MOTHERS AND FATHERS SHAPE INFANT AND YOUNG CHILD FEEDING PRACTICES IN RURAL TANZANIA: A MIXED-METHODS STUDY OF THE FAMILY FOOD ENVIRONMENT

by

Cristiana K. Verissimo

A Thesis

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Master of Science

Department of Nutrition Science

West Lafayette, Indiana

May 2022

THE PURDUE UNIVERSITY GRADUATE SCHOOL
STATEMENT OF COMMITTEE APPROVAL

Dr. Nilupa S. Gunaratna, Chair

Department of Public Health

Dr. Laura E. Murray-Kolb

Department of Nutrition Science

Dr. Regan L. Bailey

Institute for Advancing Health through Agriculture

Texas A&M University

Approved by:

Dr. Laura E. Murray-Kolb

To my Lord and Savior Jesus Christ, through whom I have life and without whom I can do nothing, to my beloved husband Joseph who has faithfully supported and encouraged me, and has helped me smile, take a break, and finish the work, and to my dear family and friends near and far who have cheered me on in every season of life

ACKNOWLEDGMENTS

I am sincerely grateful for my major professor Dr. Nilupa Gunaratna for her continued mentorship, guidance, and patience. She has been an excellent example of a team leader who is understanding, shapes an encouraging lab culture, and supports work/life balance. I deeply appreciate all the time you took, Dr. Gunaratna, to train me over these past three years, to explain concepts so clearly, and to provide me with opportunities to build skills in research, cross-sectoral collaboration, and teaching. I am thankful to have been a part of this lab.

I would also like to thank my committee members, Dr. Laura E. Murray-Kolb and Dr. Regan Bailey: I sincerely appreciate your guidance on work presented in this thesis, your encouragement, and your help in my academic journey.

To my lab members, Dr. Ramya Ambikapathi, Savannah Froese, Susmita Ghosh, and Morgan Boncyk: Thank you for your continued encouragement, support, collaboration, and examples of perseverance. Ramya, thank you for your excellent mentorship, for training me on how to use Stata, and helping equip me with skills to become a better researcher. Savannah, thank you for your prayers, for brainstorming ideas, and for helping me trouble shoot and learn Stata codes to further build quantitative research skills. Susmita, thank you for your collaboration on projects and your encouragement especially in these last stages of finishing this thesis. Morgan, thank you for helping me build qualitative research skills and for being so reliable.

To Dr. Crystal Patil: Thank you for your mentorship, training, feedback, and collaboration on qualitative methods related to work in this thesis. I greatly appreciate it.

In addition, I am grateful for all the collaborators on the EFFECTS trial, for the study participants, and for the funders who made it possible to collect data presented in this thesis. Lauren Galvin, I would like to thank you specifically for all you did to make this study happen.

To my beloved husband Joseph, thank you from the bottom of my heart for your continued encouragement, tangible support, love, and care. Thank you for helping me have a more balanced life, keep things in perspective, go on adventures, laugh, and also carve out extra time to work when needed. To my treasured parents, Jay and Kirsten Edwards, thank you for your unwavering encouragement to me, for your care for those in need, and for letting yourselves be used by God to help shape my outlook on life and my passions. To all my family, friends, teachers, and mentors – thank you each for your role in helping me stand where I am today.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Infant and young child feeding practices are suboptimal in Tanzania, but optimal nutrition during the first two years of life is critical for development. At this age, behaviors of caregivers determine children's diets, but few studies quantify how fathers or couples jointly influence child feeding. We investigate how men and women shape the family food environment to determine children's diets in rural Mara, Tanzania. This mixed methods study used quantitative baseline data from the Engaging Fathers for Effective Child Nutrition and Development in Tanzania (EFFECTS) trial (ClinicalTrials.gov Identifier: NCT03759821), including 960 rural households with both parents and a young child. Logistic and linear mixed effects regressions examined associations between parental determinants and exclusive breastfeeding (n=189) and child dietary diversity over one day and one week (n=764 children 6-23 months; n=597 children 9-23 months). Parental determinants measured knowledge of breastfeeding and complementary feeding, self-efficacy on provision of diverse or nutritious diets, workload away from home, social support, household savings, and couples' communication and decision-making, indicating women's empowerment. Qualitative data drew from formative research (July-August 2018) conducted with parents of children aged 0-36 months, including eight focus group discussions (FGDs) with mothers and fathers (four FGDs each, 31 and 30 participants, respectively). FGDs were transcribed, translated, quality checked, and coded to identify key themes. The odds of exclusive breastfeeding decreased with mothers' higher workload away from home and increased with mothers' reports of more frequent couples' communication over household decisions. Higher child dietary diversity was linked to mothers' reports of higher knowledge of nutritious foods, higher social support, and higher couples' communication frequency and quality. Generally, fathers' determinants were not associated with children's diets. Qualitative findings indicated that knowledge of exclusive breastfeeding was common, but challenges of perceived breastmilk insufficiency, women's workload, and concerns about breastmilk quality led to early introduction of complementary foods. Affordability was a common challenge to appropriate complementary feeding, while couples' decision-making dynamics and attitudes and beliefs about foods had the potential to be both enablers and barriers. Interventions must improve nutrition knowledge and social support, and they must empower women through joint decision-making and more gender-equitable workloads between parents to enable optimal child diets.

