the last 12 months and consented to participate. Children's ages were calculated based on mother's recall of the birth date. A local events calendar was used to estimate child age when a mother had difficulty recalling the child's birthdate.

Households were not aware of the other intervention arms; consent forms were specific to a participant's group allocation. We conducted the baseline survey prior to participant's 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 the Cornell University (USA, 1612006823), the Oromia state IRB (Ethiopia, BEIO/AHBHN/1-8/2670), and Myungsung Medical College (Ethiopia).

RANDOMIZATION AND MASKING

All villages in Ejere were eligible for clusters. We randomly selected three rural kebeles (equivalent to a ward) and all three urban kebeles within the Ejere district in order to include both urban and rural localities. Within the 6 selected kebeles, 63 garees (villages) were identified through Kebele leaders. We randomly assigned garees into treatment and control groups in a 1:3 (treatment: control) ratio: T1, maternal BCC only; T2, maternal BCC and paternal BCC; and C, control. Randomization was conducted for each of the six kebele separately. The randomization was computer generated using STATA program. Randomization and assignment of villages to intervention and control arms were done by researchers at Cornell University. 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 prevent social desirability bias, we assessed father's behavior change through mother's report.

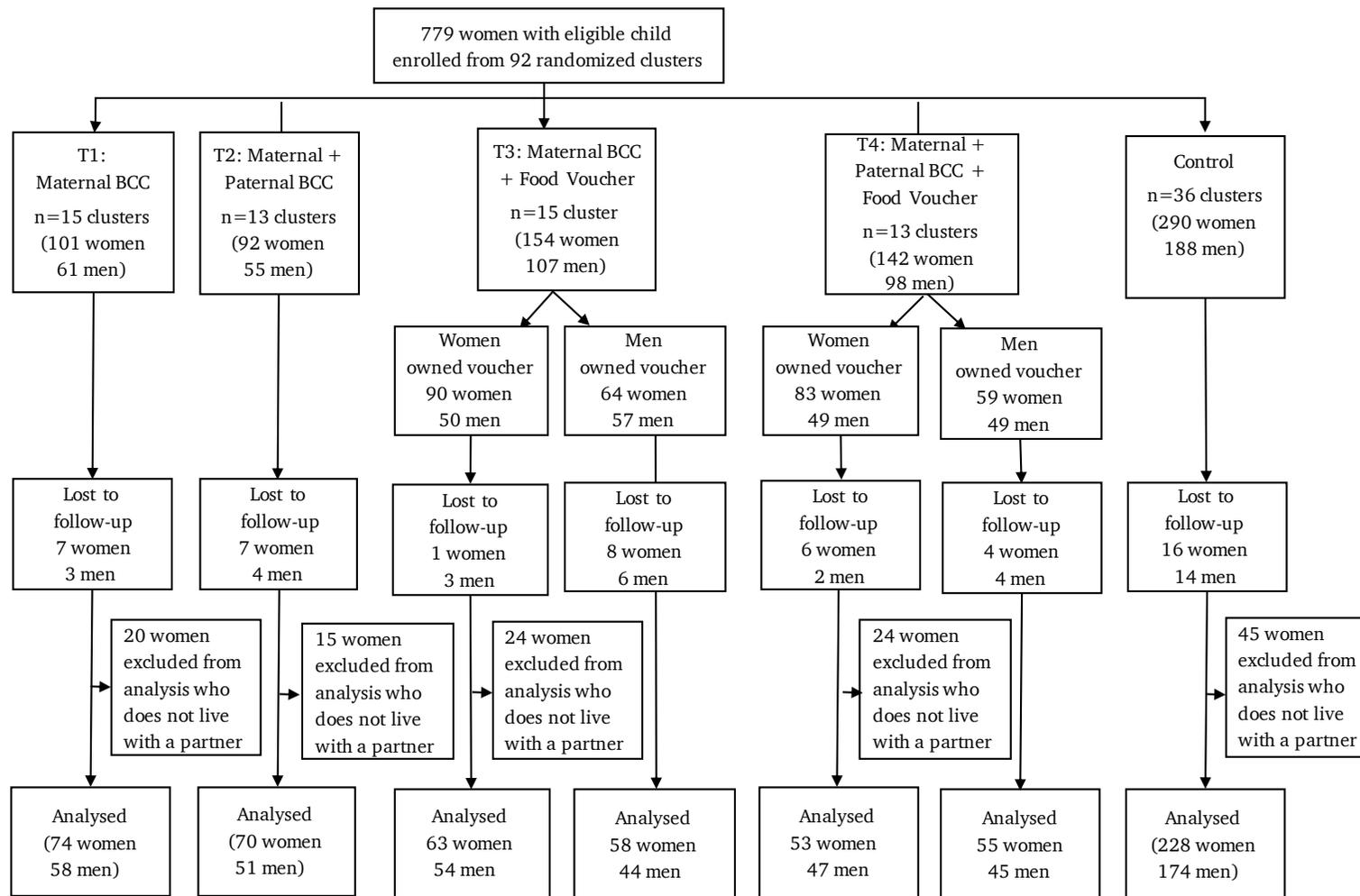


Figure 2.1. Consolidated Standards of Reporting Trials (CONSORT) diagram.

INTERVENTION

The maternal BCC program lasted for 16 weeks. Seven to fourteen participants from the same garee (village) formed one BCC group and met 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. An image-oriented booklet containing a summary of optimal IYCF practices and action plans were distributed to all participants. Role-play and food demonstration sessions were also included. Prior to implementation, situational assessment, formative research, and multiple rounds of pretesting were conducted to ensure that the BCC modules are acceptable and persuasive. To increase attendance, BCC groups competed for a monthly prize worth 35 birr (~\$1.50) per person, awarded to members of the group with the highest group attendance rate.

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. Paternal BCC program included messages about diet diversity, consequence of malnutrition during the first two years, father's role in childcare, shared division of household labor, and gender equal intra-household decision. Multiple rounds of pretesting and pilot tests were conducted to ensure that the BCC programs were acceptable and persuasive. Paternal BCC participants also competed for a monthly prize. Details of paternal BCC curriculum is presented in supplementary figure 2.3.

Male and female BCC facilitators who held a secondary school certificate were recruited from the local community. BCC facilitators completed three rounds of training over an 18-month period. They implemented two pilot studies to check the delivery and acceptability of the BCC materials. BCC materials were finalized after the second BCC pilot. To monitor the quality of the BCC interventions, BCC supervisors randomly joined the BCC group session at least twice a week per BCC facilitators and gave feedbacks.

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 made. Baseline and the follow-up surveys for the mothers included detailed information on IYCF knowledge, child food consumption, household expenditures, gender norms, household labor allocation, household decision-making, anthropometry, demographics, and socioeconomic information. The surveys for the fathers included detailed information on IYCF knowledge, gender norm, household labor allocation, household decision-making, food frequency, and agriculture and livestock production. BCC attendance data was collected for all BCC participants.

Figure 2.2. Behavior change communication curriculum

MATERNAL BCC PROGRAM	
1 Introduction	9 Part A: Frequency and amount of complementary food Part B: Eating schedule and discussion
2 Food diversity score and weekly diet schedule	10 Recipe and cooking demonstration
3 When to start complementary feeding	11 Responsive feeding
4 Thickness and consistency of complementary food	12 Feeding during illness
5 Role-play and discussion	13 Role-play and discussion
6 Food variety -- iron, proteins from meat	14 Hygiene, safe preparation, and storage of complementary food
7 Part A: Enrichment of complementary food Part B: Household food processing strategy	15 Group discussion and review
8 Role-play and discussion	16 Testimonials and ceremony
1. PATERNAL BCC PROGRAM	
Understanding child nutrition	7. Part A: Ideal diet for healthy growth Part B: Prioritizing spending
2. Quality of diet	8. Part A: Division of labor Part B: Story
3. Household decision-making	9. Review and role play
4. Child dietary diversity	10. Understanding gender and gender roles
5. Part A: Review of food groups and sources Part B: Food processing technology	11. Effective communication
6. Part A: Preference on household expenditures between men and women Part B: Role play	12. Testimonial Ceremony

OUTCOMES

The primary outcomes of interest were mean difference in parents' nutrition knowledge and child dietary diversity score (CDDS). Mother and father's IYCF knowledge were assessed using a separate survey module that contained 34 and 27 questions, respectively, on topics such as importance of the first two years in child growth, appropriate feeding frequency and dietary diversity, and nutrient rich foods. We counted number of questions correct and divided the number by total number of questions. 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. For each question, the interviewer asked the mother "Yesterday, during the day or night, did [NAME] eat [FOOD ITEM]?" If the answer was yes, the interviewer asked how many times the food item was fed to the child the previous day. The food items were grouped into seven food groups, and CDDS was calculated by summing up 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 (WHO, 2010). Minimum meal frequency is the proportion of children who consumed minimum number of meals recommended for the age, and minimum dietary diversity is proportion of children who receive food from 4 or more food groups. Minimum acceptable diet is calculated by combining minimum dietary diversity and minimum feeding frequency adjusting for child's age.

Father's attitude was measured including father's gender norm attitude, household decision, labor allocation, and communication between partners. We construct father's gender norm attitude score by asking whether or not respondent agree or disagree on 14 questions and counted number of questions that was answered correctly. We measured father's attitude on household decision making by asking questions on a Likert-type scale ranging from 0 to 10, 0 as father making the decision alone, and 10 as mother making the

decision alone. We measured father's attitude on household labor allocation by asking questions on 14 different household chores, assessed on a five-tiered scale ranging from "I did almost everything" to "Other members of the household did almost everything".

We measured mother's perceived health, frequency of physical or emotional problems interfering with social activities, perceived social support, and perceived time stress. Mother's perception of their health was asked on a five-tiered scale ranging from excellent to poor. The social support scale is created by asking 11 questions to be answered on a four-tiered scale ranging from definitely true to definitely false. We construct time stress score by asking three questions on a three-tiered scale ranging from always to never. Physical/emotional problems were assessed on a five-tiered scale ranging from all of the time to none of the time.

Lastly, we measured mother and 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 the WHO child growth standards.

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

SAMPLE SIZE AND STATISTICAL ANALYSIS

The sample size (ie, the number of clusters and individuals) was based on the minimum detectable difference of child dietary diversity score and father's knowledge score, the two primary outcomes. The sample size calculation estimated mean detectable difference of 2.48 points in father's 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 father's 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 ²⁸. All calculations were set at 95% confidence levels, 90% power and assumed 10% attrition.

We used generalized estimating equations that accounted for within cluster correlation and contained two dummy variables representing the maternal BCC compared to control and maternal plus paternal BCC compared to control, adjusting for pre-specified covariates and baseline outcomes. Individual's demographic variables (e.g., age, marital status, birth order, and household size) and socioeconomic status (e.g., level of education, employment status/history, and household income and asset) was used as control covariates. To compare between treatment arms, we performed F-test. We performed robustness checks for primary outcomes results by running three different regression models (Supplementary table S2.1). First, we estimated regression with area variables only. Second with area and the baseline of outcome variable. Third with area, baseline of outcome variable, and other control variables. We find that the results are robust, and the point estimates and their degree of statistical significance remain similar.

Stata (version 14) was used for data analysis. The study is registered with ClinicalTrials.gov, number NCT03229629.

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

Between April 2017 and March 2018, 482 eligible women were enrolled from 64 clusters. 304 partners of the participating women were enrolled. We conducted the intent-to-treat analysis, including all mothers who has partners. We excluded mothers without partners from the analysis.

The majority of the rural population in Ejere were poor, agrarian semi-subsistence economy, and the urban population were a mix of agrarian and wage employees. Baseline results showed mean household size was 4.6 people, 83% were Orthodox, 77% were Oromo, and 65% had handwashing place near the cooking area (Table 2.1). Mothers were, on average, 28 years old, 87 percent married, went to school for 4.5 years, and 54% worked. Fathers were, on average, 34 years old and went to school for 6.5 years. Mean age of the eligible child was 14 months. The WHO standard IYCF indicators showed inadequate of complementary feeding practices, consuming only 2.7 out of 7 food groups the previous day.

Fidelity of intervention delivery was higher for maternal BCC group. Average BCC attendance rate was 74% (~12 out of 16 sessions) and 66% (~8 out of 12 sessions) for mothers and fathers, respectively (Table 2.1). The first paternal BCC session had the highest attendance at 89% and stayed between 49% and 72% for the remaining paternal BCC program (Supplementary figure S2.7). Looking at the average individual BCC attendance, more than 67% of fathers attended half or more BCC sessions (Supplementary figure S2.7).

We assessed balance at baseline across treatment and the control arms in terms for both outcomes and control variables used in our analysis. Overall, the sample is balanced between the treatment and the control groups. All 54 t-tests failed to reject the null hypothesis of mean equality at the 5% significance (Table 2.1). Attrition rate at the follow-up survey was 7.8%, 7.1%, and 16.4% for mother, father, and child, respectively, and was balanced across the treatment and the control groups (Table 2.1).

Table 2.1. Maternal, paternal, child, household, IYCF characteristics and anthropometry at baseline.

	Maternal BCC	Maternal & Paternal BCC	Control
Mother (N)	74	70	228
Father (N)	58	51	174
Maternal BCC attendance	0.72 (0.19)	0.75 (0.19)	N/A
Paternal BCC attendance	N/A	0.66 (0.17)	N/A
Mother attrition	0.08 (0.28)	0.09 (0.28)	0.06 (0.24)
Father attrition	0.04 (0.21)	0.07 (0.26)	0.07 (0.27)
Child attrition	0.19 (0.4)	0.23 (0.42)	0.12 (0.33)
Maternal			
Knowledge score	0.63 (0.13)	0.64 (0.13)	0.63 (0.11)
Married	0.86 (0.34)	0.87 (0.33)	0.87 (0.32)
Age	27.29 (5.53)	28.59 (6.87)	28.16 (6.36)
Number of school years	4.88 (5.55)	4.41 (6)	4.26 (5.32)
Currently work	0.53 (0.5)	0.51 (0.5)	0.54 (0.49)
Paternal			
Knowledge score	0.6 (0.14)	0.54 (0.16)	0.61 (0.14)
Age	33.9 (8.22)	34.16 (8.63)	34.06 (8.1)
Number of school years	7.32 (6.16)	6.53 (7.01)	6.36 (6.7)
Currently work	0.85 (0.35)	0.87 (0.33)	0.91 (0.28)
Child			
Eligible child's age	13.44 (4.97)	12.92 (5.3)	12.03 (4.8)
Sex	1.54 (0.5)	1.49 (0.5)*	1.5 (0.5)
Eligible child's birth order	2.29 (1.43)	2.42 (1.37)	2.45 (1.49)
Household			
Household size	4.51 (1.45)	4.68 (1.37)	4.7 (1.51)
Orthodox	0.83 (0.36)	0.83 (0.37)	0.84 (0.36)
Oromo	0.76 (0.42)	0.83 (0.37)	0.75 (0.43)
Rural	0.49 (0.5)	0.51 (0.5)	0.5 (0.5)
Handwashing place near cooking area	0.7 (0.45)	0.64 (0.48)	0.6 (0.49)
Asset	0.15 (1.85)	-0.12 (1.59)	0.09 (1.76)
IYCF practices			
Child dietary diversity score	2.74 (1.71)	2.66 (1.79)	2.74 (1.62)
Minimum acceptable diet	0.28 (0.45)	0.15 (0.36)	0.2 (0.4)
Minimum dietary diversity	0.35 (0.48)	0.27 (0.44)	0.33 (0.47)
Minimum meal frequency	0.6 (0.49)	0.53 (0.5)	0.51 (0.5)
Anthropometry			
WHZ	0.44 (1.25)*	0.21 (1.53)	0.09 (1.34)
HAZ	-1.12 (1.31)	-1.23 (1.63)	-1.01 (1.38)

Values are mean (SD), unless stated. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.
*P value for joint test of orthogonality

Maternal plus paternal BCC improves fathers' IYCF knowledge by 5 percentage point compared to the maternal BCC group (Table 2.2 Panel B). The differences in impact of maternal and paternal BCC on fathers' IYCF knowledge, relative to maternal BCC alone is statistically significant at 5% level.

We further categorized the IYCF questions into seven sub-indices by topic. Results show that fathers in maternal plus paternal BCC group improves knowledge on the importance of dietary diversity, animal sourced food, and timely initiation of complementary feeding (Table S2.3). The additional impact of paternal BCC on fathers' IYCF knowledge is driven by knowing the importance of animal sourced food. This suggest that fathers are more likely to remember information related to their responsibilities since fathers are usually the ones deciding the purchase of more expensive food such as animal sourced food.

Table 2.2: Primary outcomes

	Mother knowledge score (0-1)	Father knowledge score (0-1)	Child dietary diversity score (0-7)
Panel A. Full sample			
Maternal BCC (T1)	0.052*** (0.013)	0.043 (0.024)	0.380** (0.182)
Maternal + Paternal BCC (T2)	0.036** (0.017)	0.086*** (0.019)	0.659*** (0.166)
Control group mean	0.685	0.623	3.219
Observations	368	282	368
Panel B. Sample without the control group			
Maternal + Paternal BCC (T2)	-0.017 (0.015)	0.050** (0.022)	0.241 (0.232)
Maternal BCC (T1) group mean	0.731	0.666	3.743
Observations	142	109	142
P value: maternal BCC= maternal+ paternal BCC	0.302	0.039	0.304

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses.
, and * denote significance at 5%, and 1%, respectively.

We find both maternal BCC and maternal plus paternal BCC significantly improves child dietary diversity score (CDDS) by 0.38 and 0.66 food groups, respectively, compared to control (Table 2.2 Panel A). Looking at the individual food groups, maternal plus paternal BCC increase consumption of legumes and nuts, dairy products, eggs, and vitamin A rich fruits and vegetables compared to the control group (Table 2.4 Panel A). Although maternal plus paternal BCC shows a greater magnitude of impact on CDDS compared to maternal BCC, the null hypothesis that they are equal is not rejected (Table 2.2 Panel B).

We examined impacts on the standard WHO IYCF indicators to assess child's diet quality and quantity. Maternal plus paternal BCC increased the proportion of children who met minimum diet diversity by 18.4 percentage point compared to control (Table 2.3 Panel A). The proportion of children who met the minimum acceptable diet standard, which combines minimum meal frequency and minimum diet diversity standard, increases for both the maternal BCC and maternal plus paternal BCC groups by 13 and 20 percentage points, respectively (Table 2.3 Panel A). However, the additional impact of paternal BCC is not significant for all of the IYCF indicators (Table 2.3 Panel B).

Table 2.3. Pre-specified IYCF indicators

	Minimum dietary diversity (0-1)	Minimum meal freq (0-1)	Minimum acceptable diet (0-1)
Panel A. Full sample			
Maternal BCC (T1)	0.063 (0.054)	0.097 (0.084)	0.134*** (0.049)
Maternal + Paternal BCC (T2)	0.184*** (0.068)	0.142 (0.084)	0.194*** (0.058)
Control group mean	0.382	0.574	0.162
Observations	368	288	288
Panel B. Sample without the control group			
Maternal + Paternal BCC (T2)	0.114 (0.077)	0.008 (0.083)	0.009 (0.079)
Maternal BCC (T1) group mean	0.500	0.646	0.323
Observations	142	107	107.000
P value: maternal BCC= maternal+ paternal BCC	0.133	0.879	0.861

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses.
, and * denote significance at 5%, and 1%, respectively.

To explain this further, we conduct a plausibility analysis, and look at household decision power for the individual 7 food groups. We find in the maternal plus paternal BCC group, fathers are more involved in decisions of egg purchases (Supplementary Table S2.4 Panel A), the most affordable animal source food and one that was heavily emphasized during BCC sessions. This resulted in increased consumption of eggs by 17 percentage point compared to control (Table 2.4 Panel A). However, the additional impact of paternal BCC on household decision power and individual food consumption is not statistically significant.

As the paternal BCC program included messages on gender roles and the related behavior change, we examined father's gender norm attitude, mother's perceived social support, household decision, labor allocation, and communication as intermediary pre-specified outcomes (Table 2.5). The maternal plus paternal BCC group show modest but significant increase in mother's perceived social support by 0.12 point compared to control (Table 2.5 Panel A), however, the additional impact of paternal BCC is not significant (Table 2.5 Panel B). We see no changes in other intermediary outcomes (Table 2.5).

Table 2.4. Child food consumption

	Whether child consumed from the food group yesterday							
	All foods combined	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Panel A. Full sample								
Maternal BCC (T1)	0.387** (0.184)	-0.013 (0.016)	0.117 (0.066)	0.084 (0.049)	0.098 (0.054)	0.087 (0.068)	0.021 (0.070)	-0.012 (0.060)
Maternal + Paternal BCC (T2)	0.651*** (0.162)	-0.018 (0.022)	0.133** (0.055)	0.149** (0.056)	0.078 (0.041)	0.169*** (0.060)	0.105** (0.044)	0.033 (0.041)
Control group mean	3.218	0.991	0.367	0.419	0.114	0.279	0.227	0.821
Observations	369	369	369	369	369	369	369	369
Panel B. Sample without the control group								
Maternal + Paternal BCC (T2)	0.244 (0.233)	-0.016 (0.032)	-0.003 (0.079)	0.074 (0.056)	-0.047 (0.067)	0.104 (0.066)	0.110 (0.065)	0.024 (0.058)
Maternal BCC (T1) group mean	3.743	0.973	0.527	0.514	0.243	0.392	0.270	0.824
Observations	142	142	142	142	142	142	142	142
P value: maternal = maternal + paternal	0.304	0.617	0.973	0.202	0.491	0.128	0.104	0.686

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

Table 2.5. Pre-specified intermediary outcomes

	Father's gender norm attitude (0-1)	Household decision (0-10)	Household labor (0-5)	Social support score (1-4)
Panel A. Full sample				
Maternal BCC (T1)	0.020 (0.024)	-0.112 (0.077)	-0.051 (0.070)	-0.007 (0.054)
Maternal + Paternal BCC (T2)	0.049** (0.024)	-0.036 (0.080)	0.055 (0.061)	0.115** (0.051)
Control group mean	0.743	5.166	2.407	2.645
Observations	282	355	356	368
Panel B. Sample without the control group				
Maternal + Paternal BCC (T2)	0.015 (0.029)	0.031 (0.210)	0.136 (0.084)	0.102 (0.073)
Maternal BCC (T1) group mean	0.778	5.037	2.347	0.986
Observations	109	142	139	142
P value: maternal BCC= maternal+ paternal BCC	0.622	0.883	0.119	0.172

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

Looking at child growth, the average HAZ score decreased from -1.09 SD to -1.54 SD and the prevalence of stunting increased from 21% to 42% in the control group from baseline to follow-up. The prevalence of wasting remained largely unchanged over time - 8.7% at baseline and 7.9% at follow-up in the control group. Although we see significantly improvement in HAZ score and proportion of stunted children in maternal and paternal BCC group compared to maternal BCC group (Table 2.6) we are hesitant to draw strong conclusion from this as the results are not robust (Supplementary Table S2.2)

Table 2.6. Child growth

	WHZ score	Wasted (%)	HAZ score	Stunted (%)
Panel A. Full sample				
Maternal BCC (T1)	0.319 (0.197)	-0.054 (0.034)	-0.192 (0.166)	0.116 (0.066)
Maternal + Paternal BCC (T2)	0.199 (0.228)	-0.075** (0.033)	-0.025 (0.143)	-0.026 (0.038)
Control group mean	0.109	0.079	-1.490	0.415
Observations	302	302	294	294
Panel B. Sample without the control group				
Maternal + Paternal BCC (T2)	-0.003 (0.291)	-0.025 (0.038)	0.438** (0.190)	-0.189** (0.073)
Maternal BCC (T1) group mean	0.388	0.034	-1.502	0.424
Observations	109	109	110	110
P value: maternal BCC = maternal+ paternal BCC	0.917	0.594	0.025	0.015

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

DISCUSSION AND CONCLUSION

We evaluated the effects of maternal and paternal BCC program on IYCF practices and growth among children between 4-20 months. The first two years of child's life are particularly important, as nutrition during this period is linked to short- and long-term life outcomes, affecting morbidity, cognitive function, schooling, and wages. Our hypothesis was that gender integrated paternal BCC program would have an additional impact on father's IYCF knowledge and improve the quality of children's diets. We reasoned educating both men and women is particularly important as fathers are usually the ones in control of expensive household purchases, and expensive foods are the food items commonly lacking in child's diet.

We find paternal BCC has additional impact on father's IYCF knowledge however, we do not see evidence of increased IYCF knowledge translating into improvement in IYCF practices as measured by CDDS and WHO standard IYCF indicators. Although provision of both maternal and paternal BCC shows modest but significant increase in mother's perceived social support, we see no changes in the division of household labor or intra-household decisions between mothers and fathers. Possible explanation for our finding is

that providing 12 weeks long paternal BCC program that covers broad topics on gender equal household dynamics in addition to IYCF practices does not increase father's IYCF knowledge sufficiently enough to change intra-household dynamics and IYCF practices. Also, although fathers are the ones in control of household purchases, it was common for mothers to make decisions independently for food items, except for meat. As mothers had the power to decide household food purchases, increasing father's nutrition knowledge may have limited additional impact. Furthermore, financial constraints may have been the main barriers to buying foods that are more expensive but lacking in child's diet such as animal sourced foods and vitamin A rich fruits and vegetables, which was heavily emphasized during BCC. Therefore, improving knowledge alone may have limited impacts on IYCF practices.

The enrolled participants were broad. It was diverse in age, years of education, marital status, and employment status. This trial population represent both the urban and rural population. As all participants had children between 4 and 20 months, the trial results are generalizable to participants who has children between 4 and 20 months.

The limited existing literature on the effects of BCC or nutrition education on child-feeding practices find moderate effects using a narrow range of diet quality measures. A study conducted in Malawi showed BCC significantly increase consumption of only one out of eight food groups ²⁹. A similar study conducted in Malawi that provide 10 sessions of 2-3 hours long nutrition education to mothers also showed increase in CDDS by 0.39 food groups ³⁰.

Although growing literature that examines the effects of fathers' involvement on maternal and child outcomes show positive impacts especially in developing countries settings where men are the key decision-makers that determines women's access to economic resources ^{16,17,31}, to the best of our knowledge, this study is the first that assess the impact of engaging fathers in nutrition BCC in order to improve complementary feeding practices.

This study has some limitations. First, IYCF practices are primarily assessed through self-reported outcome measures and pose a risk for social desirability bias. However, this will unlikely to affect comparison between treatment arms. Secondly, CDDS based on child's consumption in the past 24 hours may not be sensitive enough to capture the changes in IYCF practices in settings where baseline CDDS and consumption of certain food group is low. For example, only 5% of children were fed meat the previous day at baseline. Thirdly, although we extensively trained BCC facilitators to ensure quality of service delivery, there may have been differential delivery of BCC program due to variation in BCC facilitator's ability.

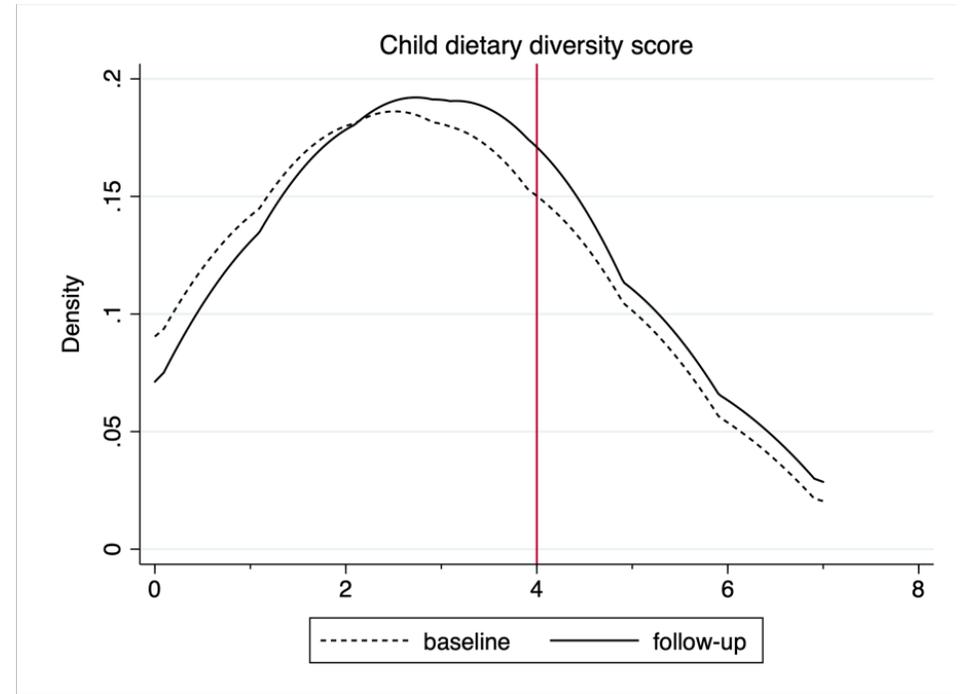
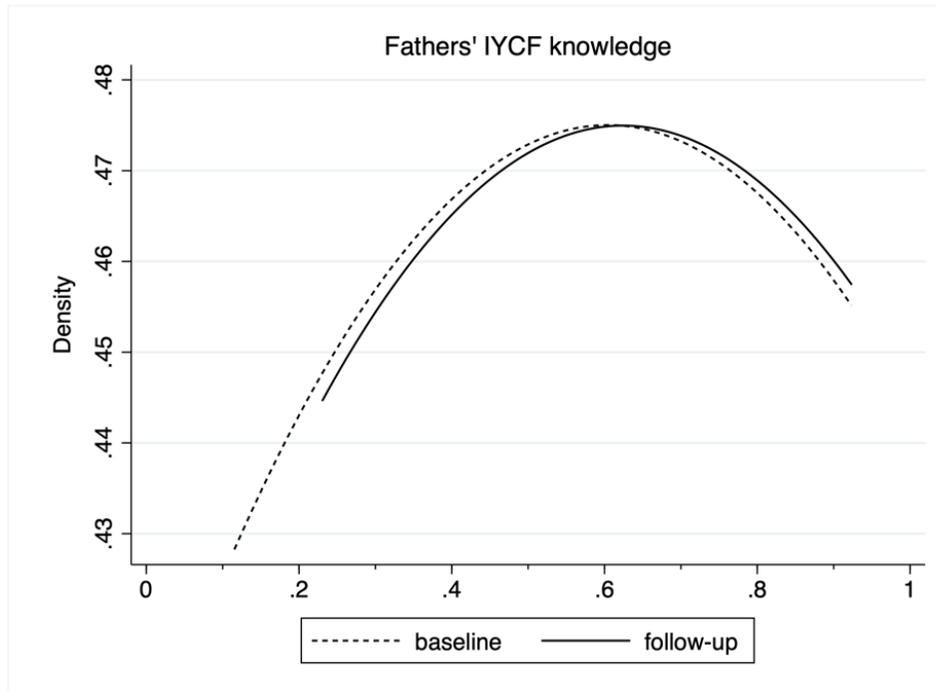
REFERENCES

1. de Onis, M., Blossner, M. & Borghi, E. Prevalence and trends of stunting among pre-school children, 1990-2020. *Public Health Nutr* **15**, 142–148 (2012).
2. Black, R. E. *et al.* Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* **382**, 427–451 (2013).
3. Hodinott, J. *et al.* Adult consequences of growth failure in early childhood. *Am J Clin Nutr* **98**, 1170–1178 (2013).
4. Uauy, R., Kain, J., Mericq, V., Rojas, J. & Corvalan, C. Nutrition, child growth, and chronic disease prevention. *Ann Med* **40**, 11–20 (2008).
5. Smith, L. C. & Haddad, L. 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 (2002).
6. Headey, D., Hirvonen, K., Hodinott, J. & Stifel, D. Rural Food Markets and Child Nutrition. *Am J Agric Econ* **101**, 1311–1327 (2019).
7. Bhandari, N. *et al.* Use of multiple opportunities for improving feeding practices in under-tuos within child health programmes. *Health Policy and Planning* **20**, 328–336 (2005).
8. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *J Nutr* **130**, 1204–1211 (2000).
9. Zaman, S., Ashraf, R. N. & Martines, J. Training in complementary feeding counselling of healthcare workers and its influence on maternal behaviours and child growth: a cluster-randomized controlled trial in Lahore, Pakistan. *J Health Popul Nutr* **26**, 210–222 (2008).
10. Bhandari, N., Mazumder, S., Bahl, R. & Martines, J. An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, \ldots. *Community and international nutrition* (2004).
11. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *J Nutr* **130**, 1204–1211 (2000).
12. Santos, I. *et al.* Nutrition counseling increases weight gain among Brazilian children. *J Nutr* **131**, 2866–2873 (2001).
13. Gebremedhin, S. *et al.* Predictors of dietary diversity in children ages 6 to 23 mo in largely food-insecure area of South Wollo, Ethiopia. *Nutrition* **33**, 163–168 (2017).
14. Bilal, S. *et al.* Fathers' Perception, Practice, and Challenges in Young Child Care and Feeding in Ethiopia. *Food Nutr Bull* (2016) doi:10.1177/0379572116654027.

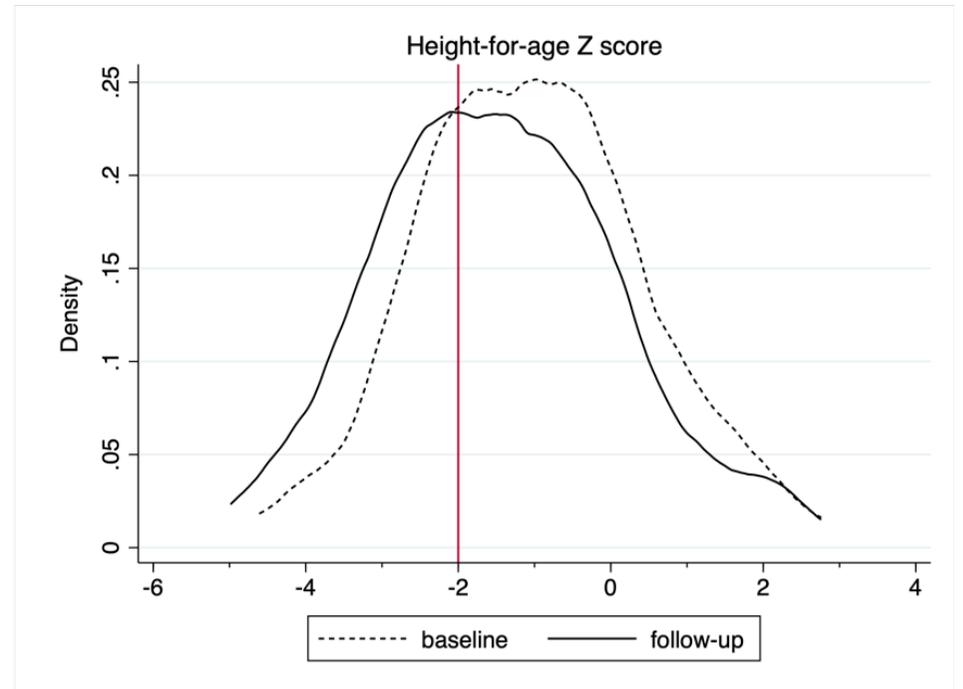
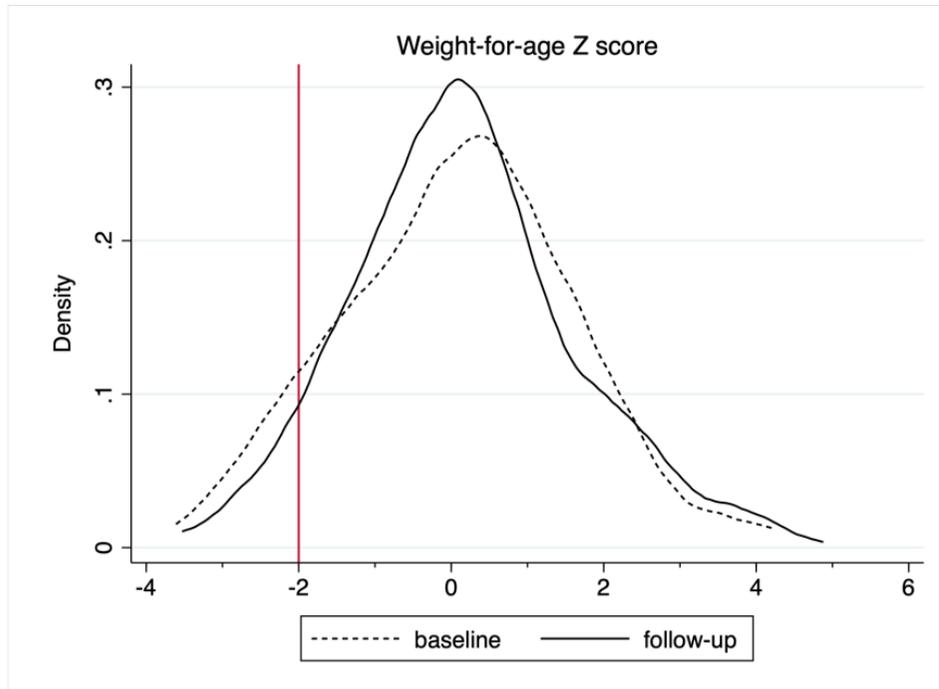
15. Engle, P. L., Menon, P. & Haddad, L. Care and Nutrition: Concepts and Measurement. *World development* **27**, 1309–1337 (1999).
16. Redshaw, M. & Henderson, J. Fathers' engagement in pregnancy and childbirth: evidence from a national survey. *BMC Pregnancy Childbirth* **13**, 70 (2013).
17. Schaffer, M. A. & Lia-Hoagberg, B. Effects of social support on prenatal care and health behaviors of low-income women. *Journal of obstetric, gynecologic, and neonatal nursing : JOGNN* **26**, 433–440 (1997).
18. Martin, L. T., McNamara, M. J., Milot, A. S., Halle, T. & Hair, E. C. The effects of father involvement during pregnancy on receipt of prenatal care and maternal smoking. *Matern Child Health J* **11**, 595–602 (2007).
19. Kiernan, K. & Pickett, K. E. Marital status disparities in maternal smoking during pregnancy, breastfeeding and maternal depression. *Soc Sci Med* **63**, 335–346 (2006).
20. Bielinski-Blattmann, D., Lemola, S., Jaussi, C., Stadlmayr, W. & Grob, A. Postpartum depressive symptoms in the first 17 months after childbirth: the impact of an emotionally supportive partnership. *Int J Public Health* **54**, 333–339 (2009).
21. O'Hara, M. W. Social support, life events, and depression during pregnancy and the puerperium. *Archives of general psychiatry* **43**, 569–573 (1986).
22. Gremigni, P., Mariani, L., Marracino, V., Tranquilli, A. L. & Turi, A. Partner support and postpartum depressive symptoms. *Journal of psychosomatic obstetrics and gynaecology* **32**, 135–140 (2011).
23. Mekonnen, W. & Worku, A. Determinants of low family planning use and high unmet need in Butajira District, South Central Ethiopia. *Reproductive health* **8**, 37 (2011).
24. Yue, K., O'Donnell, C. & Sparks, P. L. The effect of spousal communication on contraceptive use in Central Terai, Nepal. *Patient education and counseling* **81**, 402–408 (2010).
25. Mukuria, A. G., Martin, S. L., Egondi, T., Bingham, A. & Thuita, F. M. Role of Social Support in Improving Infant Feeding Practices in Western Kenya: A Quasi-Experimental Study. *Glob Health Sci Pract* **4**, 55–72 (2016).
26. Baker, J., Sanghvi, T., Hajeebhoy, N., Martin, L. & Lapping, K. Using an Evidence-Based Approach to Design Large-Scale Programs to Improve Infant and Young Child Feeding. *Food Nutr Bull* **34**, S146–S155 (2013).
27. Nurturing Connections in Bangladesh. *Helen Keller International*
<https://www.hki.org/node/566>.
28. The DHS Program - Ethiopia: Standard DHS, 2016. <https://dhsprogram.com/what-we-do/survey/survey-display-478.cfm>.

29. Nutrition, information and household behavior: Experimental evidence from Malawi - ScienceDirect. <https://www-sciencedirect-com.proxy.library.cornell.edu/science/article/pii/S0304387816300359>.
30. Kuchenbecker, J., Reinbott, A., Mtimuni, B., Krawinkel, M. B. & Jordan, I. Nutrition education improves dietary diversity of children 6-23 months at community-level: Results from a cluster randomized controlled trial in Malawi. *PLoS One* **12**, (2017).
31. Paternal Participation in Child Care and Its Effects on Children's Self-Esteem and Attitudes Toward Gendered Roles - FRANCINE M. DEUTSCH, LAURA J. SERVIS, JESSICA D. PAYNE, 2001. <https://journals.sagepub.com/doi/10.1177/019251301022008003>.

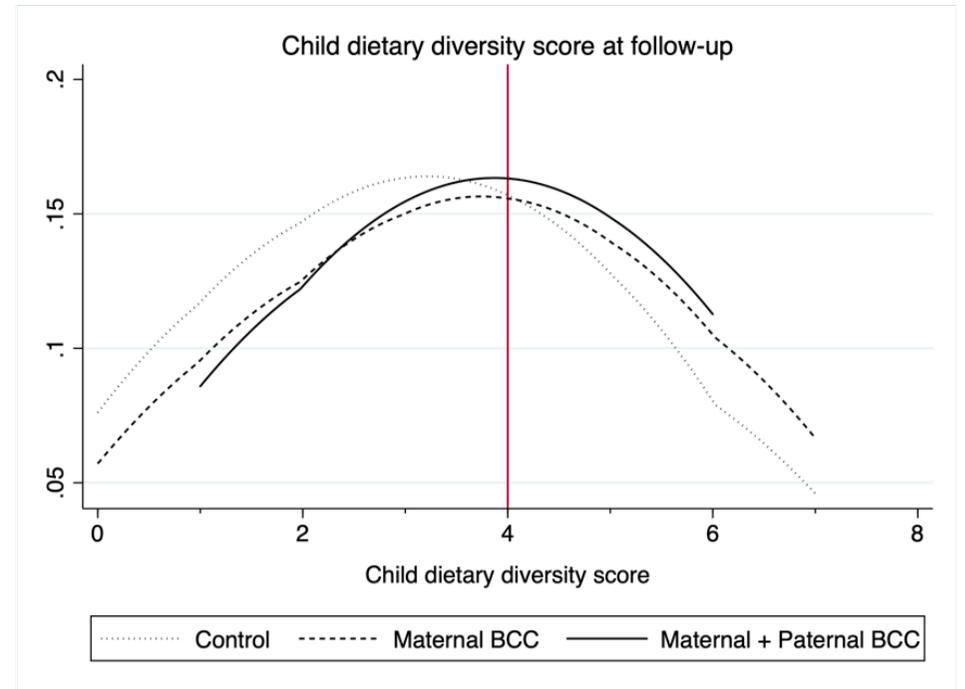
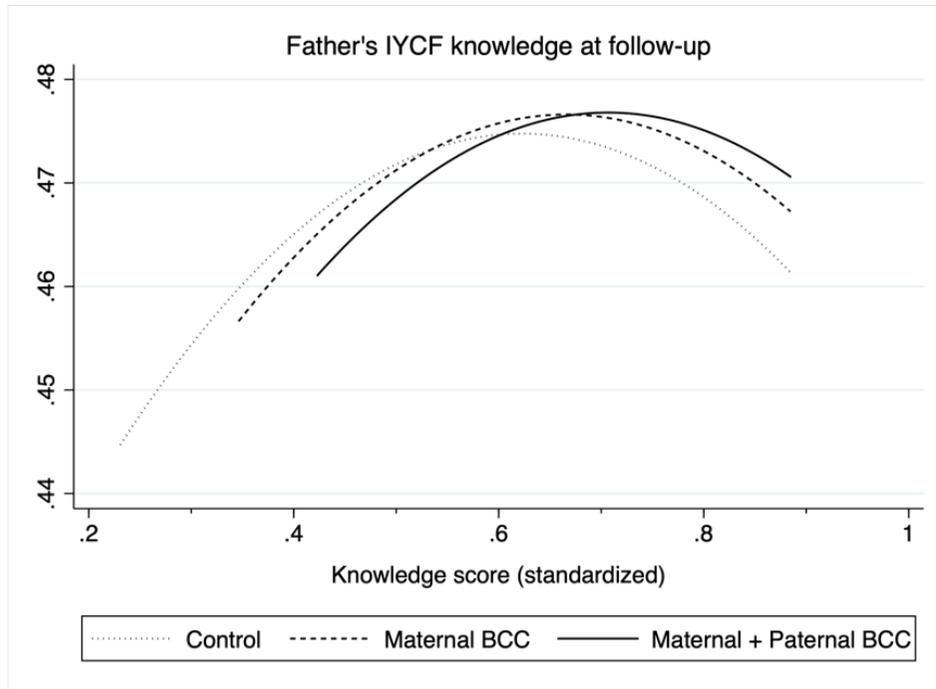
Supplementary tables and figures



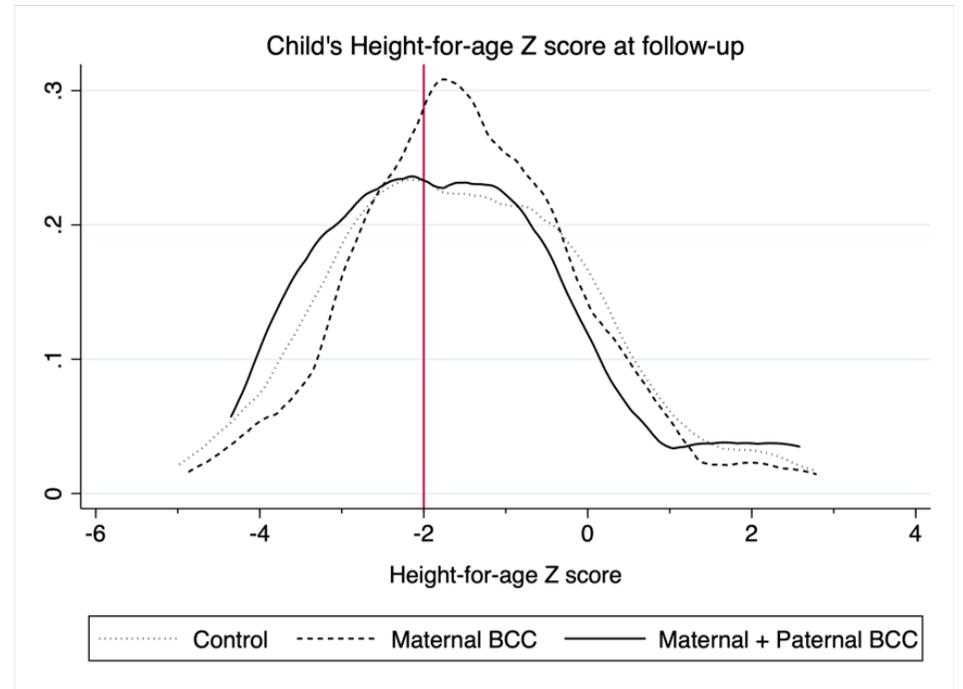
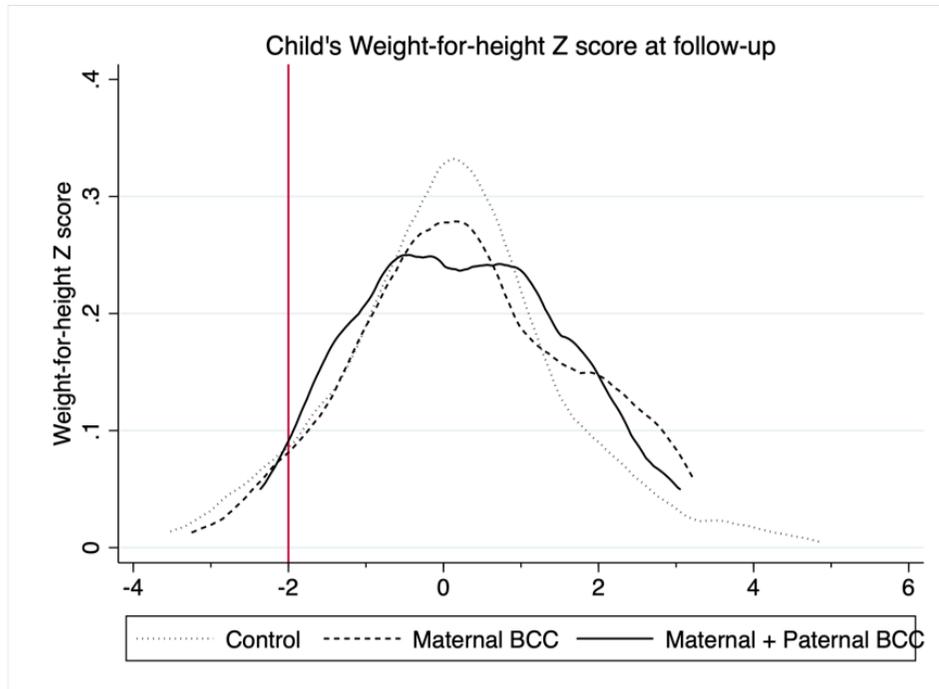
Supplementary figure S2.1. Distribution of father's knowledge and CDDS of control group at baseline and follow-up



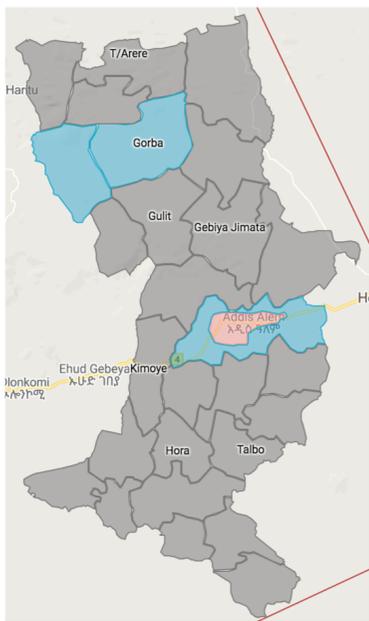
Supplementary figure S2.2. Distribution of weight-for-height Z score and height-for-age Z score of control group at baseline and follow-up.



Supplementary figure S2.3. Distribution of father's knowledge and CDDS score by group assignment.



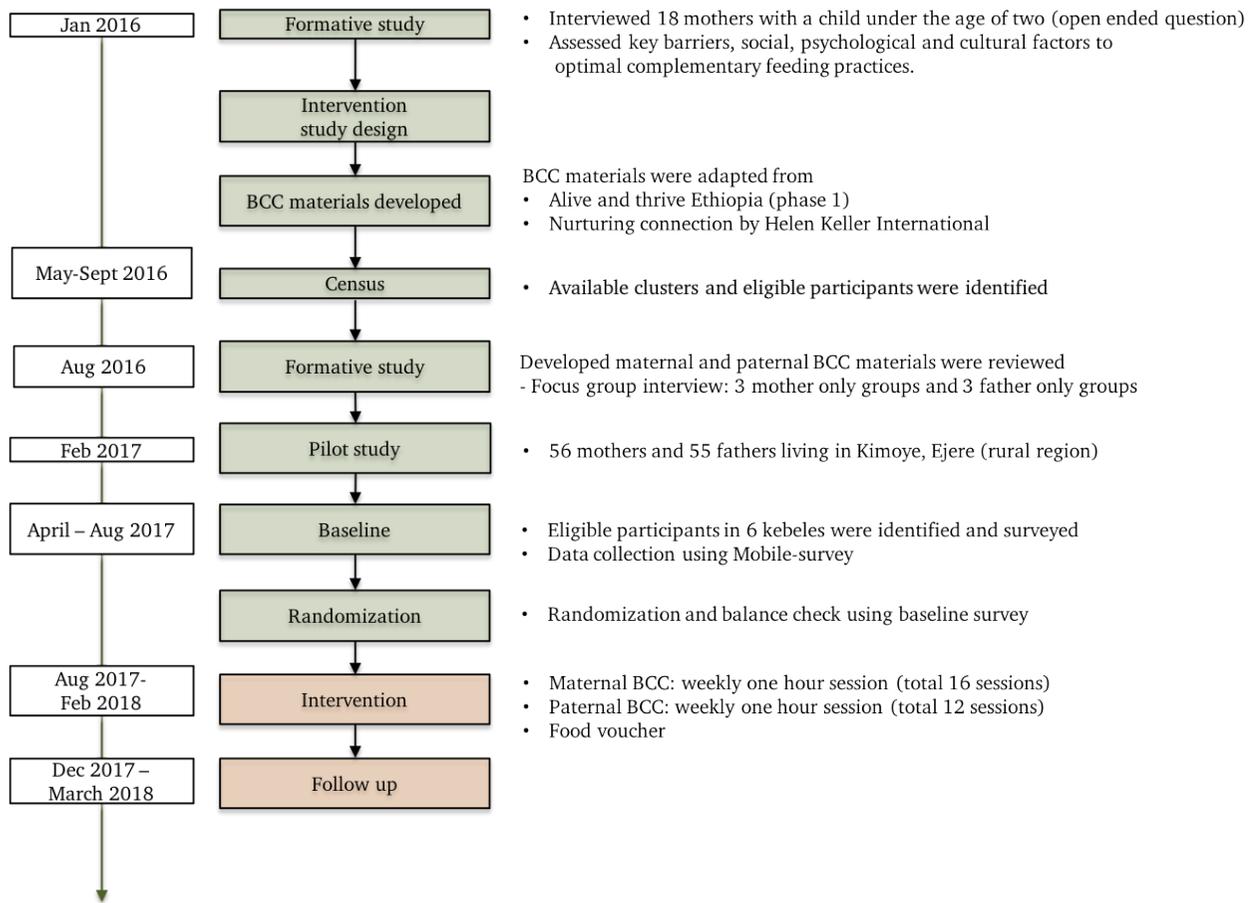
Supplementary figure S2.4. Distribution of weight-for-height Z score and height-for-age Z score by group assignment



	Ejere (district)	Study site
Land size	Approx. 300km ²	
No of Kebeles	30	6
No of Gotts	92	19
No of Garees (village)	487	90
No of households	23,356	~5000
Live birth per year	3,779	~900