CHAPTER 1. LITERATURE REVIEW

1.1 Infant and young child nutrition

1.1.1 The importance of optimal nutrition during the first 1,000 days

Adequate nutrition during the first 1,000 days of life, from conception until a child's second birthday, is associated with various benefits throughout the life-course (Black et al. 2013). Women's nutritional status during pregnancy and children's nutritional status until two years of age have been characterized as determinants of both undernutrition in childhood, and of obesity and related diseases in adulthood (Black et al. 2013). According to Black et al. (2013), optimal fetal and child nutrition may contribute to decreased morbidity and mortality in childhood; increased cognitive, motor, socioemotional development; increased performance and learning capacity; increased adult stature; decreased risk of obesity and non-communicable diseases, and increased work capacity and productivity.

1.1.2 Measuring infant and young child feeding practices

Among children under two years of age, caregiver behaviors determine their diets (Raza et al. 2020). Infant and young child feeding (IYCF) practices are used as to estimate the adequacy of children's diets and nutritional status, especially at a population level. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) have proposed a total of 17 recommended IYCF indicators, some of which were recently revised or added in 2021 (WHO and UNICEF 2021). Some examples of IYCF indicators include whether a child was ever breastfed, early initiation of breastfeeding, exclusive breastfeeding under six months, continued breastfeeding, introduction of complementary foods, minimum dietary diversity, and minimum meal frequency (WHO and UNICEF 2021).

1.1.3 Suboptimal nutritional status and IYCF practices among infants and young children worldwide and in Tanzania

Despite the importance of optimal nutrition early in life, children remain malnourished worldwide and in Tanzania. It is estimated that among children under 5 years of age worldwide,

22% were stunted, 6.7% were wasting, and 5.7% were overweight in 2020 (FAO, IFAD, UNICEF, WFP and WHO 2021). Rates of stunting, an indicator that children are not developing well (UNICEF 2019), have substantially decreased in multiple regions of the world (FAO, IFAD, UNICEF, WFP and WHO 2021). However, prevalence of overweight children and anemia among women of reproductive age have not shown improvements in these last two decades (FAO, IFAD, UNICEF, WFP and WHO 2021). Concerning IYCF practices, rates of exclusive breastfeeding have improved, but more progress is needed: It is estimated that half (44%) of infants under the age of six months were exclusively breastfed in 2019, compared to only 37% in 2012 (FAO, IFAD, UNICEF, WFP and WHO 2021).

In Tanzania, rates of stunting among children under five years of age have also decreased from 34.7% in 2014 to 31.8% in 2018 (Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland] et al. 2018), but this indicator of chronic malnutrition remains high and is still higher than the global average. Adherence to the recommended practice of exclusive breastfeeding also improved from 2014 to 2018 in Tanzania, rising from 41.1% to 57.8% (MoHCDGEC [Tanzania Mainland] et al. 2018). Among children six to 23 months in Tanzania, rates of minimum dietary diversity also improved over those four years from 24.5% to 35.1% of children in that age group consuming at least four of seven food groups (MoHCDGEC) [Tanzania Mainland] et al. 2018). Thus, IYCF practices have improved in Tanzania over the last few years but they remain inadequate, especially for achieving recommended complementary feeding practices.