Supplementary figure S2.5. Map of Ejere district



Supplementary figure S2.6. Study Timeline

Supplementary table S2.1. Robustness check for the primary outcomes

	Father's IYCF knowledge			Child dietary diversity score		
	Unadjusted	Baseline outcome	Baseline outcome + other control variables	Unadjusted	Baseline outcome	Baseline outcome + other control variables
Maternal BCC (T1)	0.043* (0.022)	0.043* (0.022)	0.042* (0.024)	0.508** (0.237)	0.514** (0.243)	0.387** (0.184)
Maternal + Paternal BCC (T2)	0.084*** (0.020)	0.084*** (0.021)	0.084*** (0.019)	0.653*** (0.234)	0.661*** (0.240)	0.651*** (0.162)
Control group mean	0.623	0.623	0.623	3.219	3.219	3.219
Observations	283	283	282	372	372	369
Panel B. Sample without the control group						
Maternal + Paternal BCC (T2)	0.041* (0.023)	0.041* (0.023)	0.048** (0.022)	0.145 (0.295)	0.147 (0.308)	0.244 (0.233)
Maternal BCC (T1) group mean	0.666	0.666	0.666	3.743	3.743	3.743
Observations	109	109	109	143	143	142
P value: maternal= maternal + paternal	0.085	0.095	0.039	0.627	0.637	0.304

Table S2.1 report regression without control groups for robustness check. Unadjusted estimation: Not adjusted. Baseline outcome estimation: include baseline outcome. Baseline outcome + other control variables: include baseline outcome and other pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S2.2. Robustness check for the child growth outcomes

	WHZ score			Wasted (%)			HAZ score			Stunted (%)		
	Unadjusted	Baseline control	Baseline + control	Unadjusted	Baseline control	Baseline + control	Unadjusted	Baseline control	Baseline + control	Unadjusted	Baseline control	Baseline + control
Maternal BCC (T1)	0.312*	0.286	0.319	-0.044	-0.043	-0.054	-0.035	-0.069	-0.192	0.023	0.065	0.116*
	(0.173)	(0.194)	(0.197)	(0.029)	(0.031)	(0.034)	(0.203)	(0.183)	(0.166)	(0.072)	(0.066)	(0.066)
Maternal & Paternal BCC (T2)	0.271	0.212	0.199	-0.067**	-0.069**	-0.075**	-0.067	-0.103	-0.025	0.016	-0.008	-0.026
	(0.208)	(0.213)	(0.228)	(0.026)	(0.028)	(0.033)	(0.218)	(0.210)	(0.143)	(0.076)	(0.064)	(0.038)
Control mean	0.109	0.109	0.109	0.079	0.079	0.079	-1.490	-1.490	-1.490	0.415	0.415	0.415
Observations	320	304	302	320	304	302	315	296	294	315	296	294
Maternal & Paternal BCC (T2)	-0.112	-0.108	-0.031	-0.012	-0.022	-0.024	0.045	0.152	0.461**	-0.038	-0.091	-0.190**
	(0.229)	(0.221)	(0.298)	(0.032)	(0.032)	(0.044)	(0.201)	(0.162)	(0.192)	(0.083)	(0.077)	(0.072)
Maternal BCC mean (T1)	0.388	0.388	0.388	0.034	0.034	0.034	-1.502	-1.502	-1.502	0.424	0.424	0.424
Observations	117	113	112	117	113	112	115	112	111	115	112	111
P value: T1=T2	0.630	0.631	0.917	0.714	0.498	0.594	0.825	0.360	0.025	0.651	0.252	0.015

Table S2.2 report regression without control groups for robustness check. Unadjusted estimation: Not adjusted. Baseline outcome estimation: include baseline outcome. Baseline outcome + other control variables: include baseline outcome and other pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S2.3. Father's IYCF knowledge

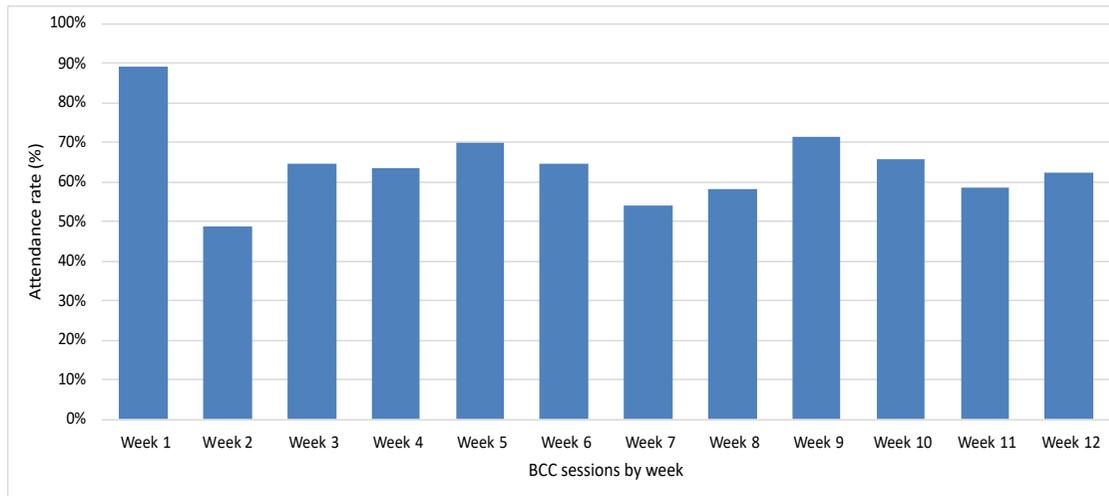
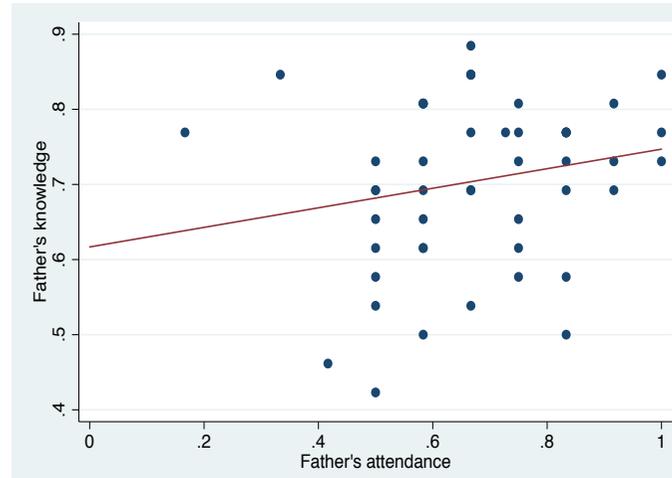
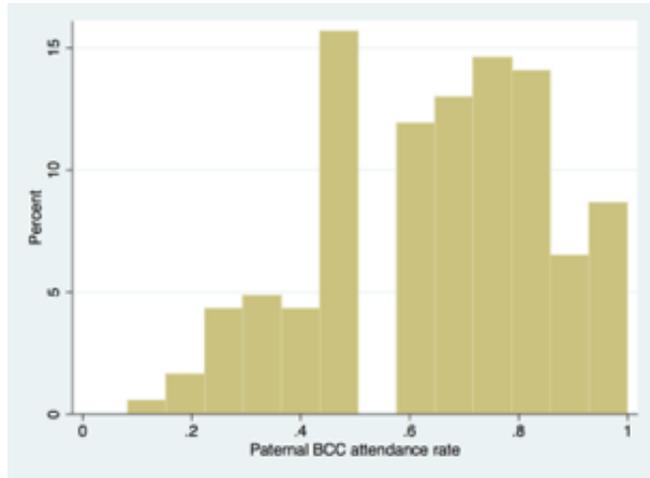
	Father IYCF knowledge score (0-1)							
	Score by topics							
	Total score	Dietary diversity	Animal sourced food	Initiation of Complementary feeding	Vitamin A rich food	Importance of first two years	Responsive feedig	Feeding frequency
Panel A. Full sample								
Maternal BCC (T1)	0.043*	0.035	0.015	0.067	0.132***	0.058	0.014	0.049
	(0.024)	(0.041)	(0.043)	(0.054)	(0.042)	(0.054)	(0.046)	(0.035)
Maternal + Paternal BCC (T2)	0.086***	0.096***	0.108***	0.177***	0.073	-0.009	0.126*	0.014
	(0.019)	(0.031)	(0.030)	(0.057)	(0.044)	(0.048)	(0.066)	(0.047)
Control group mean	0.623	0.609	0.739	0.684	0.812	0.463	0.372	0.707
Observations	282	282	282	282	282	282	282	282
Panel B. Sample without the control group								
Maternal + Paternal BCC (T2)	0.050**	0.056*	0.127**	0.069	-0.028	-0.111**	0.106	-0.025
	(0.022)	(0.032)	(0.057)	(0.061)	(0.034)	(0.045)	(0.079)	(0.045)
Maternal BCC only group mean (T1)	0.666	0.648	0.753	0.759	0.925	0.517	0.392	0.753
Observations	109	109	109	109	109	109	109	109
P value: maternal= maternal + paternal	0.039	0.109	0.035	0.293	0.379	0.017	0.212	0.590

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S2.4. Household decision on food purchases

	Mother's perception on household decision on food purchases							
	All foods combined	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Panel A. Full sample								
Maternal BCC (T1)	-0.160 (0.152)	-0.084 (0.210)	-0.126 (0.224)	0.058 (0.247)	-0.512** (0.252)	-0.271 (0.219)	0.117 (0.171)	-0.235 (0.185)
Maternal + Paternal BCC only (T2)	-0.146 (0.183)	-0.497* (0.256)	0.118 (0.220)	-0.029 (0.282)	0.119 (0.317)	-0.470** (0.232)	0.013 (0.170)	-0.152 (0.225)
Control group mean	7.043	7.264	7.725	7.441	3.274	7.825	8.000	7.763
Observations	368	367	356	357	366	368	368	368
Panel B. Sample without the control group								
Maternal + Paternal BCC (T2)	0.031 (0.210)	-0.367 (0.296)	0.192 (0.258)	0.052 (0.293)	0.530 (0.395)	-0.208 (0.283)	-0.135 (0.263)	0.075 (0.271)
Maternal BCC (T1) group mean	6.852	7.203	7.521	7.361	2.905	7.500	8.014	7.500
Observations	142	142	136	137	142	142	142	142
P value: maternal = maternal + paternal	0.951	0.182	0.378	0.781	0.102	0.502	0.639	0.757

Mother's perceived household decision (score range 0-10, 10=mother decides). All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. **, and *** denote significance at 5%, and 1%, respectively.



Supplementary figure S2.7. Paternal BCC attendance

Supplementary table S2.5. Maternal, paternal, child, household, IYCF, and anthropometry characteristics at baseline by paternal BCC attendance

	Low attendance (average attendance 50% or below)		High attendance (average attendance 80% or above)		Difference
	N	Mean	N	Mean	Mean difference
Maternal					
Knowledge score	16	0.675	17	0.599	0.076
Married	20	0.85	19	0.737	0.113
Age	20	28.8	19	28.737	0.063
Number of school years	20	3.6	19	3.105	0.495
Currently work	20	0.55	19	0.632	-0.082
Paternal					
Knowledge score	11	0.629	14	0.456	0.173*
Age	20	33.7	19	34.105	-0.405
Number of school years	20	5.45	19	4.263	1.187
Currently work	20	0.9	19	0.842	0.058
Child					
Eligible child's age	20	14.95	19	13.211	1.739
Sex	20	1.45	19	1.737	-0.287
Eligible child's birth order	20	2.35	19	2.947	-0.597
Household					
Household size	20	4.7	19	5.053	-0.353
Orthodox	20	0.25	19	0.053	0.197
Oromo	20	0.75	19	0.842	-0.092
Rural	20	0.45	19	0.579	-0.129
Handwashing place	20	0.65	18	0.611	0.039
Asset	20	0.046	19	-0.139	0.185
IYCF practices					
Child dietary diversity score	20	3.5	19	2.211	1.289*
Minimum acceptable diet	19	0.316	15	0.067	0.249
Minimum dietary diversity	20	0.45	19	0.105	0.345*
Minimum meal frequency	19	0.684	15	0.533	0.151
Growth					
WHZ score	14	-0.189	15	0.326	-0.515
HAZ score	14	-1.138	15	-1.323	0.185
Wasted	14	0.214	15	0	0.214
Stunted	14	0.429	15	0.267	0.162

*, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Supplementary table S2.6. CONSORT 2010 checklist

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomized trial in the title	16
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	17
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	18-20
	2b	Specific objectives or hypotheses	20
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	22
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	21
Participants	4a	Eligibility criteria for participants	21
	4b	Settings and locations where the data were collected	21
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	23
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	26
	6b	Any changes to trial outcomes after the trial commenced, with reasons	27
Sample size	7a	How sample size was determined	27-28
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	22
	8b	Type of randomization; details of any restriction (such as blocking and block size)	22
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	22
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	22

Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	21, 22
	11b	If relevant, description of the similarity of interventions	N/A
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	N/A
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	23
	13b	For each group, losses and exclusions after randomisation, together with reasons	Reason not assessed
Recruitment	14a	Dates defining the periods of recruitment and follow-up	24
	14b	Why the trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	30
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	30
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Panel B
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	N/A
Harms	19	All-important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	None
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	37
Generalisability	21	Generalizability (external validity, applicability) of the trial findings	37
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	36-37
Other information			
Registration	23	Registration number and name of trial registry	18, 28
Protocol	24	Where the full trial protocol can be accessed, if available	N/A
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	18, 28

CHAPTER 3

Engaging fathers in improving infant and young child feeding (IYCF) practices to improve child diet and anthropometric outcomes when households receive food vouchers: a clustered randomized controlled trial in Ethiopia

ABSTRACT

Context: An important cause of stunting is limited consumption of complementary foods, in terms of both quantities and nutrients. The efficacy of paternal BCC program that aims to increase paternal support on improved complementary feeding practices remains unknown when households receive food voucher.

Objective: To determine the efficacy of maternal BCC, paternal BCC, and food voucher programs.

Design, Setting, Participants: This community-based, clustered randomized controlled trial that included women who had children between 4 and 20 months old, their children, and the partners of participating women who lived in the 92 *garees* (villages) between April and August 2017; the follow-up ended in March 2018. The trial included 779 women and 509 men who met the eligibility criteria.

Intervention: We randomly assigned the 92 *garees* into treatment and control groups in a 1:3 (treatment:control) ratio: T1, maternal BCC only ($n = 15$); T2, maternal BCC and paternal BCC ($n = 13$); T3, maternal BCC and food voucher ($n = 15$); T4, maternal BCC and paternal BCC and food voucher ($n = 13$); and C, control ($n = 36$). The primary outcomes were the fathers' knowledge and the children's dietary diversity scores. Among the 779 women and 509 men who participated, 93% and 93.6% completed the trial, respectively. During treatment, mean attendance rates for the maternal BCC and the paternal BCC were 73% and 66%, respectively.

Main Outcome Measure: The primary outcome were fathers' knowledge and child dietary diversity score.

Results: Among 779 women and 509 men who participated, 93% and 93.6% completed the trial, respectively. During treatment, mean attendance rates for maternal BCC and paternal BCC were 73% and 66%, respectively. We found the group that received paternal BCC increased fathers' IYCF knowledge significantly compared to the control group. We also found that

CDDS significantly improved among the maternal BCC, maternal BCC and paternal BCC, and maternal BCC and voucher groups, compared with the control group, by 0.43, 0.65, and 0.74 food groups. However, surprisingly, providing the paternal BCC and food voucher together in addition to the maternal BCC led to a smaller increase in CDDS, by 0.31 food group. The effect was not statistically significant compared with the control group. We found that this effect was mainly driven by the households in which the husband was more actively involved in food purchases.

Conclusion: A 12-weeks-long paternal BCC program increases fathers' IYCF knowledge. However, a small change in IYCF knowledge is not enough to change fathers' behavior to positively influence child's diet meaningfully. Rather, we find larger effect size when there is *no* form of paternal engagement either through paternal BCC or ownership of food voucher. Program targeting fathers should be designed carefully.

Trial Registration: The study is registered with ClinicalTrials.gov, number NCT03229629.

Funding: This trial was supported by Africa Future Foundation, Korea Foundation for International Healthcare (KOFIH), Seoul Women's Hospital, and Dr. Taehoon Kim.

INTRODUCTION

Globally, 171 million children under the age of five are stunted (height-for-age Z score < -2), 35% of which live in Africa ¹. Stunting, an indicator of chronic malnutrition, is linked to short- and long-term life outcomes, affecting morbidity, cognitive function, schooling, and wages ^{2,3}. While the prevalence of stunting is decreasing worldwide, the absolute number of the stunted population is growing in Africa ¹. In Ethiopia, the focus of this study, the prevalence of stunting in children under the age of five was 38% in 2016 ⁴. It is widely understood that poor nutritional status in early life reflects poor maternal nutrition and limited access to health care during pregnancy and sub-optimal breastfeeding practices during the first six months of life ¹. During the period 6-24 months, another critical period for child growth, an important cause of stunting is limited consumption of complementary foods, in terms of both quantities and nutrients ¹.

Multiple factors contribute to sub-optimal complementary food consumption, including low household resources, limited availability and unaffordability ^{5,6}. Incorrect knowledge and attitudes about appropriate foods to feed to children 6-24 months also plays a role. Nutrition education is seen as a means of addressing this constraint and has been shown to improve infant and young child feeding knowledge and practices in multiple settings such as improving complementary feeding practices ⁷⁻⁹, caloric intake ¹⁰, length ^{10,11}, and weight ^{9,12}. However, most nutrition education programs address only knowledge constraint to improved IYCF and nutrition outcomes. Behavior change communication (BCC), that uses multiple communication channels including group education, individual counselling, and mass media has been shown to be effective in developing positive behavior.

Another important constraint to improved IYCF practices is lack of paternal support. A number of qualitative and association studies have pointed to the constraining effects of limited paternal engagement ^{13,14}. A lack of paternal support may affect mothers' ability to improve

complementary feeding practices either because fathers often determine the purchases of nutritious but expensive food items that are absent from a child's diet or because while mothers are often overburdened with the dual responsibilities of childcare and time-intensive domestic work, fathers ascribe to a traditional gendered division of roles and responsibilities, making it difficult to share the domestic work. Without paternal support with household chores, mother will have difficulties cooking improved complementary food, which requires additional tasks and time ^{11,15}.

A number of studies have shown a positive relationship between paternal involvement and maternal health ¹⁶⁻²⁴ and there are several association studies that have shown positive correlation between paternal knowledge and improved feeding practice ^{13,14}. However, to the best of our knowledge, there are no intervention studies that assess the impact of engaging fathers in nutrition BCC in order to improve complementary feeding practices. We implement a cluster randomized controlled trial to assess whether adding paternal nutrition BCC to a maternal nutrition BCC program has a larger impact on complementary feeding practices compared to a maternal nutrition BCC program alone.

In this study, we test whether there are additional impacts of maternal plus paternal BCC program on complementary feeding practices compared to maternal BCC program alone when households are receiving food vouchers through a cluster randomized controlled trial.

METHODS

STUDY DESIGN AND PARTICIPANTS

This study is a community-based, clustered randomized controlled trial conducted from April 2017 until March 2018. To minimize contamination by spill-over of knowledge, we used a clustered randomized controlled trial as our study design. The study was conducted in Ejere district located in the Oromia region of central Ethiopia, 52km west of Addis Ababa. Ejere

covers an area of 300km² and consists of 3 urban and 27 rural kebeles (ward). The total population of the Ejere district in 2015 was 112,111; 5% of children were between 4-20 months of age. BCC facilitators and enumerators were hired through Africa Future Foundation (AFF), a collaborating NGO.

The census data of 22,000 households living in Ejere district was collected in collaboration with AFF during 2016 was used to identify eligible participants. Key household characteristics such as the youngest child's age, the mother's age, and spouse information collected in the census were used to identify eligible participants. Enumerators made household visits to invite eligible mothers to participate in the study. For inclusion in our study, women had to be permanent resident of the study cluster and have children between 4-20 months and consented to participate. For illiterate mothers, enumerators read the consent form and received signature if they were willing to participate. Men were eligible if they lived with the participating women more than nine months in the last 12 months and consented to participate. Children's ages were calculated based on mother's recall of the birth date. A local events calendar was used to estimate child age when a mother had difficulty recalling the child's birthdate.

Households were not aware of the other intervention arms; consent forms were specific to a participant's group allocation. We conducted the baseline survey prior to participant's 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 the Cornell University (USA, 1612006823), the Oromia state IRB (Ethiopia, BEIO/AHBHN/1-8/2670), and Myungsung Medical College (Ethiopia).

RANDOMIZATION AND MASKING

All villages in Ejere were eligible for clusters. We randomly selected three rural kebeles (equivalent to a ward) and all three urban kebeles within the Ejere district in order to include both urban and rural localities. Within the 6 selected kebeles, 90 garees (villages) were identified through Kebele leaders. We randomly assigned garees into treatment and control groups in a 1:3 (treatment: control) ratio: T1, maternal BCC only; T2, maternal BCC and paternal BCC; T3, maternal BCC and food voucher; T4, maternal BCC and paternal BCC and food voucher; and C, control. Randomization was conducted for each of the six kebele separately. Ownership of the food vouchers were individually randomized within the household between men and women. For female headed households, the women were given ownership of the food voucher. As a result of the BCC and food voucher ownership randomizations, we have four treatment arms for voucher owned households; maternal BCC + mother voucher ownership (M-BCC & M-V), maternal BCC + father voucher ownership (M-BCC & F-V), maternal and paternal BCC & mother voucher ownership (MP-BCC & M-V), and maternal and paternal BCC & father voucher ownership (MP-BCC & F-V). The randomization was computer generated using STATA program. Randomization and assignment of villages to intervention and control arms were done by researchers at Cornell University. 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 prevent social desirability bias, we assessed fathers' behavior change through mother's report.

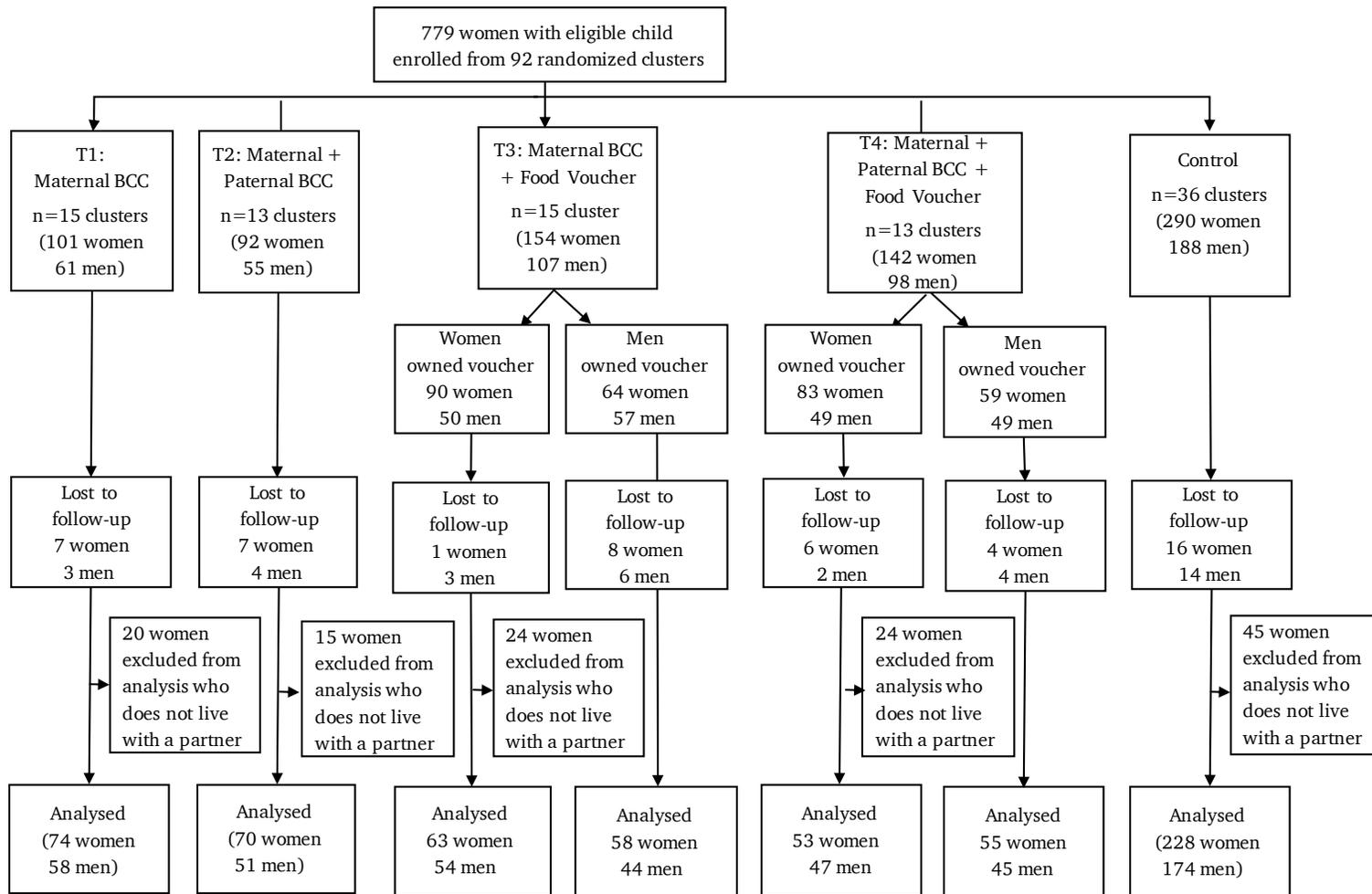


Figure 3.1. Consolidated Standards of Reporting Trials (CONSORT) diagram.

INTERVENTION

The maternal BCC program lasted for 16 weeks. Seven to fourteen participants from the same garee (village) formed one BCC group and met 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. An image-oriented booklet containing a summary of optimal IYCF practices and action plans were distributed to all participants. Role-play and food demonstration sessions were also included. Prior to implementation, situational assessment, formative research, and multiple rounds of pretesting were conducted to ensure that the BCC modules are acceptable and persuasive. To increase attendance, BCC groups competed for a monthly prize worth 35 birr (~\$1.50) per person, awarded to members of the group with the highest group attendance rate.

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. Paternal BCC program included messages about diet diversity, consequence of malnutrition during the first two years, fathers' role in childcare, shared division of household labor, and gender equal intra-household decision. Multiple rounds of pretesting and pilot tests were conducted to ensure that the BCC programs were acceptable and persuasive. Paternal BCC participants also competed for a monthly prize.

Food vouchers worth 200 ETB (approximately 10 USD) were transferred monthly to each household for the duration of 4 months. 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. At the first disbursement, careful instructions were provided as to how to use the vouchers. Each voucher had a blue-colored official stamp to prevent counterfeits, and a household identification number

to be matched with household IDs to prevent transfers. The ownership of the food vouchers was individually randomized within the household between men and women. The voucher ID included both the mother and father's names to ensure both parents could use it for food purchases. However, to emphasize the ownership of the voucher, the owner of the voucher's name was highlighted and circled. Individual purchase records were tracked. Every month, the voucher teams made a call to voucher recipients notifying them of the date and time they should expect the voucher team at their house. For those without phones, the date and time were communicated through village (kebele/gott) leaders. If the recipient failed to meet at the notified time, the voucher team tried to schedule a second visit. For those who attended BCC sessions, a voucher that was not delivered at the first visit was delivered during the BCC session.

Male and female BCC facilitators who held a secondary school certificate were recruited from the local community. BCC facilitators completed three rounds of training over an 18-month period. They implemented two pilot studies to check the delivery and acceptability of the BCC materials. BCC materials were finalized after the second BCC pilot. To monitor the quality of the BCC interventions, BCC supervisors randomly joined the BCC group session at least twice a week per BCC facilitators and gave feedbacks.

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 made. Baseline and the follow-up surveys for the mothers included detailed information on IYCF knowledge, child food consumption, household expenditures, gender norms, household labor allocation, household decision-making, anthropometry, demographics, and socioeconomic information. The surveys for the fathers included detailed information on IYCF knowledge, gender norm, household labor

allocation, household decision-making, food frequency, and agriculture and livestock production. BCC attendance data was collected for all BCC participants.

OUTCOMES

The primary outcomes of interest were mean difference in parents' nutrition knowledge and child dietary diversity score (CDDS). Mother and fathers' IYCF knowledge were assessed using a separate survey module that contained 34 and 27 questions, respectively, on topics such as importance of the first two years in child growth, appropriate feeding frequency and dietary diversity, and nutrient rich foods. We counted number of questions correct and divided the number by total number of questions. 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. For each question, the interviewer asked the mother "Yesterday, during the day or night, did [NAME] eat [FOOD ITEM]?" If the answer was yes, the interviewer asked how many times the food item was fed to the child the previous day. The food items were grouped into seven food groups, and CDDS was calculated by summing up 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 (WHO, 2010). Minimum meal frequency is the proportion of children who consumed minimum number of meals recommended for the age, and minimum dietary diversity is proportion of children who receive food from 4 or more food groups. Minimum acceptable diet is calculated by combining minimum dietary diversity and minimum feeding frequency adjusting for child's age.

Fathers' attitude was measured including fathers' gender norm attitude, household decision, labor allocation, and communication between partners. We construct fathers' gender norm attitude score by asking whether or not respondent agree or disagree on 14 questions and

counted number of questions that was answered correctly. We measured fathers' attitude on household decision making by asking questions on a Likert-type scale ranging from 0 to 10, 0 as father making the decision alone, and 10 as mother making the decision alone. We measured fathers' attitude on household labor allocation by asking questions on 14 different household chores, assessed on a five-tiered scale ranging from "I did almost everything" to "Other members of the household did almost everything".

We measured mothers' perceived health, frequency of physical or emotional problems interfering with social activities, perceived social support, and perceived time stress. Mothers' perception of their health was asked on a five-tiered scale ranging from excellent to poor. The social support scale is created by asking 11 questions to be answered on a four-tiered scale ranging from definitely true to definitely false. We construct time stress score by asking three questions on a three-tiered scale ranging from always to never. Physical/emotional problems were assessed on a five-tiered scale ranging from all of the time to none of the time.

Lastly, we measured mother and 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 the WHO child growth standards.

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

SAMPLE SIZE AND STATISTICAL ANALYSIS

The sample size (ie, the number of clusters and individuals) was based on the minimum detectable difference of child dietary diversity score and fathers' knowledge score, the two primary outcomes. The sample size calculation estimated 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 CDDS²⁸. All calculations were set at 95% confidence levels, 90% power and assumed 10% attrition.

We used generalized estimating equations that accounted for within cluster correlation and contained four dummy variables representing the maternal BCC compared to control, maternal & paternal BCC compared to control, maternal BCC plus food voucher compared to control, and maternal & paternal BCC plus food voucher compared to control, adjusting for pre-specified covariates and baseline outcomes. Individual's demographic variables (e.g., age, marital status, birth order, and household size) and socioeconomic status (e.g., level of education, employment status/history, and household income and asset) was used as control covariates. To compare between treatment arms, we performed F-test. We performed robustness checks for primary outcomes results by running three different regression models (supplementary Table S3.1). First, we estimated regression with area variables only. Second with area and the baseline of outcome variable. Third with area, baseline of outcome variable, and other control variables. We find that the results are robust, and the point estimates and their degree of statistical significance remain similar. Stata (version 14) was used for data analysis. The study is registered with ClinicalTrials.gov, number NCT03229629.

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

Between April 2017 and March 2018, 778 eligible women were enrolled from 90 clusters. 509 partners of the participating women were enrolled. We conducted an intent-to-treat analysis, including all mothers who has partners. We excluded mothers without partners from the analysis.

The majority of the rural population in Ejere were poor, agrarian semi-subsistence economy, and the urban population were a mix of agrarian and wage employees. Baseline results showed mean household size was 4.7 people, 86% were Orthodox, 75% were Oromo, and 65% had handwashing place near the cooking area (Table 3.1). Mothers were, on average, 29 years old, 88 percent married, went to school for 4.5 years, and 55% worked. Fathers were, on average, 34 years old and went to school for 6.4 years. Mean age of the eligible child was 14 months. The WHO standard IYCF indicators showed inadequate complementary feeding practices, consuming only 2.7 out of 7 food groups the previous day.

Fidelity of intervention delivery was higher for maternal BCC group. Average BCC attendance rate was 76% (12 out of 16 sessions) and 63% (8 out of 12 sessions) for mothers and fathers, respectively (Table 3.1). The first paternal BCC session had the highest attendance at 87% and stayed between 48% and 70% for the remaining paternal BCC program (supplementary Figure S3.2). Looking at the average individual BCC attendance, more than 77% of fathers attended half or more of the BCC sessions (supplementary Figure S3.2).

We assessed balance at baseline across treatment and the control arms in terms of both outcomes and control variables used in our analysis (Table 3.1). Overall, the sample is balanced between the treatment and the control groups. Only 5 out of 108 t-tests rejected the null hypothesis of mean equality at the 5% significance. Attrition rate at the follow-up survey was 7.4%, 7.5%, and 15.7% for mother, father, and child, respectively, and was balanced across the treatment and the control groups (Table 3.1).

Table 3.1. Maternal, paternal, child, household, IYCF characteristics and anthropometry at baseline.

	M-BCC [T1]	MP-BCC [T2]	M-BCC & V [T3]	MP-BCC & V [T4]	C
Mother (N)	74	70	121	108	228
Father (N)	58	51	98	92	174
Maternal BCC attendance	0.72 (0.19)	0.75 (0.19)	0.75 (0.22)	0.77 (0.2)	N/A
Paternal BCC attendance	N/A	0.66 (0.17)	N/A	0.65 (0.23)	N/A
Mother attrition	0.08 (0.28)	0.09 (0.28)	0.06 (0.25)	0.08 (0.27)	0.06 (0.24)
Father attrition	0.04 (0.21)	0.07 (0.26)	0.08 (0.27)	0.06 (0.24)	0.07 (0.27)
Child attrition	0.19 (0.4)	0.23 (0.42)	0.19 (0.39)	0.16 (0.37)	0.12 (0.33)
Maternal					
Knowledge score	0.63 (0.13)	0.64 (0.13)	0.65 (0.11)	0.67 (0.09)	0.63 (0.11)
Married	0.86 (0.34)	0.87 (0.33)	0.91 (0.27)	0.84 (0.36)	0.87 (0.32)
Age	27.29 (5.53)	28.59 (6.87)	28.56 (5.7)	29.51 (7.66)	28.16 (6.36)
Number of school years	4.88 (5.55)	4.41 (6)	5.23 (6.52)	4.13 (5)	4.26 (5.32)
Currently work	0.53 (0.5)	0.51 (0.5)	0.55 (0.49)	0.54 (0.5)	0.54 (0.49)
Paternal					
Knowledge score	0.6 (0.14)	0.54 (0.16)	0.59 (0.12)	0.61 (0.14)	0.61 (0.14)
Age	33.9 (8.22)	34.16 (8.63)	33.86 (6.69)	35.66 (10.07)	34.06 (8.1)
Number of school years	7.32 (6.16)	6.53 (7.01)	6.68 (6.92)	6.32 (5.87)	6.36 (6.7)
Currently work	0.85 (0.35)	0.87 (0.33)	0.88 (0.32)	0.9 (0.29)	0.91 (0.28)
Child					
Eligible child's age	13.44 (4.97)	12.92 (5.3)	11.93 (5.06)	12.69 (4.77)	12.03 (4.8)
Sex	1.54 (0.5)	1.49 (0.5)	1.4 (0.49)	1.43 (0.49)**	1.5 (0.5)
Eligible child's birth order	2.29 (1.43)	2.42 (1.37)	2.41 (1.44)	2.44 (1.52)	2.45 (1.49)
Household					
Household size	4.51 (1.45)	4.68 (1.37)	4.73 (1.47)	4.66 (1.58)	4.7 (1.51)
Orthodox	0.83 (0.36)	0.83 (0.37)	0.81 (0.38)	0.91 (0.27)***	0.84 (0.36)
Oromo	0.76 (0.42)	0.83 (0.37)	0.77 (0.41)	0.71 (0.45)	0.75 (0.43)
Rural	0.49 (0.5)	0.51 (0.5)	0.32 (0.46)**	0.34 (0.47)	0.5 (0.5)
Handwashing place	0.7 (0.45)	0.64 (0.48)	0.66 (0.47)	0.72 (0.45)	0.6 (0.49)
Asset	0.15 (1.85)	-0.12 (1.59)	0.18 (1.64)	0.16 (1.61)	0.09 (1.76)
IYCF practices					
Child dietary diversity score	2.74 (1.71)	2.66 (1.79)	2.43 (1.63)	2.79 (1.65)	2.74 (1.62)
Minimum acceptable diet	0.28 (0.45)	0.15 (0.36)	0.14 (0.35)	0.12 (0.33)**	0.2 (0.4)
Minimum dietary diversity	0.35 (0.48)	0.27 (0.44)	0.23 (0.42)	0.3 (0.46)	0.33 (0.47)
Minimum meal frequency	0.6 (0.49)	0.53 (0.5)	0.56 (0.49)**	0.5 (0.5)	0.51 (0.5)
Anthropometry					
WHZ	0.44 (1.25)	0.21 (1.53)	0.16 (1.24)	-0.21 (1.35)	0.09 (1.34)
HAZ	-1.12 (1.31)	-1.23 (1.63)	-1.03 (1.46)	-0.94 (1.45)	-1.01 (1.38)

M-BCC: maternal BCC, MP-BCC: maternal & paternal BCC, M-BCC & V: maternal BCC & food voucher, MP-BCC & V: maternal & paternal BCC & food voucher. Values are mean (SD), unless stated. *** p<0.01 ** p<0.05

Mother's IYCF knowledge significantly improved in all treatment groups compared to control (Table 3.2 Panel A), and fathers' IYCF knowledge significantly improved for fathers assigned to paternal BCC in MP-BCC and MP-BCC & V groups. Interestingly, we also find a positive spillover of IYCF knowledge from BCC attending mothers to fathers not attending BCC in the M-BCC and M-BCC & V groups by 4.8 and 3.7 percentage points, respectively. Looking at the voucher ownership separately, we find knowledge spillover only when father has the ownership of the food voucher (Table 3.2 Panel B).

We also find M-BCC increases CDDS by 0.43 food groups compared to control. When paternal BCC or food voucher is provided in addition to maternal BCC, effect size increases, by 0.65 and 0.74 food group in MP-BCC and M-BCC & V, respectively, compared to control (Table 3.2 Panel A). However, the null hypothesis that they are equal is not rejected (Table 3.2 Panel C).

Surprisingly, MP-BCC & V show smaller increase in CDDS, and the increase is not statistically significant compared to control (Table 3.2 Panel A). The difference in the impact of MP-BCC & V on CDDS, relative to M-BCC & V, is statistically significant at the 5% level (Table 3.2 Panel A).

Table 3.2. Primary outcomes

	Mother knowledge score (0-1)	Father knowledge score (0-1)	Child dietary diversity score (0-7)
Panel A			
Maternal BCC (M-BCC) [T1]	0.049*** (0.012)	0.048** (0.023)	0.425** (0.199)
Maternal & paternal BCC (MP-BCC) [T2]	0.041** (0.018)	0.084*** (0.020)	0.645*** (0.166)
Maternal BCC & voucher (M-BCC & V) [T3]	0.044*** (0.014)	0.037* (0.019)	0.744*** (0.179)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	0.067*** (0.013)	0.083*** (0.019)	0.310* (0.170)
P-value: T1=T2	0.683	0.158	0.344
P-value: T1=T3	0.756	0.643	0.182
P-value: T1=T4	0.205	0.146	0.598
P-value: T2=T3	0.864	0.0292	0.622
P-value: T2=T4	0.181	0.956	0.0934
P-value: T3=T4	0.102	0.0219	0.0339
Panel B. Separate by voucher ownership for T3 and T4 group			
M-BCC & M-V	0.045** (0.018)	-0.000 (0.020)	0.872*** (0.246)
M-BCC & F-V	0.047*** (0.017)	0.071*** (0.023)	0.524*** (0.156)
MP-BCC & M-V	0.060*** (0.017)	0.084*** (0.023)	0.286 (0.241)
MP-BCC & F-V	0.075*** (0.016)	0.093*** (0.021)	0.311* (0.181)
p value: M-BCC & M-V = M-BCC & F-V	0.936	0.00715	0.150
p value: M-BCC & M-V = MP-BCC & M-V	0.483	0.00200	0.0780
p value: M-BCC & M-V = MP-BCC & F-V	0.116	0.000219	0.0388
p value: M-BCC & F-V = MP-BCC & F-V	0.141	0.394	0.220
p value: MP-BCC & M-V = MP-BCC & F-V	0.476	0.698	0.927
Panel C. Sample without control group (T1 as reference)			
Maternal & paternal BCC (MP-BCC) [T2]	-0.004 (0.019)	0.035 (0.025)	0.202 (0.224)
Maternal BCC & voucher (M-BCC & V) [T3]	-0.001 (0.013)	-0.01 (0.025)	0.25 (0.233)
T4: Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	0.014 (0.015)	0.028 (0.024)	-0.135 (0.226)
Control group mean (Maternal BCC) [T1]	0.731	0.666	3.743
Observations	367	297	366
P-value: T1=T2	0.826	0.165	0.373
P-value: T3=T4	0.302	0.0694	0.0606
All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.			

Looking at the individual food groups, we find that the increase in child dietary diversity is driven by increased consumption of dairy, meat, and eggs, the food groups that were emphasized during BCC. Consumption of meat increase only in groups receiving food voucher (Table 3.3 Panel A).

We look further at mothers' perception of intra-household decision on food purchases by the individual 7 food groups. The score ranges from 0-10, where 5 indicates equal decision power and higher score indicates greater decision power of the mothers. Looking at the control group mean, we see that mothers have greater decision power on all food groups except for meat (Table 3.4 Panel A). Moreover, we find fathers' involvement in the decision of food purchases increases in MP-BCC & V group significantly by 0.26 points, and the increase is driven by the purchase decisions of dairy products and eggs, the most affordable animal-sourced food that is commonly lacking in children's diet and ones that were heavily emphasized during the BCC sessions (Table 3.4 Panel A). However, fathers' involvement in the purchase of these food groups result in no change in children's consumption of dairy and egg (Table 3.3 Panel A). While MP-BCC & V showed no overall increase in CDDS, meat consumption increased by 7.1 percentage points (Table 3.3 Panel A).

Table 3.3. Child food consumption

	Child dietary diversity score (0-7)	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Maternal BCC (M-BCC)	0.425** (0.199)	-0.018 (0.018)	0.117* (0.067)	0.093* (0.053)	0.111* (0.057)	0.104 (0.069)	0.029 (0.076)	-0.017 (0.061)
Maternal & paternal BCC (MP-BCC)	0.645*** (0.166)	-0.017 (0.022)	0.137** (0.058)	0.161*** (0.055)	0.077* (0.039)	0.163*** (0.060)	0.099* (0.054)	0.022 (0.044)
Maternal BCC & voucher (M-BCC & V)	0.744*** (0.179)	0.007 (0.011)	0.082* (0.049)	0.144*** (0.041)	0.138*** (0.030)	0.225*** (0.058)	0.098* (0.053)	0.040 (0.044)
Maternal & paternal BCC + voucher (MP-BCC & V)	0.310* (0.170)	-0.009 (0.019)	0.036 (0.063)	0.049 (0.050)	0.071** (0.028)	0.077 (0.048)	0.075 (0.052)	0.007 (0.052)
P-value: T1=T2	0.344	0.976	0.789	0.315	0.604	0.467	0.430	0.535
P-value: T1=T3	0.182	0.251	0.623	0.373	0.672	0.142	0.412	0.387
P-value: T1=T4	0.598	0.715	0.292	0.484	0.516	0.717	0.560	0.734
P-value: T2=T3	0.622	0.330	0.357	0.754	0.224	0.409	0.984	0.688
P-value: T2=T4	0.0934	0.785	0.160	0.0915	0.891	0.194	0.706	0.778
P-value: T3=T4	0.0339	0.390	0.473	0.0742	0.0578	0.0217	0.686	0.516
Panel B. Separate by voucher ownership for T3 and T4 group								
M-BCC & M-V	0.872*** (0.246)	-0.012 (0.016)	0.106* (0.060)	0.160** (0.069)	0.117* (0.058)	0.271*** (0.094)	0.162** (0.063)	0.046 (0.047)
M-BCC & F-V	0.524*** (0.156)	0.011 (0.009)	0.048 (0.060)	0.125* (0.067)	0.177*** (0.036)	0.161*** (0.057)	-0.021 (0.049)	0.019 (0.054)
MP-BCC & M-V	0.286 (0.241)	0.001 (0.009)	0.086 (0.100)	-0.002 (0.063)	0.053 (0.044)	0.098 (0.059)	0.068 (0.070)	-0.018 (0.068)
MP-BCC & F-V	0.311* (0.181)	-0.041 (0.031)	-0.011 (0.070)	0.088 (0.056)	0.104** (0.043)	0.083 (0.064)	0.067 (0.064)	0.018 (0.050)
p value: M-BCC & M-V = M-BCC & F-V	0.150	0.224	0.432	0.739	0.435	0.253	0.00728	0.602
p value: M-BCC & M-V = MP-BCC & M-V	0.0780	0.280	0.858	0.0861	0.357	0.123	0.255	0.373
p value: M-BCC & M-V = MP-BCC & F-V	0.0388	0.364	0.128	0.395	0.835	0.0854	0.217	0.602
p value: M-BCC & F-V = MP-BCC & F-V	0.220	0.108	0.451	0.626	0.198	0.296	0.167	0.987
p value: MP-BCC & M-V = MP-BCC & F-V	0.927	0.190	0.419	0.197	0.450	0.864	0.991	0.558
Control group mean	3.218	0.991	0.367	0.419	0.114	0.279	0.227	0.821
Observations	593	593	593	593	593	593	593	593

Child food consumption (score range 0-1, 1=child ate yesterday). All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Table 3.4. Mother perceived intra-household decision on food purchases

	All foods combined	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Panel A. Full sample								
Maternal BCC (M-BCC)	-0.146 (0.145)	-0.080 (0.195)	-0.104 (0.222)	0.013 (0.232)	-0.463* (0.259)	-0.272 (0.214)	0.160 (0.161)	-0.198 (0.184)
Maternal & paternal BCC (MP-BCC)	-0.119 (0.209)	-0.452 (0.293)	0.153 (0.247)	-0.013 (0.295)	0.130 (0.312)	-0.433 (0.264)	0.039 (0.205)	-0.122 (0.261)
Maternal BCC & voucher (M-BCC & V)	-0.223* (0.114)	-0.361** (0.179)	-0.164 (0.149)	-0.186 (0.212)	-0.014 (0.204)	-0.200 (0.161)	-0.340*** (0.120)	-0.363** (0.150)
Maternal & paternal BCC + voucher (MP-BCC & V)	-0.258** (0.124)	-0.354* (0.178)	-0.226 (0.170)	-0.524** (0.238)	-0.049 (0.259)	-0.377** (0.160)	-0.167 (0.139)	-0.239 (0.160)
P-value: T1=T2	0.912	0.263	0.392	0.936	0.108	0.613	0.615	0.799
P-value: T1=T3	0.606	0.209	0.782	0.360	0.0960	0.754	0.00327	0.415
P-value: T1=T4	0.435	0.191	0.592	0.0170	0.169	0.610	0.0581	0.837
P-value: T2=T3	0.586	0.761	0.161	0.503	0.618	0.370	0.0547	0.340
P-value: T2=T4	0.505	0.751	0.133	0.0855	0.594	0.838	0.345	0.665
P-value: T3=T4	0.762	0.971	0.671	0.0604	0.886	0.268	0.179	0.476
Panel B. Separate by voucher ownership for T3 and T4 group								
M-BCC & M-V	-0.087 (0.175)	-0.246 (0.242)	-0.033 (0.249)	-0.127 (0.241)	0.118 (0.341)	0.029 (0.220)	-0.129 (0.155)	-0.245 (0.218)
M-BCC & F-V	-0.218 (0.131)	-0.315 (0.208)	-0.108 (0.192)	-0.070 (0.240)	-0.133 (0.228)	-0.236 (0.176)	-0.415** (0.178)	-0.314** (0.146)
MP-BCC & M-V	-0.264 (0.160)	-0.449* (0.237)	-0.234 (0.207)	-0.421 (0.308)	0.151 (0.318)	-0.404** (0.194)	-0.229 (0.159)	-0.222 (0.219)
MP-BCC & F-V	-0.186 (0.162)	-0.192 (0.208)	-0.103 (0.279)	-0.505 (0.333)	-0.316 (0.527)	-0.287 (0.209)	-0.026 (0.173)	-0.125 (0.170)
p value: M-BCC & M-V = M-BCC & F-V	0.473	0.780	0.813	0.779	0.527	0.263	0.179	0.714
p value: M-BCC & M-V = MP-BCC & M-V	0.382	0.504	0.475	0.307	0.941	0.0659	0.545	0.933
p value: M-BCC & M-V = MP-BCC & F-V	0.619	0.844	0.822	0.180	0.480	0.233	0.566	0.593
p value: M-BCC & F-V = MP-BCC & F-V	0.832	0.599	0.984	0.132	0.715	0.808	0.0463	0.215
p value: MP-BCC & M-V = MP-BCC & F-V	0.684	0.332	0.700	0.841	0.492	0.594	0.212	0.633
Control group mean	7.043	7.264	7.725	7.441	3.274	7.825	8.000	7.763
Observations	593	591	575	576	586	592	593	593

Mother's perceived intra-household decision (score range 0-10, 10=mother decide alone). All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

To explore this interesting pattern further, we look at the effect of the M-BCC & V and MP-BCC & V on CDDS separately by the voucher ownership (Table 3.2 Panel B). The CDDS is highest in the group that receive maternal BCC and has mother ownership of the food voucher (M-BCC & M-V), increasing CDDS by 0.872 food groups. However, the effect size is smaller when fathers are involved either through receiving the paternal BCC program and/or having the ownership of the food voucher, increasing the CDDS by 0.582, 0.290, 0.328 food groups in the M-BCC & F-V, MP-BCC & M-V, MP-BCC & F-V group, respectively (Table 3.2 Panel B). The differences in CDDS between the M-BCC & M-V and MP-BCC & F-V group is statistically significant at the 5% level. Looking at the individual food groups, we find that the increase in CDDS is driven by the increased consumption of dairy, meat, and eggs, the food groups that were emphasized during BCC (Table 3.3 Panel B). In the MP-BCC & F-V group, meat is the only food group that show increase in consumption (Table 3.3 Panel B).

Furthermore, an exploratory analysis shows negative impact on CDDS when father involves in decisions of food purchases and positive significant impact on CDDS when father does not involve in decisions of food purchases in the MP-BCC & V group (Table S3.3). The difference is statistically significant at the 1% level. This suggest when fathers receive both the paternal BCC and food voucher, greater father involvement reduces maternal decision-making autonomy in a sphere where, in the past, mothers may have had more decision-making power.

It is worth noting that the paternal BCC program had much less emphasis on IYCF compared to the maternal BCC program in terms of the number and depth of the BCC sessions directly related to IYCF. Maternal BCC program only focused on messages related to improved IYCF practices, whereas paternal BCC delivered messages on broader topics including IYCF practices as well as intra-household gender equality. Therefore, mothers had greater understanding of improved IYCF practices compared to fathers.

We look further at the standard WHO IYCF indicators to assess child's diet quality and quantity (Table S3.6 Panel A). The results are in line with the results on CDDS. The effect size on the proportion of children who meet the minimum diet diversity standard is larger in the MP-BCC and M-BCC & V groups by 19.2 and 20.9 percentage points, respectively, compared to control. The effect size is smaller in the M-BCC and MP-BCC & V groups (8.7 and 13.5 percentage points, respectively), and the effect of M-BCC is not statistically significant compared to the control group (Table S3.6 Panel A).

We also find similar patterns in minimum meal frequency and minimum acceptable diet standards. MP-BCC significantly increases the proportion of children who meet the minimum meal frequency standard, a proxy for minimum acceptable meal quantity, by 15.2 percentage points (Table S3.6 Panel A). Also, M-BCC, MP-BCC, and M-BCC & V increase the proportion of children who meet the minimum acceptable diet standard compared to control. However, we do not see a significant change in the MP-BCC & V group.

As the paternal BCC program included messages on intra-household equality, we examined fathers' gender norm attitude, mother's perceived social support, and mother's perceived intra-household labor allocation. We do not see meaningful changes in these regards (Table S3.8 Panel A)

Lastly, we study the effects of treatments on child's growth. The average HAZ score decreased from -1.09 SD to -1.54 SD and the prevalence of stunting increased from 21% to 42% in the control group from baseline to follow-up. The prevalence of wasting remained largely unchanged over time—8.7% at baseline and 7.2% at follow-up in the control group. In general, we do not find significant changes in child growth. Although we see a decrease in the proportion of wasted children in the MP-BCC group and a decrease in the proportion of stunted children in the M-BCC & V group (Table S3.10), the results are not robust (Table S3.2)

DISCUSSION AND CONCLUSION

We evaluated the effects of a maternal BCC, paternal BCC, and food voucher program on IYCF practices and growth among children between 4 and 20 months. We find that both maternal BCC and paternal BCC significantly increase IYCF knowledge of mothers and fathers, respectively.

Next, we find that CDDS significantly improves among the maternal BCC, maternal BCC and voucher, and maternal & paternal BCC groups compared to control. However, surprisingly, providing paternal BCC and food voucher together in addition to maternal BCC leads to smaller increase in CDDS, and the effect is not statistically significant compared to control. The difference in the impact of MP-BCC & V on CDDS, relative to M-BCC & V, is statistically significant at the 5% level (Table 3.2 Panel A). Looking at voucher ownership separately within the voucher receiving households, we also find increase in CDDS is biggest when only mothers are involved (M-BCC & M-V) compared to mother & father involvement (M-BCC & F-V/MP-BCC & M-V/MP-BCC & F-V).

We find that this is mainly driven by the households where the husband is more actively involved in food purchases, which suggest a possibility that greater paternal engagement reduces maternal decision-making autonomy in a sphere where, in the past, women may have had more decision-making power. It is also important to note that while we see the treatment groups significantly improve child's diet quality compared to control, the differences between treatment arms are relatively small.

The enrolled participants were broad. It was diverse in age, years of education, marital status, and employment status. This trial population represent both the urban and rural population. As all participants had children between 4 and 20 months, the trial results are generalizable to participants who has children between 4 and 20 months.

The existing literature on the effects of BCC or nutrition education on child-feeding practices find moderate effects on diet quality measures. A study conducted in Malawi showed BCC significantly increase consumption of only one out of eight food groups²⁹. A similar study conducted in Malawi that provide 10 sessions of 2-3 hours long nutrition education to mothers also showed increase in CDDS by 0.39 food groups³⁰, which is comparable to our study.

Literatures that examines the effect of fathers' involvement on maternal and child health outcomes has shown positive impacts especially in developing country settings where men are the key decision-makers that determines women's access to economic resources^{16,17,31}. However, arguments on the downside of the fathers' involvement have also been highlighted such as increased male dominance in decision-making - increased male involvement may result in men usurping what was formerly women's territory and thereby worsening existing male dominance^{32,33}. Furthermore, "joint" control over loans has been described as a disguise for male dominance³⁴ and insufficient for improving women's position^{32,33}. This is in line with our study result which showed no change in consumption of food items when paternal involvement in decision making increase.

The main strengths of this study are the cluster-randomized design that minimize key sources of bias including contamination, collecting baseline measures before randomization to reduce risk of differential uptake, masking survey enumerators to group allocation and assessing father's behavior through mothers to reduce risk of social desirability bias.

This study has some limitations. First, IYCF practices are primarily assessed through self-reported outcome measures which pose a risk for social desirability bias. However, this will unlikely to affect comparison between treatment arms as the main outcome measures are assessed through mothers' report, and mothers' social desirability bias is unlikely to be different between the maternal BCC group and maternal & paternal BCC group. Second, CDDS based on child's consumption in the past 24 hours may not be sensitive enough to capture the changes

in IYCF practices in settings where baseline CDDS and consumption of certain food group is low. For example, only 5% of children were fed meat the previous day at baseline. Third, average paternal BCC attendance was relatively low at 63%. As paternal BCC covered broader topics compared to maternal BCC, it is likely fathers are not aware of all the topics that was covered during the paternal BCC. Fourth, duration of the maternal BCC and paternal BCC programs were 16 weeks and 12 weeks, respectively. The small effect size may be due to short duration of the BCC programs. Lastly, although all analysis presented in this study were pre-specified outcomes, due to the large number of tests we conducted, there are increased probability of a false-positive findings.

The overall findings suggest although 12 weeks long paternal BCC program increase fathers' nutrition knowledge, small change in nutrition knowledge is not enough to change fathers' behavior to positively influence child's diet meaningfully. Rather, we find larger effect size when there is no form of paternal engagement either through paternal BCC or ownership of food voucher, and find suggestive evidence that this is mainly driven by the households where the husband is more actively involved in food purchases, which suggest a possibility that greater paternal engagement reduces maternal decision-making autonomy. Future research should focus on understanding the changes in intra-household dynamics when fathers are engaged, and to find effective communication strategies to change paternal behavior. Furthermore, as financial constraints and limited availability of the healthy foods in the market were among the major barriers to improved IYCF practices, future research should focus on developing interventions to addressing multiple barriers simultaneously.

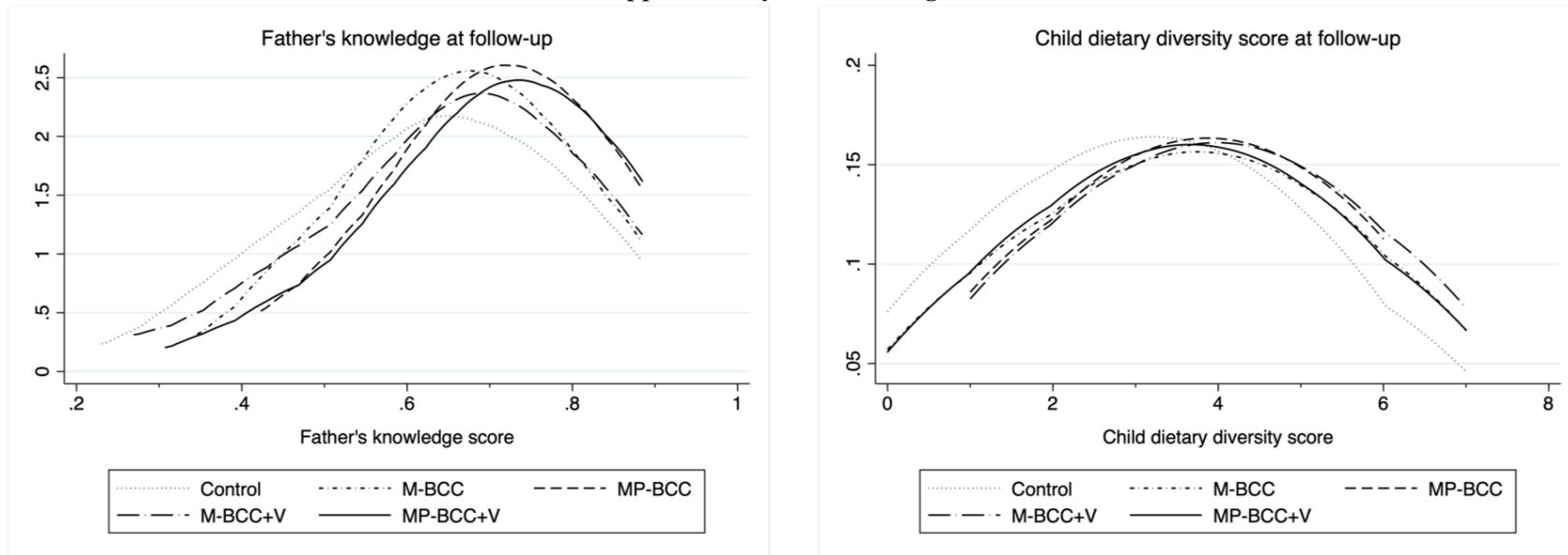
REFERENCES

1. de Onis, M., Blossner, M. & Borghi, E. Prevalence and trends of stunting among pre-school children, 1990-2020. *Public Health Nutr* **15**, 142–148 (2012).
2. Black, R. E. *et al.* Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* **382**, 427–451 (2013).
3. Hoddinott, J. *et al.* Adult consequences of growth failure in early childhood. *Am J Clin Nutr* **98**, 1170–1178 (2013).
4. Uauy, R., Kain, J., Mericq, V., Rojas, J. & Corvalan, C. Nutrition, child growth, and chronic disease prevention. *Ann Med* **40**, 11–20 (2008).
5. Smith, L. C. & Haddad, L. 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 (2002).
6. Headey, D., Hirvonen, K., Hoddinott, J. & Stifel, D. Rural Food Markets and Child Nutrition. *Am J Agric Econ* **101**, 1311–1327 (2019).
7. Bhandari, N. *et al.* Use of multiple opportunities for improving feeding practices in under-twos within child health programmes. *Health Policy and Planning* **20**, 328–336 (2005).
8. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *J Nutr* **130**, 1204–1211 (2000).
9. Zaman, S., Ashraf, R. N. & Martines, J. Training in complementary feeding counselling of healthcare workers and its influence on maternal behaviours and child growth: a cluster-randomized controlled trial in Lahore, Pakistan. *J Health Popul Nutr* **26**, 210–222 (2008).
10. Bhandari, N., Mazumder, S., Bahl, R. & Martines, J. An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, \ldots. *Community and international nutrition* (2004).
11. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *J Nutr* **130**, 1204–1211 (2000).
12. Santos, I. *et al.* Nutrition counseling increases weight gain among Brazilian children. *J Nutr* **131**, 2866–2873 (2001).

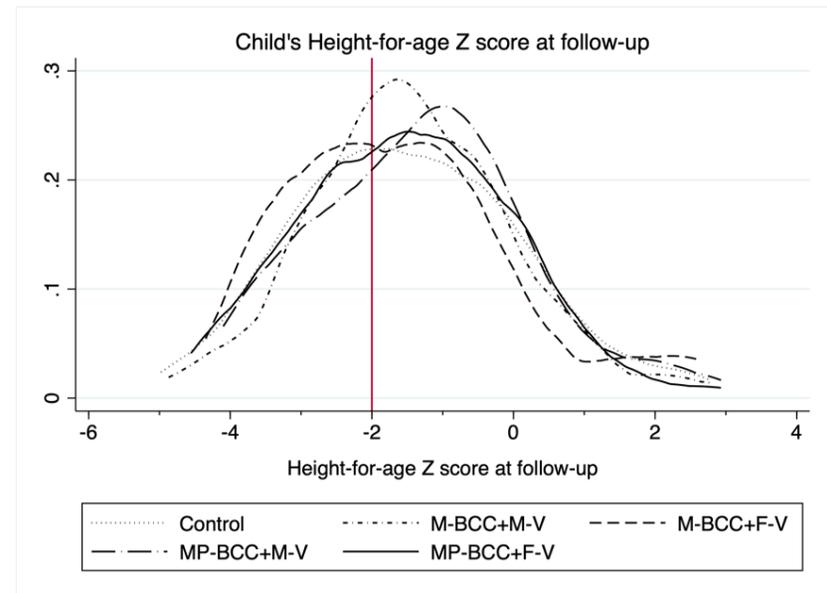
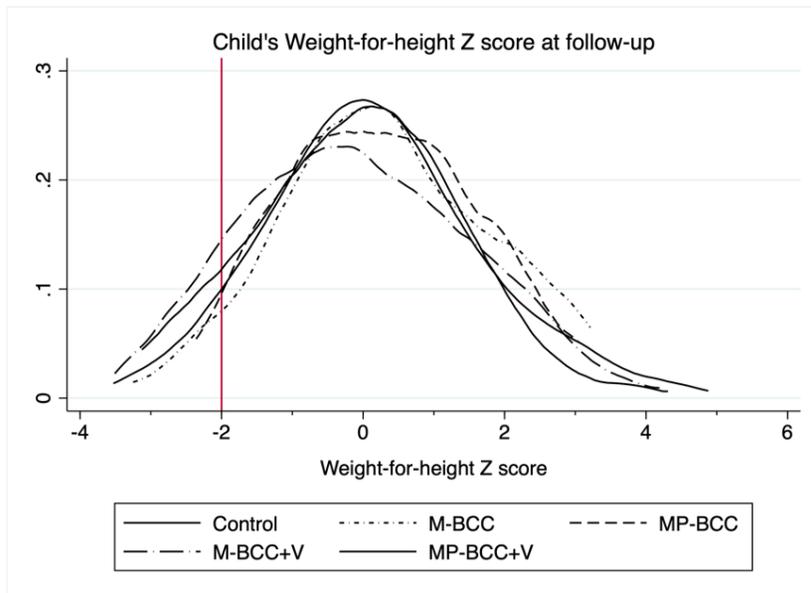
13. Gebremedhin, S. *et al.* Predictors of dietary diversity in children ages 6 to 23 mo in largely food-insecure area of South Wollo, Ethiopia. *Nutrition* **33**, 163–168 (2017).
14. Bilal, S. *et al.* Fathers' Perception, Practice, and Challenges in Young Child Care and Feeding in Ethiopia. *Food Nutr Bull* (2016) doi:10.1177/0379572116654027.
15. Engle, P. L., Menon, P. & Haddad, L. Care and Nutrition: Concepts and Measurement. *World development* **27**, 1309–1337 (1999).
16. Redshaw, M. & Henderson, J. Fathers' engagement in pregnancy and childbirth: evidence from a national survey. *BMC Pregnancy Childbirth* **13**, 70 (2013).
17. Schaffer, M. A. & Lia-Hoagberg, B. Effects of social support on prenatal care and health behaviors of low-income women. *Journal of obstetric, gynecologic, and neonatal nursing : JOGNN* **26**, 433–440 (1997).
18. Martin, L. T., McNamara, M. J., Milot, A. S., Halle, T. & Hair, E. C. The effects of father involvement during pregnancy on receipt of prenatal care and maternal smoking. *Matern Child Health J* **11**, 595–602 (2007).
19. Kiernan, K. & Pickett, K. E. Marital status disparities in maternal smoking during pregnancy, breastfeeding and maternal depression. *Soc Sci Med* **63**, 335–346 (2006).
20. Bielinski-Blattmann, D., Lemola, S., Jaussi, C., Stadlmayr, W. & Grob, A. Postpartum depressive symptoms in the first 17 months after childbirth: the impact of an emotionally supportive partnership. *Int J Public Health* **54**, 333–339 (2009).
21. O'Hara, M. W. Social support, life events, and depression during pregnancy and the puerperium. *Archives of general psychiatry* **43**, 569–573 (1986).
22. Gremigni, P., Mariani, L., Marracino, V., Tranquilli, A. L. & Turi, A. Partner support and postpartum depressive symptoms. *Journal of psychosomatic obstetrics and gynaecology* **32**, 135–140 (2011).
23. Mekonnen, W. & Worku, A. Determinants of low family planning use and high unmet need in Butajira District, South Central Ethiopia. *Reproductive health* **8**, 37 (2011).

24. Yue, K., O'Donnell, C. & Sparks, P. L. The effect of spousal communication on contraceptive use in Central Terai, Nepal. *Patient education and counseling* **81**, 402–408 (2010).
25. The DHS Program - Ethiopia: Standard DHS, 2016. <https://dhsprogram.com/what-we-do/survey/survey-display-478.cfm>.
26. Nutrition, information and household behavior: Experimental evidence from Malawi - ScienceDirect. <https://www.sciencedirect.com.proxy.library.cornell.edu/science/article/pii/S0304387816300359>.
27. Kuchenbecker, J., Reinbott, A., Mtimuni, B., Krawinkel, M. B. & Jordan, I. Nutrition education improves dietary diversity of children 6-23 months at community-level: Results from a cluster randomized controlled trial in Malawi. *PLoS One* **12**, (2017).
28. Paternal Participation in Child Care and Its Effects on Children's Self-Esteem and Attitudes Toward Gendered Roles - FRANCINE M. DEUTSCH, LAURA J. SERVIS, JESSICA D. PAYNE, 2001. <https://journals.sagepub.com/doi/10.1177/019251301022008003>.
29. Helzner, J. F. Men's involvement in family planning. *Reproductive Health Matters* **4**, 146–154 (1996).
30. Men's involvement in family planning: Reproductive Health Matters: Vol 4, No 7. <https://www.tandfonline.com/doi/abs/10.1016/S0968-8080%2896%2990018-X>.
31. Montgomery, R., Bhattacharya, D. & Hulme, D. (Centre for D. S. Credit for the poor in Bangladesh. The BRAC Rural Development Programme and the Government Thana Resource Development and Employment Programme. (1996).
32. Goetz, A. M. & Gupta, R. S. Who takes the credit? Gender, power, and control over loan use in rural credit programs in Bangladesh. *World Development* **24**, 45–63 (1996).
33. Story, W. T. & Burgard, S. A. Couples' reports of household decision-making and the utilization of maternal health services in Bangladesh. *Social Science & Medicine* **75**, 2403–2411 (2012).

Supplementary tables and figures



Supplementary figure S3.1. Kernel density plots of fathers' knowledge and child dietary diversity score



Supplementary figure S3.2. Kernel density plots of child growth

Supplementary table S3.1: Robustness check for the primary outcomes

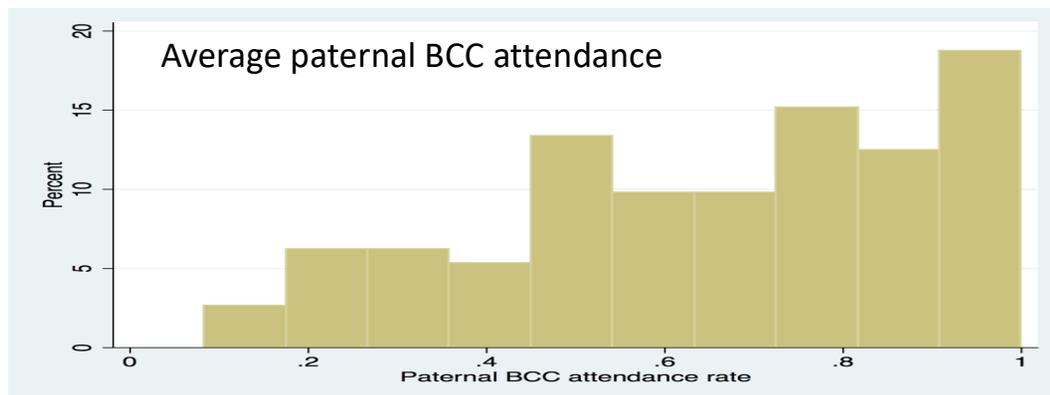
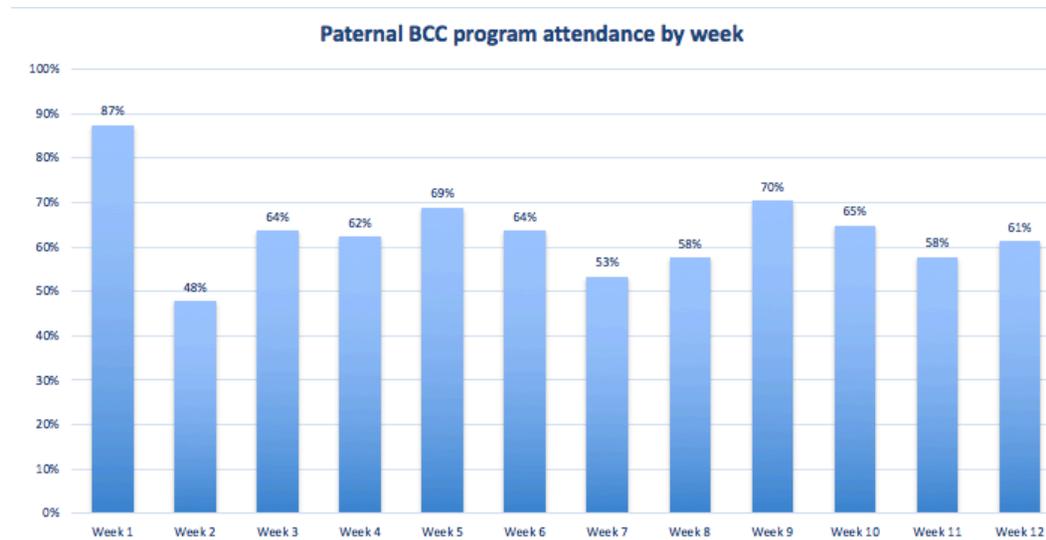
	Fathers' IYCF knowledge			Child dietary diversity score		
	Unadjusted	Baseline outcome	Baseline outcome + other control variables	Unadjusted	Baseline outcome	Baseline outcome + other control variables
Maternal BCC (M-BCC)	0.043* (0.022)	0.043* (0.022)	0.048** (0.023)	0.508** (0.237)	0.514** (0.242)	0.425** (0.199)
Maternal & paternal BCC (MP-BCC)	0.084*** (0.020)	0.085*** (0.021)	0.084*** (0.020)	0.653*** (0.234)	0.661*** (0.239)	0.645*** (0.166)
Maternal BCC & voucher (M-BCC & V)	0.029 (0.024)	0.029 (0.024)	0.037* (0.019)	0.765*** (0.270)	0.793*** (0.267)	0.744*** (0.179)
Maternal & paternal BCC + voucher (MP-BCC & V)	0.083*** (0.020)	0.083*** (0.020)	0.083*** (0.019)	0.433** (0.179)	0.428** (0.182)	0.310* (0.170)
Control group mean	0.623	0.623	0.623	3.219	3.219	3.219
Observations	473	473	470	599	599	593

Fathers' IYCF knowledge (0-1). Child dietary diversity score (0-7). All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.2: Robustness check for the child growth outcomes

	WHZ score			Wasted (%)			HAZ score			Stunted (%)		
	Unadjusted	Baseline outcome	Baseline outcome + other control variables	Unadjusted	Baseline outcome	Baseline outcome + other control variables	Unadjusted	Baseline outcome	Baseline outcome + other control variables	Unadjusted	Baseline outcome	Baseline outcome + other control variables
Full sample												
Maternal BCC (M-BCC)	0.304* (0.170)	0.258 (0.190)	0.279 (0.187)	-0.030 (0.027)	-0.028 (0.030)	-0.039 (0.031)	0.009 (0.199)	-0.008 (0.187)	-0.073 (0.172)	0.009 (0.072)	0.046 (0.066)	0.090 (0.065)
Maternal & paternal BCC (MP-BCC)	0.233 (0.202)	0.164 (0.191)	0.148 (0.191)	-0.057** (0.027)	-0.058** (0.029)	-0.061** (0.029)	-0.080 (0.211)	-0.100 (0.210)	-0.023 (0.144)	0.016 (0.076)	-0.009 (0.066)	-0.032 (0.039)
Maternal BCC & voucher (M-BCC & V)	-0.172 (0.215)	-0.159 (0.199)	-0.163 (0.182)	0.047 (0.029)	0.044 (0.034)	0.042 (0.037)	0.148 (0.176)	0.091 (0.143)	0.058 (0.130)	-0.087 (0.062)	-0.094* (0.055)	-0.082** (0.036)
Maternal & paternal BCC + voucher (MP-BCC & V)	-0.192 (0.148)	-0.120 (0.159)	-0.104 (0.197)	0.026 (0.034)	0.014 (0.034)	0.002 (0.037)	-0.028 (0.176)	-0.123 (0.163)	-0.192 (0.179)	-0.021 (0.055)	-0.014 (0.053)	0.010 (0.055)
Control group mean	0.133	0.133	0.133	0.072	0.072	0.072	-1.540	-1.540	-1.540	0.424	0.424	0.424
Observations	508	482	478	508	482	478	501	476	472	501	476	472
P-value: T1=T2	0.738	0.647	0.542	0.340	0.317	0.488	0.683	0.679	0.782	0.929	0.477	0.0627
P-value: T1=T3	0.0373	0.0511	0.0262	0.00969	0.0302	0.0341	0.484	0.583	0.462	0.209	0.0432	0.00875
P-value: T1=T4	0.00646	0.0656	0.0848	0.111	0.218	0.279	0.855	0.571	0.579	0.686	0.383	0.301
P-value: T2=T3	0.123	0.159	0.148	0.000595	0.00188	0.00263	0.283	0.340	0.584	0.188	0.216	0.184
P-value: T2=T4	0.0423	0.157	0.283	0.0230	0.0498	0.0850	0.800	0.916	0.363	0.620	0.935	0.452
P-value: T3=T4	0.925	0.848	0.782	0.586	0.454	0.336	0.343	0.200	0.134	0.311	0.173	0.0915

All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, **, and *** denote significance at 5%, and 1%, respectively.



Supplementary figure S3.3. Paternal BCC program attendance

Supplementary table S3.3: Treatment effects by fathers' involvement in household food purchases

	Child dietary diversity score (0-7)	Grains, roots, and tubers (0-1)	Legumes and nuts (0-1)	Dairy products (0-1)	Flesh foods (0-1)	Eggs (0-1)	Vit A rich F&V (0-1)	Other F&V (0-1)
Maternal BCC-FD [T1_FD]	0.093 (0.509)	-0.081 (0.091)	0.176 (0.144)	0.044 (0.127)	-0.030 (0.101)	0.001 (0.146)	0.047 (0.154)	-0.075 (0.135)
Maternal BCC- MD [T1_MD]	0.484** (0.192)	-0.007 (0.015)	0.107 (0.069)	0.100 (0.053)	0.138** (0.066)	0.122 (0.069)	0.025 (0.073)	-0.007 (0.066)
Maternal & paternal BCC-FD [T2_FD]	0.455 (0.344)	-0.034 (0.049)	-0.123 (0.107)	0.139 (0.107)	0.302*** (0.101)	-0.012 (0.115)	0.076 (0.105)	0.071 (0.118)
Maternal & paternal BCC - MD [T2_MD]	0.718*** (0.197)	-0.011 (0.022)	0.239*** (0.076)	0.169** (0.067)	-0.010 (0.028)	0.231*** (0.071)	0.108** (0.053)	0.003 (0.051)
Maternal BCC & voucher -FD [T3_FD]	0.863*** (0.296)	0.014 (0.008)	-0.052 (0.084)	0.321*** (0.052)	0.016 (0.103)	0.309*** (0.090)	0.196 (0.112)	0.051 (0.071)
Maternal BCC & voucher -MD [T3_MD]	0.715*** (0.176)	0.004 (0.012)	0.108** (0.052)	0.104** (0.047)	0.168*** (0.048)	0.204*** (0.065)	0.077 (0.052)	0.040 (0.045)
Maternal & paternal BCC + voucher -FD [T4_FD]	-0.296 (0.287)	0.009 (0.009)	-0.100 (0.106)	0.015 (0.080)	0.076 (0.086)	-0.070 (0.091)	-0.124 (0.066)	-0.086 (0.091)
Maternal & paternal BCC + voucher - MD [T4_MD]	0.454*** (0.170)	-0.013 (0.022)	0.068 (0.064)	0.057 (0.054)	0.074 (0.042)	0.110** (0.052)	0.122** (0.055)	0.030 (0.055)
Control group mean	3.218	0.991	0.367	0.419	0.114	0.279	0.227	0.821
Observations	593	593	593	593	593	593	593	593
P-value: T1_FD=T1_MD	0.436	0.430	0.630	0.658	0.199	0.390	0.874	0.644
P-value: T2_FD = T2_MD	0.508	0.664	0.00389	0.812	0.00132	0.0800	0.761	0.625
P-value: T3_FD=T3_MD	0.564	0.354	0.0572	0.000484	0.275	0.319	0.281	0.857
P-value: T4_FD = T4 MD	0.00786	0.229	0.0963	0.619	0.983	0.0789	0.00254	0.221

FD: Father decides, MD: Mother decides, Total CDDS (0-7), all other variables (0-1). All estimations include the baseline outcome, area dummies, and pre-specified control variables. Robust standard errors clustered at the unit of randomization, the village level, **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.4: Mother involvement vs. Father involvement on primary outcomes

	Mother knowledge score (0-1)	Father knowledge score (0-1)	Child dietary diversity score (0-7)
Mother vs. father involvement			
M-BCC	0.049*** (0.012)	0.049** (0.023)	0.427** (0.198)
M-BCC & M-V	0.043** (0.018)	0.001 (0.022)	0.917*** (0.257)
MP-BCC + M-BCC & F-V + MP-BCC & M-V + MP-BCC & F-V (father involvement)	0.053*** (0.011)	0.079*** (0.016)	0.485*** (0.134)
P value: M-BCC= M-BCC & M-V	0.772	0.0743	0.108
P value: M-BCC & M-V = Father involvement	0.545	0.000186	0.0756
Control group mean	0.685	0.623	3.219
Observations	594	470	593

All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.5. Mother involvement vs. Father involvement (intra-household food decision and child food consumption)

	All foods combined	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Panel A. Intra-household decision								
M-BCC	-0.147 (0.145)	-0.081 (0.195)	-0.104 (0.222)	0.019 (0.232)	-0.464* (0.259)	-0.273 (0.213)	0.155 (0.160)	-0.201 (0.184)
M-BCC & M-V	-0.132 (0.173)	-0.290 (0.227)	-0.094 (0.250)	-0.196 (0.231)	0.117 (0.346)	-0.034 (0.214)	-0.152 (0.155)	-0.282 (0.211)
MP-BCC + M-BCC & F-V + MP-BCC & M-V + MP-BCC & F-V (father involvement)	-0.226* (0.118)	-0.403** (0.162)	-0.110 (0.155)	-0.280 (0.210)	-0.013 (0.212)	-0.389** (0.150)	-0.188 (0.126)	-0.251* (0.143)
P value: M-BCC= M-BCC & M-V	0.941	0.439	0.974	0.351	0.149	0.383	0.104	0.751
P value: M-BCC & M-V = Father involvement	0.593	0.617	0.950	0.620	0.723	0.0894	0.831	0.883
Control group mean	7.043	7.264	7.725	7.441	3.274	7.825	8.000	7.763
Observations	593	591	575	576	586	592	593	593
Panel B. Child consumption by food group								
M-BCC	0.427** (0.198)	-0.018 (0.018)	0.117* (0.066)	0.093* (0.053)	0.113* (0.057)	0.105 (0.069)	0.028 (0.075)	-0.017 (0.060)
M-BCC & M-V	0.917*** (0.257)	-0.004 (0.018)	0.112* (0.060)	0.160** (0.066)	0.102* (0.056)	0.279*** (0.091)	0.197*** (0.064)	0.055 (0.048)
MP-BCC + M-BCC & F-V + MP-BCC & M-V + MP-BCC & F-V (father involvement)	0.485*** (0.134)	-0.005 (0.011)	0.073 (0.046)	0.105** (0.041)	0.098*** (0.023)	0.129*** (0.040)	0.066 (0.041)	0.017 (0.038)
P value: M-BCC= M-BCC & M-V	0.108	0.608	0.941	0.403	0.890	0.117	0.0689	0.297
P value: M-BCC & M-V = Father involvement	0.0756	0.940	0.516	0.458	0.949	0.0966	0.0248	0.335
Control group mean	3.218	0.991	0.367	0.419	0.114	0.279	0.227	0.821
Observations	593	593	593	593	593	593	593	593

Mother's perceived intra-household decision (score range 0-10, 10=mother decide alone). All estimations include the baseline outcome, area dummies, and pre-specified control variables. Child food consumption (score range 0-1, 1=child ate yesterday). **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.6. Pre-specified outcomes- IYCF indicators

	Minimum dietary diversity (0-1)	Minimum meal freq (0-1)	Minimum acceptable diet (0-1)
Panel A. Full sample			
Maternal BCC (M-BCC) [T1]	0.087 (0.060)	0.091 (0.081)	0.146*** (0.049)
Maternal & paternal BCC (MP-BCC) [T2]	0.192*** (0.072)	0.152** (0.075)	0.189*** (0.058)
Maternal BCC & voucher (M-BCC & V) [T3]	0.209*** (0.052)	0.102 (0.081)	0.127*** (0.047)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	0.135** (0.056)	0.057 (0.081)	0.078 (0.069)
P-value: T1=T2	0.211	0.507	0.556
P-value: T1=T3	0.0729	0.908	0.770
P-value: T1=T4	0.473	0.732	0.394
P-value: T2=T3	0.826	0.593	0.383
P-value: T2=T4	0.466	0.300	0.208
P-value: T3=T4	0.238	0.646	0.544
Panel B. Separate by voucher ownership for T3 and T4 group			
M-BCC & M-V	0.227*** (0.084)	0.113 (0.091)	0.164*** (0.057)
M-BCC & F-V	0.193*** (0.063)	0.093 (0.090)	0.092 (0.063)
MP-BCC & M-V	0.065 (0.087)	0.106 (0.082)	0.074 (0.077)
MP-BCC & F-V	0.207*** (0.063)	0.003 (0.102)	0.082 (0.086)
p value: M-BCC & M-V = M-BCC & F-V	0.745	0.808	0.332
p value: MP-BCC & M-V = MP-BCC & F-V	0.160	0.251	0.929
p value: M-BCC & M-V = MP-BCC & M-V	0.165	0.948	0.359
p value: M-BCC & F-V = MP-BCC & F-V	0.861	0.479	0.918
Control group mean	0.382	0.574	0.162
Observations	593	461	461
All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.			

Supplementary table S3.7: Pre-specified outcomes- IYCF indicators (sample without control)

	Minimum dietary diversity (0-1)	Minimum meal freq (0-1)	Minimum acceptable diet (0-1)
Sample without control group			
Maternal & paternal BCC (MP-BCC) [T2]	0.101 (0.082)	0.057 (0.080)	0.025 (0.073)
Maternal BCC & voucher (M-BCC & V) [T3]	0.106 (0.071)	0.027 (0.097)	-0.031 (0.073)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	0.052 (0.069)	-0.007 (0.094)	-0.060 (0.083)
Control group mean (Maternal BCC (M-BCC) [T1])	0.500	0.646	0.323
Observations	366	280	280
P-value: T1=T2	0.221	0.478	0.736
P-value: T1=T3	0.139	0.78	0.675
P-value: T1=T4	0.456	0.941	0.472
P-value: T2=T3	0.944	0.702	0.459
P-value: T2=T4	0.527	0.411	0.354
P-value: T3=T4	0.418	0.719	0.737

All estimations include the baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.8. pre-specified intermediary outcomes

	Fathers' gender norm attitude (0-1)	Household labor (0-5)	Social support score (1-4)
Panel A. Full sample			
Maternal BCC (M-BCC) [T1]	0.029 (0.023)	-0.052 (0.070)	-0.010 (0.056)
Maternal & paternal BCC (MP-BCC) [T2]	0.042 (0.027)	0.026 (0.063)	0.113 (0.058)
Maternal BCC & voucher (M-BCC & V) [T3]	0.035 (0.021)	0.177*** (0.052)	0.075 (0.055)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	0.007 (0.023)	0.030 (0.055)	0.135*** (0.049)
P-value: T1=T2	0.644	0.324	0.0965
P-value: T1=T3	0.779	0.00196	0.233
P-value: T1=T4	0.367	0.252	0.0241
P-value: T2=T3	0.797	0.0210	0.580
P-value: T2=T4	0.204	0.956	0.745
P-value: T3=T4	0.178	0.00353	0.334
Panel B. Separate by voucher ownership for T3 and T4 group			
M-BCC & M-V	0.014 (0.035)	0.231*** (0.062)	0.074 (0.060)
M-BCC & F-V	0.053*** (0.020)	0.132** (0.053)	0.077 (0.089)
MP-BCC & M-V	0.021 (0.031)	0.073 (0.058)	0.125** (0.062)
MP-BCC & F-V	-0.007 (0.029)	-0.017 (0.061)	0.145** (0.065)
p value: M-BCC & M-V = M-BCC & F-V	0.292	0.0403	0.984
p value: MP-BCC & M-V = MP-BCC & F-V	0.471	0.0513	0.803
p value: M-BCC & M-V = MP-BCC & M-V	0.864	0.0110	0.519
p value: M-BCC & F-V = MP-BCC & F-V	0.0268	0.0145	0.502
Control group mean	0.281	0.196	2.645
Observations	470	574	594
Mother's perceived social support (score range 1-4, 4= highest social support). Mother's perceived household labor allocation (score range 0-5, 5=father works more). All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.			

Supplementary table S3.9: Pre-specified intermediary outcomes (sample without control)

	Father's gender norm attitude (0-1)	Household labor (0-5)	Social support score (1-4)
Sample without control group			
Maternal & paternal BCC (MP-BCC) [T2]	0.005 (0.029)	0.088 (0.085)	0.115 (0.081)
Maternal BCC & voucher (M-BCC & V) [T3]	-0.000 (0.027)	0.247*** (0.075)	0.098 (0.076)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	-0.024 (0.025)	0.111 (0.072)	0.160** (0.066)
Control group mean (Maternal BCC (M-BCC) [T1])	0.778	2.347	2.644
Observations	297	356	367
P-value: T1=T2	0.869	0.307	0.159
P-value: T1=T3	0.995	0.002	0.203
P-value: T1=T4	0.345	0.128	0.019
P-value: T2=T3	0.853	0.0322	0.823
P-value: T2=T4	0.278	0.728	0.545
P-value: T3=T4	0.286	0.00878	0.340

Mother's perceived social support (score range 1-4, 4= highest social support). Mother's perceived household labor allocation (score range 0-5, 5=father works more). All estimations include the baseline outcome, area dummies, and pre-specified control variables. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.10. Child growth

	WHZ score	Wasted (%)	HAZ score	Stunted (%)
Full sample				
Maternal BCC (M-BCC) [T1]	0.279 (0.187)	-0.039 (0.031)	-0.073 (0.172)	0.090 (0.065)
Maternal & paternal BCC (MP-BCC) [T2]	0.148 (0.191)	-0.061** (0.029)	-0.023 (0.144)	-0.032 (0.039)
Maternal BCC & voucher (M-BCC & V) [T3]	-0.163 (0.182)	0.042 (0.037)	0.058 (0.130)	-0.082** (0.036)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	-0.104 (0.197)	0.002 (0.037)	-0.192 (0.179)	0.010 (0.055)
P-value: T1=T2	0.542	0.488	0.782	0.0627
P-value: T1=T3	0.0262	0.0341	0.462	0.00875
P-value: T1=T4	0.0848	0.279	0.579	0.301
P-value: T2=T3	0.148	0.00263	0.584	0.184
P-value: T2=T4	0.283	0.0850	0.363	0.452
P-value: T3=T4	0.782	0.336	0.134	0.0915
Panel B. Separate by voucher ownership for T3 and T4 group				
M-BCC & M-V	-0.397 (0.250)	0.118** (0.059)	0.176 (0.155)	-0.124** (0.060)
M-BCC & F-V	0.090 (0.186)	-0.040 (0.034)	-0.068 (0.175)	-0.037 (0.041)
MP-BCC & M-V	0.000 (0.209)	-0.015 (0.042)	-0.368 (0.206)	0.028 (0.087)
MP-BCC & F-V	-0.206 (0.242)	0.017 (0.059)	-0.009 (0.207)	-0.008 (0.067)
p value: M-BCC & M-V = M-BCC & F-V	0.0450	0.0106	0.224	0.246
p value: MP-BCC & M-V = MP-BCC & F-V	0.343	0.638	0.0917	0.743
p value: M-BCC & M-V = MP-BCC & M-V	0.161	0.0399	0.0154	0.142
p value: M-BCC & F-V = MP-BCC & F-V	0.255	0.348	0.787	0.680
Control group mean	0.133	0.072	-1.540	0.424
Observations	478	478	472	472

All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.11: Child growth (sample without control)

	WHZ score	Wasted (%)	HAZ score	Stunted (%)
Sample without control group				
Maternal & paternal BCC (MP-BCC) [T2]	-0.092 (0.214)	-0.024 (0.034)	-0.013 (0.192)	-0.100 (0.071)
Maternal BCC & voucher (M-BCC & V) [T3]	-0.315 (0.198)	0.070** (0.034)	0.083 (0.187)	-0.174** (0.068)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	-0.261 (0.263)	0.016 (0.035)	-0.155 (0.242)	-0.082 (0.083)
Control group mean (Maternal BCC (M-BCC) [T1])	0.389	0.045	-1.520	0.438
Observations	288	288	289	289
P-value: T1=T2	0.667	0.482	0.948	0.168
P-value: T1=T3	0.118	0.045	0.66	0.014
P-value: T1=T4	0.327	0.644	0.525	0.333
P-value: T2=T3	0.242	0.009	0.565	0.161
P-value: T2=T4	0.495	0.314	0.513	0.800
P-value: T3=T4	0.814	0.169	0.183	0.170

All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.12: Mother perceived intra-household decision on food purchases (sample without control)

	All foods combined	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Sample without control group								
Maternal & paternal BCC (MP-BCC) [T2]	0.024 (0.226)	-0.357 (0.325)	0.212 (0.294)	0.004 (0.293)	0.557 (0.372)	-0.168 (0.302)	-0.133 (0.247)	0.063 (0.297)
Maternal BCC & voucher (M-BCC & V) [T3]	-0.067 (0.161)	-0.265 (0.235)	-0.104 (0.228)	-0.162 (0.231)	0.411 (0.271)	0.082 (0.252)	-0.463*** (0.172)	-0.160 (0.228)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	-0.086 (0.152)	-0.243 (0.222)	-0.148 (0.233)	-0.517** (0.247)	0.490 (0.311)	-0.098 (0.213)	-0.261 (0.171)	-0.052 (0.208)
Control group mean (Maternal BCC (M-BCC) [T1])	6.852	7.203	7.521	7.361	2.905	7.500	8.014	7.500
Observations	367	366	355	356	362	366	367	367
P-value: T1=T2	0.917	0.277	0.473	0.99	0.141	0.58	0.594	0.832
P-value: T1=T3	0.679	0.265	0.649	0.486	0.136	0.747	0.01	0.488
P-value: T1=T4	0.572	0.278	0.527	0.042	0.121	0.647	0.134	0.804
P-value: T2=T3	0.596	0.759	0.148	0.441	0.611	0.310	0.111	0.368
P-value: T2=T4	0.574	0.719	0.152	0.0546	0.850	0.793	0.585	0.665
P-value: T3=T4	0.882	0.916	0.773	0.0621	0.755	0.322	0.144	0.580

Mother's perceived intra-household decision (score range 0-10, 10=mother decide alone). All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.13: Child food consumption (sample without control)

	Child dietary diversity score (0-7)	Grains, roots, and tubers	Legumes and nuts	Dairy products	Flesh foods	Eggs	Vit A rich fruits and vegetables	Other fruits and vegetables
Sample without control group								
Maternal & paternal BCC (MP-BCC) [T2]	0.202 (0.224)	0.002 (0.028)	0.019 (0.074)	0.073 (0.066)	-0.049 (0.067)	0.052 (0.073)	0.078 (0.080)	0.034 (0.062)
Maternal BCC & voucher (M-BCC & V) [T3]	0.250 (0.233)	0.026 (0.022)	-0.042 (0.071)	0.049 (0.058)	-0.009 (0.065)	0.098 (0.079)	0.084 (0.080)	0.042 (0.066)
Maternal & paternal BCC + voucher (MP-BCC & V) [T4]	-0.135 (0.226)	0.009 (0.025)	-0.096 (0.082)	-0.038 (0.064)	-0.057 (0.064)	-0.046 (0.079)	0.067 (0.071)	0.025 (0.072)
Control group mean (Maternal BCC (M-BCC) [T1])	3.743	0.973	0.527	0.514	0.243	0.392	0.270	0.824
Observations	366	366	366	366	366	366	366	366
P-value: T1=T2	0.373	0.945	0.796	0.271	0.469	0.482	0.334	0.588
P-value: T1=T3	0.289	0.244	0.559	0.405	0.896	0.218	0.296	0.526
P-value: T1=T4	0.554	0.725	0.251	0.549	0.375	0.565	0.345	0.727
P-value: T2=T3	0.788	0.330	0.290	0.634	0.412	0.477	0.922	0.854
P-value: T2=T4	0.102	0.828	0.139	0.0967	0.841	0.129	0.872	0.877
P-value: T3=T4	0.0606	0.371	0.428	0.116	0.166	0.0277	0.792	0.738

Child food consumption (score range 0-1, 1=child ate yesterday). All estimations include the baseline outcome, area dummies, and pre-specified control variables. M-BCC & M-V= Maternal BCC & mother owned voucher, M-BCC & F-V= Maternal BCC & father owned voucher, MP-BCC & M-V= Maternal and paternal BCC & mother owned voucher, MP-BCC & F-V= Maternal and paternal BCC & father owned voucher. **, and *** denote significance at 5%, and 1%, respectively.

Supplementary table S3.14. CONSORT 2010 checklist

Section/Topic	Item No	CONSORT Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomized trial in the title	56
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	57-58
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	59-60
	2b	Specific objectives or hypotheses	60
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	62
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	62
Participants	4a	Eligibility criteria for participants	61
	4b	Settings and locations where the data were collected	61
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	64
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	66
	6b	Any changes to trial outcomes after the trial commenced, with reasons	67
Sample size	7a	How sample size was determined	67-68
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	62
	8b	Type of randomization; details of any restriction (such as blocking and block size)	62
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	62
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	62
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	61 & 62

Statistical methods	11b	If relevant, description of the similarity of interventions	N/A
	12a	Statistical methods used to compare groups for primary and secondary outcomes	68
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	76
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	63
	13b	For each group, losses and exclusions after randomisation, together with reasons	63
Recruitment	14a	Dates defining the periods of recruitment and follow-up	65
	14b	Why the trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	70
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	70
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	All tables
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	Table S3.3-S3.5
Harms	19	All-important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	None
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	79
Generalisability	21	Generalizability (external validity, applicability) of the trial findings	78
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	79
Other information			
Registration	23	Registration number and name of trial registry	68
Protocol	24	Where the full trial protocol can be accessed, if available	N/A
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	68

CHAPTER 4

Couples' responses to a behavior change communication to improve parenting and feeding practices for young children in Ethiopia: Concordance, beliefs in the father's role in childcare, shared decision-making, and shared division of household labor among couples: a qualitative investigation

ABSTRACT

An important cause of stunting is limited consumption of complementary foods, in terms of both quantities and nutrients. However, interventions designed to improve complementary feeding practices often target mothers, although existing associational studies show a positive association between fathers' engagement and children's diet. As a response to this, a maternal behavior change communication (BCC) and paternal BCC program were designed and implemented in Ethiopia using a clustered randomized controlled trial (RCT) design. The paternal BCC program included gender-equal messages to increase fathers' participation in childcare, household labor, and decision-making. The research reported in this chapter is an examination of the paternal BCC program, characterizing the behavioral, normative, and control beliefs of both mothers and fathers in BCC households compared to those in control households. Furthermore, we assessed an intra-dyadic comparison to explore how mothers and fathers within the same household share or do not share the same beliefs, and to understand whether the BCC may have altered this. 14 and 7 mother-father pairs in the maternal plus paternal BCC plus food voucher group and the control group, respectively, were interviewed separately. We found that BCC mothers showed more gender-equal tendencies than the control mothers despite being more rural in location, overcoming the rural bias. On the contrary, the beliefs of BCC and control fathers were similar overall, suggesting men are more resistant to gender-equal BCC despite having more years of formal education than mothers that increased exposure to gender-equal messages and norms. Although intra-dyadic concordance between couples in the gender-equal direction was similar between BCC and control households, more BCC households had discordance between gender-equal mothers and traditional fathers than control households because more BCC mothers have shifted in the gender-equal direction. More work is needed to develop and test effective methods for changing fathers' beliefs and practices.

BACKGROUND

Studies of infant and young child feeding (IYCF) practice interventions designed to influence knowledge, attitude, feeding practices, and child growth often target mothers. However, existing associational studies show a positive association between fathers' engagement and children's diet¹. Fathers' involvement may be crucial because fathers are usually the ones earning money and therefore making decisions on household expenditures, especially in resource-limited settings where gender inequality is common². Furthermore, preparing nutritious food for the child requires additional tasks and time³; therefore, fathers' support may be crucial.

Existing literature show positive association between the father's knowledge and child's health outcomes^{4,5}. Evidence from women-only studies indicates that fathers' direct involvement in feeding practices is positively associated with diet diversity⁴. Few qualitative researchers who assessed intra-household decision-making and social support related to infant-feeding practices identified significant others as facilitators of IYCF practices⁶⁻⁹.

In addition, a body of research focusing on aspects of gender and child health and nutrition suggests that children benefit when their mothers' status rises because of increased decision-making power and increased access to and control over resources^{10,11}. Furthermore, "women's autonomy" within their households was positively associated with reduced levels of stunting, underlining women's bargaining power as an important factor in child's health and growth^{12,13}.

As a response to this, a maternal behavior change communication (BCC) and paternal BCC program was designed and implemented in Ethiopia using a clustered randomized controlled trial (RCT) design. It was hypothesized that a paternal BCC, in addition to a maternal BCC, program would have an additional impact on children's diet compared to maternal BCC alone. The underlying assumption was that increasing fathers' awareness of the importance of

children's diet and gender-equal intra-household dynamics through a paternal BCC program would increase fathers' involvement in childcare and household chores and facilitate joint decision-making. We hypothesized that the changes would create an enabling environment for mothers to improve children's diet.

The research reported here is therefore an examination of an intervention designed to improve fathers' IYCF knowledge and facilitate gender-equal household dynamics. The original study was an evaluation of the intervention's goals of increasing fathers' knowledge and child feeding practices. The aim of the present study was to characterize the behavioral, normative, and control beliefs and perceived practices of both mothers and fathers in BCC households compared to those in control households.

Changing health behavior is complex. Behavior change communications regarding child feeding have met with mixed success¹⁴, and much remains to be learned about how to best design and implement them. Although existing research provides support for facilitators and barriers to changes in mothers' behavior in response to a BCC program¹⁵, despite compelling calls for couple-level studies, most researchers have based their conclusions solely on mothers' self-reports¹⁶. Characterizing changes in beliefs as mothers and fathers enact new practices in response to BCC at the matched-couple level may increase our understanding.

This study relied on an interview-based qualitative approach to explore how perceived intra-household dynamics differ by gender (men vs. women) and by assignment group (BCC vs. control). Interview questions were structured based on the theory of planned behavior. We interviewed subsets of individuals who participated in an RCT providing maternal BCC and paternal BCC programs to households with children under two years old.

This study is aimed at addressing these gaps in the literature by addressing three interlinked research aims qualitatively on topics related to fathers' roles in childcare, household chores, and household decision-making:

1. Characterize the differences between BCC mothers and control mothers
2. Characterize the differences between BCC fathers and control fathers
3. Explore the direction of intra-dyadic concordance (gender-equal/traditional) between BCC and control households
4. To explore possible explanations for the unexpected findings in the trial

STUDY DESIGN AND PARTICIPANTS

Design of the clustered randomized controlled trial

We implemented a clustered randomized controlled trial in Ejere. 90 garees (villages) were identified and randomly assigned into treatment and control groups in a 1:3 (treatment: control) ratio: T1, maternal BCC only; T2, maternal BCC and paternal BCC; T3, maternal BCC and food voucher; T4, maternal BCC and paternal BCC and food voucher; and C, control.

The BCC programs were delivered weekly for about one hour to mothers and fathers separately in groups of seven to fourteen. The maternal and paternal BCC programs lasted sixteen and twelve weeks, respectively. The maternal BCC modules included only messages specific to improved IYCF practices, whereas the paternal BCC program included messages on improved IYCF practices as well as gender roles, household decision-making, and division of labor. Detailed BCC curriculums are shown in supplementary Table S2.

Recruitment for the current study

Subsets of participants who participated in the RCT were recruited for individual interviews. A maximum variation sampling strategy was used to capture heterogeneity, and the following variables from the quantitative data were used: eligible child's age, residence, number of school years, and child dietary diversity score at baseline. The key variables used to select the participants are shown in Table 4.1. Participant characteristics for the BCC and control

households are presented in Table 4.2. It is important to note the difference in the proportion of rural households in the BCC and the control group—41% and 16% of the participants lived in rural villages in the BCC and control groups, respectively. The control households also had larger assets than the BCC households.

All participants were approached through kebele leaders or phone calls. We initially approached a total of twenty-seven couples. 7 couples were excluded from the qualitative sample. 3 couples were excluded as both the mother and father was not interviewed. 2 couples were excluded as either one of them refused to participate. 2 couples were excluded as they missed the interview (2 couples). As a result, we interviewed twenty couples (forty participants) from the maternal and paternal BCC group, maternal and paternal BCC and food voucher group, and control group, and the mother and father were interviewed separately. For the current study, we combined the maternal and paternal BCC group and the maternal and paternal BCC and food voucher group to assess differences between the BCC and control groups.

All interviews were conducted at the health posts because these are commonly used as a meeting location for community members. We used the theory of planned behavior as the theoretical framework to build the semi structured interview questions; the three major constructs of this theory (behavioral, normative, and control beliefs) were all likely to be responsive to the BCC interventions and play a role in behavior change. Questions were pilot tested. Three topics were investigated: fathers' roles in childcare, household chores, and household decision-making. For each topic, we explored three different constructs—behavioral belief, normative belief, and control belief—for mothers and fathers separately.

Table 4.1. Key variables used to select participants

	Rural (<i>N</i> = 12)	Urban (<i>N</i> = 28)
Eligible child's age		
< 12 months	3	4
12–16 months	2	6
16–20 months	1	2
CDDS score (FU)		
2	3	2
3	1	5
4	1	3
5	1	1
6	0	3
Men's knowledge score		
< 40%	0	2
40–65%	3	3
> 65%	3	8
Men's school year		
0	0	1
2–5	4	4
6–8	2	2
>= 9	0	7
Birth order		
1	2	4
2	3	4
3	0	3
4	1	1
5	0	2

Table 4.2. Participants' characteristics

	BCC (N=28)	Control (N=14)	All (N=682)
Maternal			
Knowledge score	0.68 (0.14)	0.63 (0.14)	0.64 (0.11)
Married	0.83 (0.38)	0.83 (0.4)	0.87 (0.33)
Age	27 (6.31)	27 (5.79)	28.37 (6.34)
Number of school years	6 (7.44)	2.66 (3.2)	4.43 (5.54)
Currently work	0.5 (0.52)	0.16 (0.4)	0.54 (0.49)
Paternal			
Knowledge score	0.61 (0.18)	0.64 (0.07)	0.6 (0.14)
Age	32.33 (6.44)	39 (15.81)	34.19 (8.13)
Number of school years	8.83 (7.9)	7 (3.34)	6.38 (6.47)
Currently work	1 (0)	1 (0)	0.88 (0.31)
Child			
Eligible child's age	12.66 (4.07)	12.5 (3.61)	12.34 (4.93)
Sex	1.58 (0.51)	1.5 (0.54)	1.47 (0.49)
Eligible child's birth order	2.25 (1.05)	2.33 (1.5)	2.43 (1.49)
Household			
Household size	4.66 (0.98)	4.33 (1.5)	4.7 (1.53)
Orthodox	0.75 (0.45)	0.66 (0.51)	0.84 (0.35)
Oromo	0.66 (0.49)	0.66 (0.51)	0.76 (0.42)
Rural	0.41 (0.51)	0.16 (0.4)	0.44 (0.49)
Handwashing place near cooking area	0.83 (0.38)	0.66 (0.51)	0.64 (0.47)
Asset	0.11 (1.15)	0.82 (1.75)	0.09 (1.7)
IYCF practices			
Child dietary diversity score	3.41 (1.62)	2.66 (1.03)	2.65 (1.64)
Minimum acceptable diet	0.16 (0.38)	0.16 (0.38)	0.18 (0.38)
Minimum dietary diversity	0.25 (0.45)	0.25 (0.45)	0.29 (0.45)
Minimum meal frequency	0.66 (0.49)	0.66 (0.49)	0.54 (0.49)

Theoretical consideration

We used the theory of planned behavior (TPB) developed by Icek Ajzen¹⁷ to explore the concordance between mothers, between fathers, and between couples by treatment group: BCC and control groups. The TPB posits that behavioral, normative, and control beliefs influence behavioral intention. The first construct of the theory is behavioral belief: whether a person has a favorable or unfavorable appraisal of a given behavior. The second construct is normative belief, which is social pressure in a larger cultural context to perform or not to perform a given behavior. Control belief refers to a person's perception of the ease or difficulty of performing a given behavior. Behavioral belief, normative belief, and control belief influence each other and predict individuals' intention to perform a behavior.

Although maternal BCC sessions did not include messages specific to intra-household gender equality, they included role play designed to demonstrate gender-equal decision-making between couples. Therefore, we expected that BCC mothers would have gender-equal views compared to control mothers because they attended the BCC sessions. We expected control mothers to be traditional because they would have far fewer opportunities to be influenced by peers, given they spend most of their time at home. We expected BCC fathers to have formed gender-equal views compared to control fathers by attending BCC sessions that specifically delivered messages on gender-equal household dynamics.

Comparing mothers and fathers, we expected the latter to have more exposure to messages on gender equality than the former because the topics are covered in high school in Ethiopia. Because the average number of school years is smaller for girls than for boys—a difference of about five and three years in urban and rural areas, respectively—fathers are more likely to have prior exposure to messages on gender equality and therefore have more awareness. However, we did not expect the fathers' exposure to the messages to be in line with actual practices because the gender-equal practices we expected from fathers require additional tasks

and time; therefore, it would be harder for fathers to actually translate the gender-equal beliefs and attitudes into practice. We expected fathers in general to have more gender-equal beliefs than control fathers.

We expected intra-dyadic concordance between couples to be more gender-equal in BCC households and more traditional in control households.

PROCEDURE

Top-performing enumerators who completed surveys for the RCT were interviewed by the principal investigator (PI). One male and one female interviewer were selected. Although neither interviewer had prior experience with qualitative interviews, both had more than two years of work experience as enumerators, and their performance showed their capabilities in conducting qualitative interviews. The PI and a research assistant trained the interviewers over fourteen days. During this period, the interviewers translated the semi structured interview scripts into the Oromo and Amharic languages. Back translation was done after the data collection because of time constraints; however, it confirmed no errors were made in translation. During the training period, the interviewers were trained to understand the interview scripts, and their interview skills were evaluated and tested by having them interview four participants before the data collection. The PI provided feedback after the pilot interviews, and the interviewers were trained for two more days. The pilot interviews were not included in the data analysis. The PI and interviewers had no prior relationship with the participants.

Before the start of the interviews, participants were asked to choose between the female and male interviewer. Based on the participant's preference, one of the interviewers led the interview, and the other interviewer assisted or took notes, sitting at the back of the room. The PI observed the first eighteen interviews to ensure the quality of the data collection and intervened during the interview process to elicit further details when necessary.

DATA ANALYSIS

Following transcription of the Oromo/Amharic audio scripts and cross-checking of the audio files, the transcripts were translated into English by one Oromo and one Amharic translator. The translated scripts were imported into Atlas.ti for coding. An initial structural coding framework was developed around the main topics by the PI using the pilot interview scripts, and three coders, including the PI, coded the scripts. These codes were then sorted into categories to reflect common themes and patterns in the data. The identification of convergent and divergent categories between couples as well as assignment groups helped to highlight similarities and differences.

The average interview length was forty minutes. The interviews the PI participated in were about fifteen minutes longer than those he did not participate in. We examined the transcripts to check whether all questions were covered, which they were, and found that shortened interview lengths were mainly caused by less probing.

We performed thematic analysis of individuals' responses. In addition, their responses to individual questions were simplified and categorized into gender-equal or traditional. We define gender-equal beliefs as those that tend to favor gender-equal intra-household dynamics.

We define concordance as agreement in responses between matched partners. We present two different classifications of concordance: 1) concordant in a gender-equal way and 2) not concordant—with the mother expressing gender-equal and the father expressing traditional beliefs.

We asked identical questions of mothers and fathers. All topics focused on the father's involvement in childcare, household chores, and decision-making on household purchases. Therefore, fathers answered questions on their own behavior, whereas mothers answered questions on their partners' behavior. For example, mothers were asked to report fathers' involvement in household chores.

RESULTS

The difference between BCC mothers and control mothers

The first research question concerns the comparison between BCC and control mothers on the three topics of interest—men’s role in childcare, intra-household division of labor, and intra-household decision-making.

On the whole, the data suggest that BCC mothers are more gender-equal than the control mothers. The differences between the BCC and control mothers were larger on questions related to the father’s role in household chores, especially for normative and control belief constructs. Among the BCC mothers, 79% perceived men doing household chores such as cooking, cleaning, and washing as culturally acceptable compared to 29% of control mothers (Table 4.3). Also, 57% of BCC mothers perceived fathers’ involvement in household chores as not a difficult task compared to 14% of the control mothers.

Table 4.3. The difference between BCC mothers and control mothers

Constructs	Question	BCC mother gender-equal	Control mother gender-equal	Difference BCC - control mothers
	Men's role in childcare, n (%)			
Behavioral	If children are younger than two years old, fathers have a limited role to play.	64%	43%	21%
Behavioral	Tell me about what men can do to keep the child happy and healthy.	93%	86%	7%
Behavioral	Why are you (your husband) not involved in these activities?	64%	57%	7%
Normative	It is common for men to be involved in childcare activities.	79%	57%	21%
Normative	It is culturally acceptable for men to do childcare activities.	71%	71%	0%
Control	It is difficult for men to do childcare activities.	64%	71%	-7%
	Men's role in household chores (%)			
Behavioral	Why are you (your husband) not involved in these activities?	36%	0%	36%
Normative	It is common for men to be involved in household chores.	64%	43%	21%
Normative	It is culturally acceptable for men to do household chores.	79%	29%	50%
Control	It is difficult for men to do household chores.	57%	14%	43%
	Intra-household decision-making, n (%)			
Behavioral	Men make better decisions than women.	57%	57%	0%
Behavioral	What do you feel when men give women power to make household decisions?	64%	43%	21%
Normative	What would others say if men gave women power to make household decisions?	43%	14%	29%

Fathers' role in childcare

In qualitative interviews, both BCC and control mothers indicated that fathers' role in childcare is primarily earning money. Fathers earning more money so they can afford nutritious food for the child is perceived to be the most important job for the fathers and is more important than their spending time with the children. This perception was frequently framed positively with important implications for the present as well as the future happiness of the child.

Fulfilling all that is necessary for the child [is important]. He has the responsibility to buy clothes for the child; he should ensure that the child gets a balanced diet for his mental development by buying additional nutritious food. (BCC mother)

However, more control mothers than BCC mothers indicated that fathers' involvement in childcare activities such as feeding, washing, and playing is limited if the child is younger than two years old. The main reason was that mothers are the ones near the children because of breastfeeding responsibilities, so they know the children's needs better than the fathers.

Because almost everything is done by the mother. The mother is responsible for washing the child's clothes, cooking the child's food. Here, the role of the father is very limited. (Control mother)

Since she has nurturing responsibility. The father also has a responsibility to nurture. Since the father has another way of nurturing and no ability to take care of the small children, the mothers' responsibility must on this. (Control mother)

BCC mothers, in contrast, had higher expectations for the fathers. Several BCC mothers expressed frustration over fathers' lack of involvement and expected fathers to be involved whenever they were around. On questions related to normative and control beliefs, more than two-thirds of mothers perceived fathers' involvement in childcare as socially acceptable and not a difficult task for the fathers, and no differences were found between BCC and control mothers.

Father's role in household chores

The differences between BCC and control mothers were larger for questions related to fathers' role in household chores. More BCC mothers than control mothers believed in shared division of household chores and expected fathers to be more involved in household chores than they currently were. Several BCC mothers expressed frustration over the current level of the fathers' involvement in household chores.

When he is involved [in household chores], I feel we should equally work and care for the child. On the other hand, when he isn't involved, I feel that he leaves all burdens to me for his child. (BCC mother)

In contrast, control mothers often indicated that fathers' increased involvement would make them happier, but many added that they accepted the current division of household labor because the fathers are busy working outside the home. A few control mothers also noted that they refused fathers' help even when fathers offered it.

I don't feel anything [about fathers not helping with household chores]. If he does not go outside and always stay home, how will we live? He must work. (Control mother)

I am happy [with the current division of household labor]. That is my desire. Even when he works at home, I don't allow him [to do it]. (Control mother)

Bigger differences were found for the control belief construct. When asked if it is difficult for men to do household chores, 86% of the control mothers indicated that household chores are difficult jobs for men compared to 43% of the BCC mothers. The control mothers were less likely to share household chores with their partners, and some refused the support even when fathers offered to help. Some of the reasons behind mothers' unwillingness to share household chores were as follows: 1) the father is not familiar with them, 2) it is more important for fathers to focus on earning money, and 3) the father has no time.

Yes. Just some males work; others do not work. Since they do not know how to work, most of the time it is the work that matters to females. I think it concerns them, but I think it is not familiar to them. (Control mother)

Differences between BCC and control mothers were also found for the normative belief construct. Almost 70% of the BCC mothers perceived fathers' engagement in household chores as socially acceptable compared to 29% of the control mothers.

There is one who works [at home] and one who does not work [at home]. It is females. It is customary. Starting from my childhood, I don't have experience. I don't have any other reason. (Control mother)

I feel about why he doesn't help me on my part, and I am happy if he helps me, but neighbor women say cleaning the home belongs to women rather than men. (Control mother)

He doesn't clean the house because the floor of our house is muddy. It is shameful to him to clean the house. I shouldn't order him to clean while women are at home because it is shameful. He couldn't clean the home using animal dung. (Control mother)

It is the mother who cleans the clothes and cooks injera; she does it for the family or for the child. It is good if men support women by feeding the children while she washes clothes. Therefore, men are not expected to leave everything to her. (BCC mother)

Despite leaving every burden to her, it looks good if men share some work. I mean its advantage, its limitation is if he goes leaving everything to her, both the child and the mother may be risked. (BCC mother)

Intra-household decision-making

BCC and control mothers both indicated that decisions on household purchases are jointly made through discussion with their partners. Because fathers are usually the ones earning money, to receive money, mothers commonly discuss with fathers what they plan to buy from the market, and the fathers give the mothers the amount of money they need.

He asks me what I want when I am ready to go to the market. If I tell him I want this amount of money to buy items from the market, he asks me the prices of the item I want to buy. You know the market price is known? He gives it to me when I ask that. Whether it is sufficient to buy or not, I purchase and go back home before him. Because he is a trader, I and my child eat our dinner and leave him his share. (BCC mother)

Of all the household purchases, inexpensive food purchases were those that mothers had most control of, and mothers often indicated that decisions on inexpensive food purchases are made without discussing them with their husbands. This was not the case for other expenses such as buying clothes or costs related to health facilities. However, all the women indicated that fathers are the ones that decide when there is disagreement.

Both of us sit down and think this for this and this for that, and it will be enough. There is a day he buys when he gets money; he sends the children to buy. Unless it is big things, for the things you told me above, I do not discuss it with my husband since I know what my house needs. (Control mother)

He makes the big decisions. If he does not accept my decision, I will say nothing. (BCC mother)

Differences were found in mother's willingness to make decisions. More than half of the control mothers perceived making decisions without fathers' involvement as a burdensome task for women and preferred fathers' involvement. Several control mothers perceived mothers making the decisions as an indication of fathers' lack of interest or support for the family, and some wanted to avoid making decisions because it meant taking responsibility. Such mothers wanted to simply follow fathers' directions and avoid conflict.

He shouldn't decide on her; he should not give her [the power to decide]. Now when she buys for the child, if the father also decides to share the burden, it looks good. (Control mother)

I leave the decision to him for what he supports me with. I simply accept what he decides. (Control mother)

Knowledge was an important determinant of mothers' confidence in making decisions. Mothers generally believed that anyone who knows more should lead the decision-making. Those who were confident about making decisions perceived themselves as knowledgeable as fathers, and lack of confidence was common in mothers who preferred fathers to decide. In general, more BCC mothers than control mothers believed that mothers are as knowledgeable as fathers and therefore can make decisions equally well.

Both the husband and the wife equally know their home's expenses, and they should equally participate in decisions. (BCC mother)

My husband is more knowledgeable than me, and I may also know more than my husband. So, not only can men decide better but also women could know better than men and men could know better than women. (BCC mother)

That is a matter of competence. There are women having more knowledge than men. And there are also women who are less competent than their husbands. So, it is based on her knowledge and competence. (Control mother)

Although small, differences between BCC and control mothers were also found for the normative belief construct. More BCC mothers perceived mothers making decisions as socially acceptable than control mothers.

The difference between BCC fathers and control fathers

Overall, no major differences were found between BCC and control fathers. Although a slightly bigger proportion of control fathers were gender-equal, because of the small sample size, we regard the difference as insignificant. It is also important to note that because rural households were overrepresented in the BCC group, comparisons between BCC and control fathers may have downwardly biased results because we expected BCC fathers to tend toward gender-equal beliefs.

Table 4.4. The difference between BCC fathers and control fathers

Constructs	Question	BCC father gender-equal	Control father gender-equal	Difference BCC - control fathers
	Men's role in childcare, <i>n</i> (%)			
Behavioral	If children are younger than two years old, fathers have a limited role to play.	64%	71%	-7%
Behavioral	Tell me about what men can do to keep the child happy and healthy.	86%	86%	0%
Behavioral	Why are you (your husband) not involved in these activities?	64%	71%	-7%
Normative	It is common for men to be involved in childcare activities.	50%	43%	7%
Normative	It is culturally acceptable for men to do childcare activities.	57%	71%	-14%
Control	It is difficult for men to do childcare activities.	64%	71%	-7%
	Men's role in household chores, <i>n</i> (%)			
Behavioral	Why are you (your husband) not involved in these activities?	21%	43%	-21%
Normative	It is common for men to be involved in household chores.	36%	43%	-7%
Normative	It is culturally acceptable for men to do household chores.	29%	43%	-14%
Control	It is difficult for men to do household chores.	36%	43%	-7%
	Intra-household decision-making, <i>n</i> (%)			
Behavioral	Men make better decisions than women.	64%	43%	21%
Behavioral	What do you feel when men give women power to make household decisions?	71%	71%	0%
Normative	What would others say if men gave women power to make household decisions?	29%	43%	-14%

Father's role in childcare

Although many fathers were aware of the importance of the first two years of childhood, about one-third of the fathers perceived fathers' involvement in childcare as limited, especially when the child is under the age of two. Although all fathers viewed childcare as one of their responsibilities, it was limited to occasional playing and holding, usually when the mother was busy with other household chores. Because mothers are children's primary caregivers, fathers' perceived role in childcare was to earn money to provide for the family. This result is in line with mothers' reports.

Since women have the nurturing responsibility. The father also has a responsibility to nurture. Since the father has another way of nurturing and no ability to take care of the small children, it's mothers' responsibility. (Control father)

Since the mother breastfeeds and gives other food to the child, I on my side have to buy what is expected of me. I have to buy the necessary food to be eaten by the child. (Control father)

If they are below two years, I do limited work. Until the child has grown, I do not have much work. (BCC father)

More than half of the fathers perceived fathers' engagement in childcare through feeding and bathing as socially acceptable, but at the same time, they perceived childcare as something difficult. Therefore, some fathers perceived that their role in childcare is to guide mothers in the right direction by coaching mothers on children's diet, hygiene practices, taking the children to the clinic, and providing quality foods for the child.

Communication between the husband and the wife is very important. In addition to ensuring peaceful coexistence in the family, keeping healthy practices, choosing foods, and ensuring food hygiene to keep the child healthy is the father's role. (BCC father)

Fathers' role in household chores

A majority of fathers regarded household chores as a mother's job. Fathers' responsibility is to earn money outside the home, whereas the mothers' responsibility is to care for children and household matters.

But men are most of the time working out of the house; that is why we help them when we come in the house. Mothers are the ones who do this work most of the time.
(Control father)

The reasons for the differential roles were generally in line with mothers' reports, and more than half of the fathers perceived household chores as difficult for them because of the limited time they spend at home. However, most fathers perceived household chores themselves as not difficult.

I choose this because I leave home early in the morning at 2:00 local time [8:00 am]. Until this time, when my children come to me, I hold and play with them. When I come back home from work, I also play with and hold them during the evening. Concerning household chores, I don't have time for it unless I am free. (BCC father)

Honestly speaking, I never clean the home because there are children who can clean. But for me, it is no problem unless I have another outdoor activity. (Control father)

No, these are not difficult. What is important here is that we engage in activities that are more suitable for each of us to earn a living. Otherwise, it is not difficult to do these household activities. Look, she has no job, and I have to earn income by working as a tailor. We understand each other on what we should do to support our living.
(Control father)

Many fathers perceived men's involvement in household chores as socially unacceptable; however, it was common for these fathers to acknowledge the changes in social norms in a gender-equal direction that are taking place and expressed agreement with the changes.

It should be culturally acceptable. Sometimes because of the development level of our country and lack of education, there is a view that activities like cooking and other activities are only women's responsibility. This should be tolerated to assist each other. (BCC father)

Intra-household decision-making

In line with mothers' reports, fathers overall reported that decisions on household purchases are jointly made through discussion with their partners. However, fathers regarded decisions as "joint" even when fathers were the ones making decisions when a disagreement arose, which was the case for all households.

She knows which food I want most of the time even if she talks about what is better for me. I also talk to her about what is better for her. So, what is better for her and what is better for me are decided together for both expensive and inexpensive foods. Most of the time, expensive things cannot be bought because of difficulties in life. But we make decisions together. (BCC father)

It was also common for fathers to let mothers decide on inexpensive food purchases.

How do we make decisions? I simply give her money. She decides what she buys, what is necessary for her and her child. I don't decide anything on this. She makes decisions. (BCC father)

Although some fathers believed that mothers can make decisions equally well, many fathers regarded lack of involvement in the decision-making process as being irresponsible as the head of the household.

If he gives her full responsibility [for household purchases], she may not achieve what she wants. Thus, he should control and follow her rather than giving power and keeping silent. . . . He has to follow and help her because she may get busy with the added responsibility and face problems in providing good childcare. It is not good to give her all the responsibilities and order her to do everything. (BCC father)

Furthermore, regarding a story that describes how a father gives his partner the power to decide on food purchases, more than two-thirds of fathers perceived it as not socially acceptable.

The community could have different kinds of views. Those who have awareness accept the decision because they believe in equality. But others may say that she governs her husband; she is superior over her husband. These two are what I expect. (BCC father)

Comparing couples in BCC and control households

Table 4.5 presents a comparison of mothers with fathers by their assigned group. Mothers and fathers in BCC households, overall, more mothers had gender-equal perspectives on questions related to fathers' involvement in household chores than the fathers did. The difference was bigger for the normative belief construct—79% of the BCCs mothers perceived fathers' involvement in household chores as socially acceptable compared to only 29% of control mothers (Table 4.5). Although more mothers tended toward gender-equal beliefs than fathers on questions related to the father's role in childcare and household decisions, because of the small sample sizes, the difference is regarded as not significant.

The findings were the opposite for control households. More mothers had traditional perspectives than fathers (Table 4.5). Bigger differences were found for questions that asked about the reason for the lack of fathers' involvement in household chores. We found that

mothers were the ones driving the traditional intra-household dynamics in many households, and it was common for the mothers in such households to regard childcare and household-related work as women's territory and had many reasons to justify fathers' lack of participation. Furthermore, a majority of such mothers were happy about the current division of household labor and indicated that it is the ideal division of roles between men and women. It is also important to note that such households were mainly rural households.

Intra-dyadic concordance between couples in BCC and control households

Table 4.6 presents the results of intra-dyadic comparison within the household to explore how mothers and fathers within the same household shared or did not share the same beliefs and practices. Looking at the concordance between couples in BCC and control households, we see that concordance in the gender-equal direction is similar between BCC and control households (Table 4.6). A larger difference is found in BCC households on questions related to the father's involvement in childcare and household chores, which shows greater discordance because mothers are gender-equal and fathers are traditional (Table 4.6).

Table 4.5. Gender-equal mother and father- comparing couples who are in BCC and control households

Constructs	Question	BCC mother gender- equal	BCC father gender- equal	Difference BCC households	Control mother gender- equal	Control father gender- equal	Difference control households
	Men's role in childcare						
Behavioral	If children are younger than two years old, fathers have a limited role to play.	64%	64%	0%	43%	71%	-29%
Behavioral	Tell me about what men can do to keep the child happy and healthy.	93%	86%	7%	86%	86%	0%
Behavioral	Why are you (your husband) not involved in these activities?	64%	64%	0%	57%	71%	-14%
Normative	It is common for men to be involved in childcare activities.	79%	50%	29%	57%	43%	14%
Normative	It is culturally acceptable for men to do childcare activities.	71%	57%	14%	71%	71%	0%
Control	It is difficult for men to do childcare activities.	64%	64%	0%	71%	71%	0%
	Men's role in household chores						
Behavioral	Why are you (your husband) not involved in these activities?	36%	21%	14%	0%	43%	-43%
Normative	It is common for men to be involved in household chores.	64%	36%	29%	43%	43%	0%
Normative	It is culturally acceptable for men to do household chores.	79%	29%	50%	29%	43%	-14%
Control	It is difficult for men to do household chores.	57%	36%	21%	14%	43%	-29%
	Intra-household decision-making						
Behavioral	Men make better decisions than women.	57%	64%	-7%	57%	43%	14%
Behavioral	What do you feel when men give women power to make household decisions?	64%	71%	-7%	43%	71%	-29%
Normative	What would others say if men gave women power to make household decisions?	43%	29%	14%	14%	43%	-29%

Table 4.6. Concordance in gender-equal direction- comparing couples in BCC and control households

Construct	Question	BCC households		Control households		Difference: BCC - Control	
		Disagree: mother gender-equal	Gender-equal agree	Disagree: mother gender-equal	Gender-equal agree	Disagree: mother gender-equal	Gender-equal agree
	Men's role in childcare						
Behavioral	If children are younger than two years old, fathers have a limited role to play.	14%	50%	0%	43%	14%	7%
Behavioral	Tell me about what men can do to keep the child happy and healthy.	14%	79%	0%	86%	14%	-7%
Behavioral	Why are you (your husband) not involved in these activities?	21%	43%	0%	57%	21%	-14%
Normative	It is common for men to be involved in childcare activities.	29%	50%	14%	43%	14%	7%
Normative	It is culturally acceptable for men to do childcare activities.	29%	43%	14%	57%	14%	-14%
Control	It is difficult for men to do childcare activities.	21%	43%	0%	71%	21%	-29%
	Men's role in household chores						
Behavioral	Why are you (your husband) not involved in these activities?	36%	0%	0%	0%	36%	0%
Normative	It is common for men to be involved in household chores.	36%	29%	29%	14%	7%	14%
Normative	It is culturally acceptable for men to do household chores.	50%	29%	14%	14%	36%	14%
Control	It is difficult for men to do household chores.	43%	14%	0%	14%	43%	0%
	Intra-household decision-making						
Behavioral	Men make better decisions than women.	29%	29%	29%	29%	0%	0%
Behavioral	What do you think is the benefit when men give women power to make decisions on household purchases?	14%	50%	14%	29%	0%	21%
Normative	What would others say if men gave women power to make household decisions?	21%	21%	14%	0%	7%	21%

Father's role in childcare

Couple concordance in gender-equal direction was overall similar on the questions related to fathers' role in childcare in both the BCC and control households. Both mothers and fathers viewed the most important job for the fathers as earning money to buy nutritious foods and pay health-related costs. Occasional involvement in childcare was limited to holding and feeding the child when mothers were busy with other household chores. About half of mothers and fathers perceived fathers' involvement in childcare as socially acceptable and noted that the main reason for lack of involvement was the nature of their daily routine—fathers working outside the home. Although the difference was small, more BCC households showed discordance because the mothers expected fathers to be more involved in childcare.

Father's role in household chores

The discordance between couples was bigger in BCC households on the question that asked whether fathers' involvement in household chores is socially acceptable. The discordance was attributed to mothers being more gender-equal than fathers—79% of the BCC mothers compared to 29% of the BCC fathers perceived it as socially acceptable.

In control households, discordance was found for a question that asked the reason for the lack of fathers' involvement in household chores. Most of the control mothers accepted the current division of household labor and had many reasons to justify fathers' lack of involvement, driving the traditional intra-household division of labor.

Not surprisingly, in many households, discordance was found on perceived fathers' involvement in household chores. In most cases, if not all, fathers' perceived level of involvement was higher than mothers'. The discordance was larger in control households than in BCC households.

Look, helping the mother to prepare nutritious food and trying to feed the child when the child refuses to eat should be common and important. Unless the mother has nothing to do. (BCC father A)

Unless I tell him to feed the child while he eats, he never tries to feed the child by his own initiative. So, I wish he would sit and feed the child. (BCC mother A)

I can help with household chores like telling and educating how to clean the home. I can be involved, for example, in different household chores like spraying detergent after cleaning to maintain home hygiene and to prevent different kinds of mosquitoes and flies. (BCC father B)

There is nothing a father does to keep the child happy. He doesn't clean, he doesn't cook. I don't know whether or not he is afraid of doing it, but he feeds the child, he holds, he fetches water, he collects wood, he herds. But I am not clear why he doesn't go to the market, whether or not he is afraid of doing it. Though he is a trader, he never buys vegetable for the child. (BCC mother B)

Regular tasks and others vary; I can wash dishes while my spouse cooks. (Control father C)

Intra-household decision-making

Couple concordance in gender-equal direction was similar on intra-household decision-making between the BCC and control households. Most couples perceived their decision-making process as *equal* even though fathers were the ones making decisions when disagreement arose. Discussing household purchases itself was regarded as joint decision-making.

Control mothers were usually the ones driving the traditional model of intra-household decision-making. It was common for such mothers to perceive mothers having control over household purchases as socially unacceptable and preferred the traditional way of decision-making. Such mothers perceived making decisions as an added responsibility and extra burden.

Explanations of the unexpected findings of the randomized controlled trial

In the trial, we found the group that received paternal BCC increased fathers' IYCF knowledge significantly compared to the control group. We also found that CDDS significantly improved among the maternal BCC, maternal BCC and paternal BCC, and maternal BCC and voucher groups, compared with the control group, by 0.43, 0.65, and 0.74 food groups. However, surprisingly, providing the paternal BCC and food voucher together in addition to the maternal BCC led to a smaller increase in CDDS, by 0.31 food group. The effect was not statistically significant compared with the control group. We found that this effect was mainly driven by households in which the husband was more actively involved in food purchases. The qualitative findings provided a potential explanation for the unexpected findings.

The qualitative findings showed it was common for fathers who participated in the BCC program to perceive their role in childcare as guides for mothers, coaching them in providing better care for the children. This suggests that an increase in fathers' knowledge through participation in the paternal BCC may lead to fathers' becoming "too involved" in feeding decisions.

Communication between the husband and the wife is very important. In addition to ensuring peaceful coexistence in the family, keeping healthy practices, choosing foods, and ensuring food hygiene to keep the child healthy is the father's role. (BCC father)

The father can keep the child happy through educating and buying good clothes. The child can also be happy if the father advises mothers and promise to buy good clothes. (BCC father)

Getting fathers "too involved" may have unintended consequences. In most households, mothers ask fathers for money before making purchases. Although most mothers perceived discussion about receiving money as a "joint decision," all mothers indicated that fathers make the final decision when there is a disagreement. This suggested that an increase in fathers' involvement in household food purchases was likely to make the father's preferred food choices

dominant.

He makes the big decisions. If he does not accept my decision, I will say nothing.
(BCC mother)

He is superior in decision (compared to me) and he decides. (Control mother)

It is me who makes the final decision. (BCC father)

I am the one who brings the idea and I discuss with her. After the discussion, I am the one who first make a decision. I am the first one to make the decision that it must be purchased and bring the idea. (Control father)

We also found fathers' involvement in food purchases could limit the effect of the food voucher. About one third of the BCC fathers indicated they were happy that the food voucher was being used to save money, which was previously used to purchase food. Conversely, more mothers said they use food vouchers in addition to the existing food budget, purchasing more food overall. This suggested that fathers may prefer to save money to spend on purchases unrelated to food, crowding out the effect of the food voucher.

We use it (the money we save by receiving voucher) for different things for home and also buy clothes (BCC father)

Food voucher helped us reduce our spending on food purchases (BCC father)

We discuss and agree on the amount of money to be spent on food purchase and the money to be saved. When we receive 200 birr (as food voucher), we use additional 100 birr for food purchase using our own money and we save 100 birr. (BCC father)

Voucher helps us save our income that we get from other different activities such as salary. We use our salary to buy and feed the child before receiving voucher. But after receiving voucher, we are saving our salary for different things and for the future. We are saving it for the future, and we are keeping it on our account, we can use it for different things. (BCC father)

I withdraw from my (bank) account to buy butter, fruits and vegetables. I purchase what I need with my own money. (BCC mother)

Food voucher helped us save budget, and use it to buy more food (BCC mother)

Next, we explored whether fathers' getting "too involved" might weaken mothers' autonomy in decision-making despite receiving the gender-equal BCC. We found beliefs of the BCC and the control fathers on gender-equal decision-making were similar overall, suggesting men are more resistant to gender-equal BCC, despite having more years of formal education than women and greater exposure to gender-equal messages and norms.

Both the husband and the wife equally know their home's expenses, and they should equally participate in decisions. (BCC mother)

The first advantage [of making joint decision] is to feel equality. If the husband always makes decision, women would feel that she is underestimated by him. When women make independent decisions, she feels equal as her husband (BCC mother)

Women is the one who knows household expenses, how much is left, and the amount that will be enough. That is why women can also make a good decision (Control mother)

Men make better decisions compared to women and their decisions are more acceptable though the difference may be very small (BCC father)

Men's decision is better (than women) as women may not be familiar with everything; men can respond (well to things) women does not know (Control father)

We also found fathers' gender-equal behavioral beliefs did not easily translate into gender-equal household decisions. Supplementary Table S4.3 presents the zero-order correlations and reliability of the constructs. The results show that behavioral belief, normative belief, and control belief are positively correlated with perceived practices in childcare and

household chores. The resulting Cronbach's reliability coefficients were 0.815 and 0.932 for child care and household chores, respectively. The generally agreed-upon lower limit of the coefficient was 0.7¹⁸. However, for household decisions, the internal consistency of each construct was relatively low, with Cronbach's reliability coefficients of 0.646. Low internal consistency was driven by the fathers in the BCC households. We found Cronbach's reliability coefficients were higher in the control group fathers than in the BCC fathers, with coefficients of 0.539 and 0.803 for the BCC and control fathers, respectively (Table S4.3).

The majority of the BCC fathers, slightly more than the control fathers, believed women could make decisions as well as men, and that giving women the power to make household decisions was beneficial for their households (Table S4.2). However, the majority of BCC fathers at the same time believed it was not socially acceptable to give women the power to make household decisions. Only half of the BCC fathers considered their household decisions to take place gender-equally, indicating that although paternal BCC may have some effect on fathers' behavioral beliefs (overcoming the rural bias), changes in behavioral belief may have had only a limited effect on gender-equal household decision-making practices, mainly because of social norms.

DISCUSSION

Mothers' autonomy and bargaining power are considered an important factor in children's health and growth ¹⁹. Furthermore, numerous researchers have cited intra-household gender inequality as a key barrier to improved feeding practices because mothers are overburdened with household chores and lack decision-making power in the household ²⁰⁻²². To facilitate intra-household gender equality, the paternal BCC program provided messages to encourage fathers' involvement in childcare, household chores, and the joint decision-making process. Because the behavior of interest is likely to be influenced by both men's and women's beliefs, this study offered an exploration of couple concordance on the behavior of interest and compared the beliefs of men and women in BCC and control households.

We found that BCC mothers showed more gender-equal tendencies than the control mothers despite being more rural in location, overcoming the rural bias. On the contrary, the beliefs of BCC and control fathers were similar overall, suggesting men are more resistant to gender-equal BCC despite having more years of formal education than women and greater exposure to gender-equal messages and norms.

Although concordance between couples in the gender-equal direction was similar between BCC and control households, more BCC households had discordance between gender-equal mothers and traditional fathers than control households because more BCC mothers have shifted in the gender-equal direction.

The findings on fathers' involvement in childcare demonstrate that both mothers' and fathers' perception of fathers' primary role in childcare as earning money influenced fathers' limited involvement in childcare. Although mothers and fathers generally believed fathers' involvement in childcare to be beneficial for the child, fathers' earning money justified their lack of direct involvement in childcare. Mothers were the ones taking care of children because they were always near the child because of the breastfeeding responsibility, so the fathers' role

was more focused on providing resources for the family. Fathers directly engaging in childcare was socially acceptable for many; however, fathers' lack of experience with the children was one of the reasons for fathers' lack of confidence, especially when the child is younger than two years of age.

Greater differences in beliefs were observed in questions related to fathers' involvement in household chores. Although fathers' beliefs on the topic were similar between the BCC and control groups, mothers' beliefs showed a bigger difference. BCC mothers had more gender-equal beliefs than both fathers and control mothers. Many control mothers believed that household chores are women's job and viewed fathers' involvement as socially unacceptable. Control mothers' traditional perspective on household chores was the driver of a traditional intra-household division of labor. This is in line with the findings of existing literature that cited mothers' beliefs about the role of the father as a possible contributing factor to fathers' involvement within the household through mothers' influencing the amount of fathers' involvement²³.

On household decision, it was common for couples to discuss household food purchases however, fathers were the ones making decisions when a disagreement arose for all households. Perceived knowledge was an important determining factor for decision-making power. Although fathers generally opposed the idea of mothers having control of resources, many mentioned that someone with greater knowledge about the purchases should decide. Indeed, BCC mothers had greater confidence regarding decisions on household purchases and believed that women can make decisions equally well. Many control mothers on the other hand perceived having power over purchases as a burden and additional responsibility. Participating in the maternal BCC program may have affected mothers' perceived knowledge and increased their confidence in making decisions.

Finally, a qualitative investigation to explore possible explanations for the unexpected results in the trials showed that fathers had more decision-making power; were more involved in food purchases, which were previously the mother's territory; and tended to reduce the household budget for food purchases when they received food vouchers. This could provide some explanation for the limited effect of the maternal BCC and the food voucher on children's diets when fathers are involved.

STRENGTHS AND LIMITATIONS

The main strengths of this study were the use of a theoretical framework to develop the interview guide, the pilot test of the guide, and the use of maximum variation sampling. Additionally, by conducting interviews with mother-father pairs, we could measure couples' concordance to understand their communication and joint decision-making. In addition, to guard against unconscious bias in the selection of quotes, we systematically coded and tabulated individuals' responses. This allowed us to transparently identify "disconfirming" cases. However, the tables presented in this study should be interpreted with caution. First, we did not initially design this study for a quantitative analysis; therefore, we did not have the power to test the differences for the comparisons we made.

There are several limitations. First, rural households made up a larger percentage of the BCC group than the control group. We hypothesized that more BCC households had gender-equal perspectives than did control households. However, because rural households usually have more traditional perspectives than urban households, we expected that this may have biased our results downward. For example, BCC mothers showed more gender-equal tendencies than the control mothers, and there were no differences between the BCC fathers and the control fathers. Without the rural bias, we might have seen greater differences between the BCC and the control mothers and seen more BCC fathers with gender-equal beliefs. However, it is also

important to note that fathers overall had more years of education than mothers and therefore had greater exposure to gender-equal messages. Therefore, it is also possible that gender-equal messages in the paternal BCC program were not effective enough to change fathers' beliefs. Second, we did not set the saturation criterion prior to data collection to decide when to stop the data collection. However, the data indicated saturation. Third, interviews were conducted by enumerators who did not have prior experience conducting qualitative interviews. However, top-performing enumerators who completed surveys for the RCT were recruited and trained over 14 days and went through four pilot interviews; a PI attended one third of the interviews to ensure quality.

CONCLUSION

The findings suggest that maternal BCC may have influenced mothers' beliefs in a gender-equal direction through peer influence, social support, and the gaining of knowledge. However, we found the beliefs of BCC and control fathers were similar overall. This suggests the paternal BCC program may be insufficient to shift fathers' beliefs further in settings where fathers are commonly exposed to messages related to gender equality. More work is needed to develop and test effective methods for changing fathers' beliefs and practices. Moreover, further research is necessary to elucidate the findings and explore the potential explanations for the limited effect of maternal BCC and food vouchers on children's diets when fathers are more actively involved in decision-making.

SUPPLEMENTARY TABLES

Table S4.1. Participants' characteristics by rural and urban areas

	Rural (<i>N</i> = 14)	Urban (<i>N</i> = 28)
BCC group	10	16
Control group	4	12
Maternal		
Knowledge score	0.67 (0.15)	0.66 (0.13)
Married	0.83 (0.4)	0.78 (0.42)
Age	25.16 (8.4)	28.35 (5.09)
Number of school years	3.66 (4.32)	5.92 (7.64)
Currently working	0.5 (0.54)	0.35 (0.49)
Paternal		
Knowledge score	0.61 (0.09)	0.64 (0.17)
Age	32.66 (8.21)	35.5 (11.18)
Number of school years	5 (2.82)	10.42 (7.47)
Currently working	1 (0)	1 (0)
Child		
Eligible child's age	12.66 (4.27)	12.58 (3.77)
Sex	1.33 (0.51)	1.64 (0.49)
Eligible child's birth order	2 (1.09)	2.5 (1.4)
Household		
Household size	4.5 (1.22)	4.71 (1.26)
Orthodox	0.16 (0.4)	0.35 (0.49)
Oromo	0.5 (0.54)	0.78 (0.42)
Handwashing place near cooking area	0.83 (0.4)	0.71 (0.46)
Asset	-0.66 (0.97)	0.93 (1.2)
IYCF practices		
Child dietary diversity score	2.83 (1.94)	3.33 (1.23)
Minimum acceptable diet	0 (0)	0.16 (0.38)
Minimum dietary diversity	0.16 (0.4)	0.33 (0.49)
Minimum meal frequency	0.5 (0.54)	0.66 (0.49)
Anthropometry		
WHZ	-0.43 (1.66)	0.19 (1.17)
HAZ	-0.95 (2.04)	-0.70 (1.45)
Wasted	0.16 (0.4)	0 (0)
Stunted	0.33 (0.51)	0.15 (0.38)

Table S4.2. The difference between the BCC fathers and control fathers

Constructs	Question	BCC father modern	Control father modern	Difference control households
	Men's role in childcare, n (%)			
Behavioral	If children are younger than two years old, fathers have a limited role to play.	64%	71%	-7%
Behavioral	Tell me about what men can do to keep the child happy and healthy.	86%	86%	0%
Behavioral	Why are you (your husband) not involved in these activities?	64%	71%	-7%
Normative	It is common for men to be involved in childcare activities.	50%	43%	7%
Normative	It is culturally acceptable for men to do childcare activities.	57%	71%	-14%
Control Practice	It is difficult for men to do childcare activities.	64%	71%	-7%
	Men do childcare activities.	50%	71%	-21%
	Intra-household division of labor n (%)			
Behavioral	Why are you (your husband) not involved in these activities?	21%	43%	-21%
Normative	It is common for men to be involved in household chores.	36%	43%	-7%
Normative	It is culturally acceptable for men to do household chores.	29%	43%	-14%
Control Practice	It is difficult for men to do household chores.	36%	43%	-7%
	Men do household chores.	29%	43%	-14%
	Intra-household decision-making n (%)			
Behavioral	Men make better decisions as compared to women.	64%	43%	21%
Behavioral	What do you feel when men give women power to make household decisions?	71%	71%	0%
Normative	What would others say if men give women power to make household decisions?	29%	43%	-14%
Practice	If there is disagreement between men and women on household purchases, what happens?	50%	57%	-7%

Table S4.3. Correlations and reliability of constructs

	Constructs			Reliability coefficient
	1	2	3	
Childcare (All fathers)				
1. Behavioral belief				0.815
2. Normative belief	0.420			
3. Control belief	0.429	0.612**		
4. Practice	0.315	0.556**	0.817**	
Household chores (All fathers)				
1. Behavioral belief				0.932
2. Normative belief	0.767**			
3. Control belief	0.806**	0.806**		
4. Practice	0.894**	0.671**	0.693**	
Household decision (All fathers)				
1. Behavioral belief				0.646
2. Normative belief	0.158			
3. Control belief	0.884**	0.224		
4. Practice	0.316	0.071	0.224	
Household decision (BCC fathers only)				
1. Behavioral belief				0.539
2. Normative belief	-0.055			
3. Control belief	0.826***	0.050		
4. Practice	0.152	0.330	0.055	
Household decision (Control fathers only)				
1. Behavioral belief				0.803
2. Normative belief	0.548			
3. Control belief	1.000***	0.548		
4. Practice	0.548	-0.167	0.548	

Table S4.4. Intra-dyadic concordance in BCC households

Construct	Question	BCC households				Observed Agreement
		Disagree: mother gender equal	Disagree: mother traditional	Agree gender-equal	Agree traditional	
Men's role in childcare, n (%)						
1	If children are younger than two years old, fathers have a limited role to play.	2 (14.3)	2 (14.3)	7 (50.0)	3 (21.4)	71.40%
1	Tell me about what men can do to keep the child happy and healthy.	2 (14.3)	1 (7.1)	11 (78.6)	0 (0.0)	78.60%
1	Why are you (your husband) not involved in these activities?	3 (21.4)	3 (21.4)	6 (42.9)	2 (14.3)	57.10%
2	It is common for men to be involved in childcare activities.	4 (28.6)	0 (0.0)	7 (50.0)	3 (21.4)	71.40%
2	It is culturally acceptable for men to do childcare activities.	4 (28.6)	2 (14.3)	6 (42.9)	2 (14.3)	57.10%
3	It is difficult for men to do childcare activities.	3 (21.4)	3 (21.4)	6 (42.9)	2 (14.3)	57.10%
4	Men do childcare activities.	4 (28.6)	3 (21.4)	4 (28.6)	3 (21.4)	50.00%
Intra-household division of labor n (%)						
1	Why are you (your husband) not involved in these activities?	5 (35.7)	3 (21.4)	0 (0.0)	6 (42.9)	42.90%
2	It is common for men to be involved in household chores.	5 (35.7)	1 (7.1)	4 (28.6)	4 (28.6)	57.10%
2	It is culturally acceptable for men to do household chores.	7 (50.0)	0 (0.0)	4 (28.6)	3 (21.4)	50.00%
3	It is difficult for men to do household chores.	6 (42.9)	3 (21.4)	2 (14.3)	3 (21.4)	35.70%
4	Men do household chores.	5 (35.7)	4 (28.5)	0 (0.0)	5 (35.7)	35.70%
Intra-household decision-making n (%)						
1	Men make better decisions as compared to women.	4 (28.5)	5 (35.7)	4 (28.6)	1 (7.1)	35.70%
1	What do you think is the benefit when men gives women power to make decisions on household purchases?	2 (14.3)	3 (21.4)	7 (50.0)	2 (14.3)	64.30%
2	What would others say if men give women power to make household decisions?	3 (21.4)	1 (7.1)	3 (21.4)	7 (50.0)	71.40%
4	If there is disagreement between men and women on household purchases, what happens?	2 (14.3)	3 (21.4)	6 (42.9)	3 (21.4)	64.30%
Construct 1=Behavioral belief, 2=normative belief, 3=control belief, 4=perceived practice						

Table S4.5. Intra-dyadic concordance in control households

Construct	Question	Control households				Observed Agreement
		Disagree: mother gender equal	Disagree: mother traditional	Agree gender-equal	Agree traditional	
Men's role in childcare, n (%)						
1	If children are younger than two years old, fathers have a limited role to play.	0 (0.0)	2 (28.6)	3 (42.9)	2 (28.6)	71.40%
1	Tell me about what men can do to keep the child happy and healthy.	0 (0.0)	0 (0.0)	6 (85.7)	1 (14.3)	100.00%
1	Why are you (your husband) not involved in these activities?	0 (0.0)	1 (14.3)	4 (57.1)	2 (28.6)	85.70%
2	It is common for men to be involved in childcare activities.	1 (14.3)	0 (0.0)	3 (42.9)	3 (42.9)	85.70%
2	It is culturally acceptable for men to do childcare activities.	1 (14.3)	1 (14.3)	4 (57.1)	1 (14.3)	71.40%
3	It is difficult for men to do childcare activities.	0 (0.0)	0 (0.0)	5 (71.4)	2 (28.6)	100.00%
4	Men do childcare activities.	0 (0.0)	2 (28.6)	3 (42.9)	2 (28.6)	71.40%
Intra-household division of labor n (%)						
1	Why are you (your husband) not involved in these activities?	0 (0.0)	3 (42.9)	0 (0.0)	4 (57.1)	57.10%
2	It is common for men to be involved in household chores.	2 (28.6)	2 (28.6)	1 (14.3)	2 (28.6)	42.90%
2	It is culturally acceptable for men to do household chores.	1 (14.3)	2 (28.6)	1 (14.3)	3 (42.9)	57.10%
3	It is difficult for men to do household chores.	0 (0.0)	2 (28.6)	1 (14.3)	4 (57.1)	71.40%
4	Men do household chores.	0 (0.0)	2 (28.6)	1 (14.3)	4 (57.1)	71.40%
Intra-household decision-making n (%)						
1	Men make better decisions as compared to women.	2 (28.6)	1 (14.3)	2 (28.6)	2 (28.6)	57.10%
1	What do you think is the benefit when men gives women power to make decisions on household purchases?	1 (14.3)	3 (42.9)	2 (28.6)	1 (14.3)	42.90%
2	What would others say if men give women power to make household decisions?	1 (14.3)	3 (42.9)	0 (0.0)	3 (42.9)	42.90%
4	If there is disagreement between men and women on household purchases, what happens?	1 (14.3)	2 (28.6)	2 (42.9)	2 (28.6)	71.50%

Construct 1=Behavioral belief, 2=normative belief, 3=control belief, 4=perceived practice

Table S4.6. BCC curriculum

Maternal BCC curriculum

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

Paternal BCC curriculum

1. Introduction Understanding child nutrition	7. Part A: Ideal diet for healthy growth Part B: Prioritizing spending
2. Quality of diet	8. Part A: Division of labor Part B: Story
3. Household decision-making	9. Review and role play
4. Child dietary diversity	10. Understanding gender and gender roles
5. Part A: Review of food groups and sources Part B: Food processing technology	11. Effective communication
6. Part A: Preference on household expenditures between men and women Part B: Role play	12. Testimonial ceremony

REFERENCES

1. Bilal, S. M. *et al.* 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, 2013. *Matern Child Nutr* **12**, 473–483 (2016).
2. Jayachandran, S. The Roots of Gender Inequality in Developing Countries. *Annual Review of Economics* **7**, 63–88 (2015).
3. Guldan, G. S. *et al.* Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China. *J Nutr* **130**, 1204–1211 (2000).
4. Gebremedhin, S. *et al.* Predictors of dietary diversity in children ages 6 to 23 mo in largely food-insecure area of South Wollo, Ethiopia. *Nutrition* **33**, 163–168 (2017).
5. Bilal, S. *et al.* Fathers' Perception, Practice, and Challenges in Young Child Care and Feeding in Ethiopia. *Food Nutr Bull* **37**, 329–339 (2016).
6. Asiodu, I. V., Waters, C. M., Dailey, D. E. & Lyndon, A. Infant Feeding Decision-Making and the Influences of Social Support Persons Among First-Time African American Mothers. *Matern Child Health J* **21**, 863–872 (2017).
7. McInnes, R. J., Hoddinott, P., Britten, J., Darwent, K. & Craig, L. C. A. Significant others, situations and infant feeding behaviour change processes: a serial qualitative interview study. *BMC Pregnancy Childbirth* **13**, 114 (2013).
8. Bezner Kerr, R., Dakishoni, L., Shumba, L., Msachi, R. & Chirwa, M. 'We grandmothers know plenty': breastfeeding, complementary feeding and the multifaceted role of grandmothers in Malawi. *Soc Sci Med* **66**, 1095–1105 (2008).
9. Aubel, J. The role and influence of grandmothers on child nutrition: culturally designated advisors and caregivers. *Maternal & Child Nutrition* **8**, 19–35 (2012).

10. Caldwell, J. & Caldwell, P. What have we learnt about the cultural, social and behavioural determinants of health? From Selected Readings to the first Health Transition Workshop. *Health Transition Review* **1**, 3–19 (1991).
11. Heaton, T. B., Forste, R., Hoffmann, J. P. & Flake, D. Cross-national variation in family influences on child health. *Soc Sci Med* **60**, 97–108 (2005).
12. Dancer, D. & Rammohan, A. Maternal autonomy and child nutrition: Evidence from rural Nepal. *Indian Growth and Development Review* **2**, 18–38 (2009).
13. Maternal autonomy is inversely related to child stunting in Andhra Pradesh, India. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3811039/>.
14. Bentley, M. E., Wasser, H. M. & Creed-Kanashiro, H. M. Responsive feeding and child undernutrition in low- and middle-income countries. *J. Nutr.* **141**, 502–507 (2011).
15. Affleck, W. & Pelto, G. Caregivers' responses to an intervention to improve young child feeding behaviors in rural Bangladesh: A mixed method study of the facilitators and barriers to change. *Social Science & Medicine* **75**, 651–658 (2012).
16. Desired Fertility and Fertility Behaviour among the Yoruba of Nigeria: A Study of Couple Preferences and Subsequent Fertility on JSTOR. <https://www.jstor.org/stable/2175159>.
17. Ajzen, I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. *Journal of applied social psychology* **32**, 665–683 (2002).
18. Multivariate Data Analysis, 7th Edition. </content/one-dot-com/one-dot-com/us/en/higher-education/program.html>.
19. Richards, E. *et al.* Going beyond the surface: Gendered intra-household bargaining as a social determinant of child health and nutrition in low and middle income countries. *Social Science & Medicine* **95**, 24–33 (2013).

20. Nankumbi, J. & Muliira, J. K. Barriers to infant and child-feeding practices: a qualitative study of primary caregivers in Rural Uganda. *J Health Popul Nutr* **33**, 106–116 (2015).
21. Burns, J. *et al.* A Qualitative Analysis of Barriers and Facilitators to Optimal Breastfeeding and Complementary Feeding Practices in South Kivu, Democratic Republic of Congo. *Food Nutr Bull* **37**, 119–131 (2016).
22. Kabir, A. & Maitrot, M. R. L. Factors influencing feeding practices of extreme poor infants and young children in families of working mothers in Dhaka slums: A qualitative study. *PLoS ONE* **12**, e0172119 (2017).
23. McBride, B. A. *et al.* Paternal Identity, Maternal Gatekeeping, and Father Involvement*. *Family Relations* **54**, 360–372 (2005).

CHAPTER 5

Conclusion

The central premise of the paternal BCC program was that an intervention to improve father's nutrition knowledge (improved IYCF practices BCC) and awareness on gender equality (intra-household decision-making and shared division of labor BCC), would increase food expenditures, improve couple communication, encourage shared division of household labor, and ultimately improve child's diet.

The overall findings suggest although the paternal BCC program increase fathers' nutrition knowledge, a small change in nutrition knowledge is not enough to change fathers' behavior to positively influence child's diet meaningfully. Rather, when the paternal BCC and food voucher programs are provided together in addition to the maternal BCC, we find larger effect size on child dietary diversity when there is no form of paternal engagement either through the paternal BCC or ownership of the food voucher. We find suggestive evidence that this is mainly driven by the households where the husband is more actively involved in food purchases, which indicate a possibility that greater paternal engagement reduces maternal decision-making autonomy. On the contrary, when only the paternal BCC program is provided in addition to the maternal BCC program, we do not find fathers' involvement negatively affecting child's diet.

A qualitative investigation to explore possible explanations for this unexpected result showed fathers tended to reduce the household budget for food purchases when they receive food voucher. It may be that fathers become more involved when the households receive food voucher and develop a preference to reallocate the household budget previously allocated for food purchases, crowding out the effect of the maternal BCC and food voucher programs.

Literatures that examines the effect of fathers' involvement on maternal and child health outcomes has shown positive impacts on children's diet especially in developing country settings where men are the key decision-makers that determines women's access to economic resources ¹⁻³. However, arguments on the downside of the fathers' involvement have also been highlighted such as increased male dominance in decision-making – increased male involvement may result in men usurping what was formerly women's territory and thereby worsening existing male dominance ^{4,5}. Furthermore, “joint” control over loans has been described as a disguise for male dominance ⁶ and insufficient for improving women's position ^{7,8}.

Mothers having the decision-making power on food purchases were especially important in this setting as the mothers had a greater understanding of improved IYCF practices compared to the fathers. This was due to the paternal BCC program having much less emphasis on IYCF compared to the maternal BCC program by focusing heavily on messages related to gender-equality. On the other hand, the maternal BCC program included detailed messages on how and what should be fed in order to improve child's diet.

The findings from the qualitative study show the maternal BCC may have influenced mothers' beliefs in a gender-equal direction through peer influence, social support, and the gaining of knowledge. However, similarity in beliefs between the BCC and control fathers suggest that the paternal BCC program may be insufficient to shift fathers' beliefs further in settings where fathers are commonly exposed to messages related to gender equality.

Future research should focus on finding effective communication strategies and methods to change paternal behavior. More work is needed to understand the changes in intra-household dynamics when fathers are engaged, and the negative influence of fathers' involvement when both the paternal BCC and food voucher programs are provided in addition to the maternal BCC program. Moreover, as financial constraints and limited availability of the healthy foods in the market are among the major barriers to improved IYCF practices, future research should focus on developing interventions to addressing multiple barriers simultaneously.

REFERENCES

1. Redshaw, M. & Henderson, J. Fathers' engagement in pregnancy and childbirth: evidence from a national survey. *BMC Pregnancy Childbirth* **13**, 70 (2013).
2. Schaffer, M. A. & Lia-Hoagberg, B. Effects of social support on prenatal care and health behaviors of low-income women. *Journal of obstetric, gynecologic, and neonatal nursing : JOGNN* **26**, 433–440 (1997).
3. Paternal Participation in Child Care and Its Effects on Children's Self-Esteem and Attitudes Toward Gendered Roles - FRANCINE M. DEUTSCH, LAURA J. SERVIS, JESSICA D. PAYNE, 2001. <https://journals.sagepub.com/doi/10.1177/019251301022008003>.
4. Helzner, J. F. Men's involvement in family planning. *Reproductive Health Matters* **4**, 146–154 (1996).
5. Men's involvement in family planning: Reproductive Health Matters: Vol 4, No 7. <https://www.tandfonline.com/doi/abs/10.1016/S0968-8080%2896%2990018-X>.
6. Montgomery, R., Bhattacharya, D. & Hulme, D. (Centre for D. S. Credit for the poor in Bangladesh. The BRAC Rural Development Programme and the Government Thana Resource Development and Employment Programme. (1996).
7. Goetz, A. M. & Gupta, R. S. Who takes the credit? Gender, power, and control over loan use in rural credit programs in Bangladesh. *World Development* **24**, 45–63 (1996).
8. Story, W. T. & Burgard, S. A. Couples' reports of household decision-making and the utilization of maternal health services in Bangladesh. *Social Science & Medicine* **75**, 2403–2411 (2012).