1.2 Food environment frameworks

To improve diets, it is important to understand how food consumption fits within the broader food system. Turner et al. (2019) proposed a conceptual framework that depicts the idea that people's food acquisition and consumption is shaped by their food environment, that is, by "the interface within the wider food system where people interact with food sources to acquire and consume foods" (p. 2). Turner's food environment framework (Figure 1) proposes that the food environment is composed of external and personal domains. The external domain includes food prices, availability, marketing and regulation, and vendor and product properties. The personal domain encompasses a person's ability to afford and access foods, a person's desire for certain foods, and how convenient it is to obtain foods. Together, these domains represent the

food environment, which fits within the broader food system. Food environments are influenced by food production, storage, transformation, and transportation, and they influence food acquisition and consumption, which ultimately can influence health and nutrition outcomes (Turner et al. 2019).

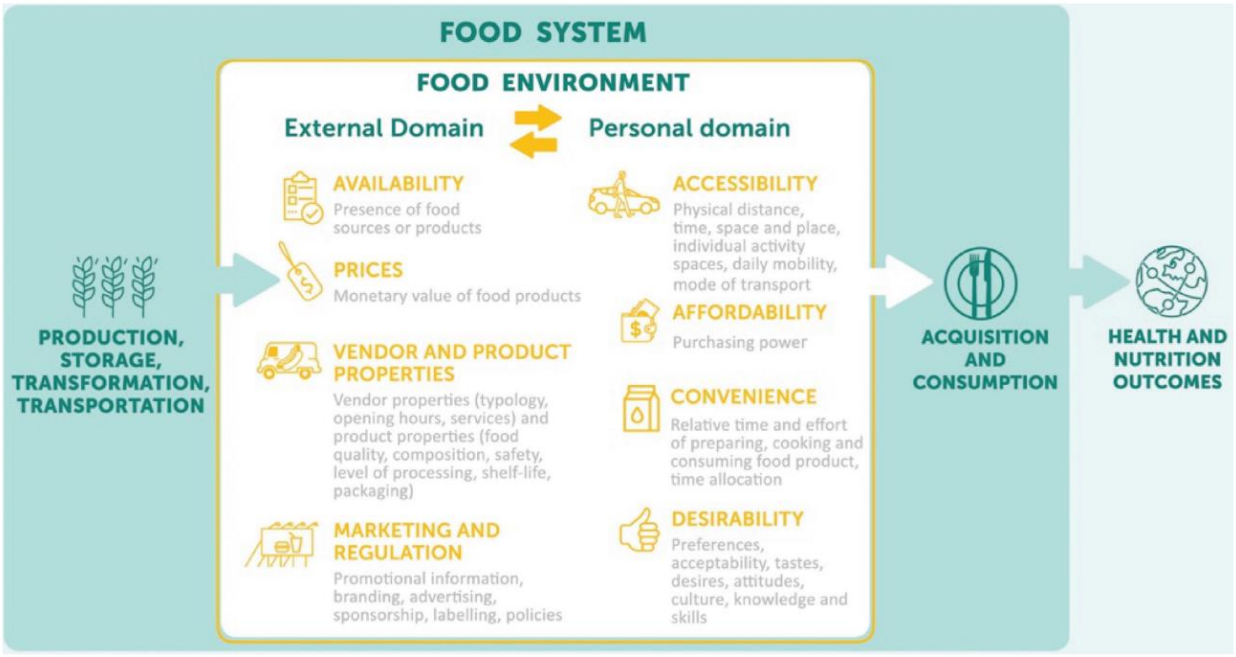


Figure 1. Turner' food environment conceptual framework (Turner et al. 2019)

Turner's food environment framework has been a useful tool to depict the concept of a food environment. However, it is adult-centric and assumes that the person consuming the food is the same person who is interacting with the external domain of the food environment. For young children who have low empowerment over their food choices, caregivers are important gatekeepers for their diets: Caregivers can determine which foods are at home and available for children (Fox and Timmer 2020). The *Innocenti* Framework for food systems and children's and adolescents' diets (Figure 2) adds to Turner's food environment framework by presenting ways in which the behaviors of caregivers, children, and adolescents can influence the diets of children and adolescents (Raza et al. 2020). The *Innocenti* Framework conceptualizes that caregivers influence children's diets through intra-household dynamics, food preparation, desirability and acceptability of food, socio-economic characteristics, eating patterns, and appetite (Raza et al. 2020). However, there is a lack of empirical evidence quantifying how all these facets of

caregiver behaviors shape children's diets within the context of a family, and identifying how other caregivers besides mothers (e.g., fathers) may also determine children's diets. Studies could benefit from the characterization of a child's family food environment more broadly to identify the ways in which all caregivers within a home influence interact with one another and the child to enable optimal diets for young children. These studies could encompass not only complementary feeding outcomes, but also breastfeeding.

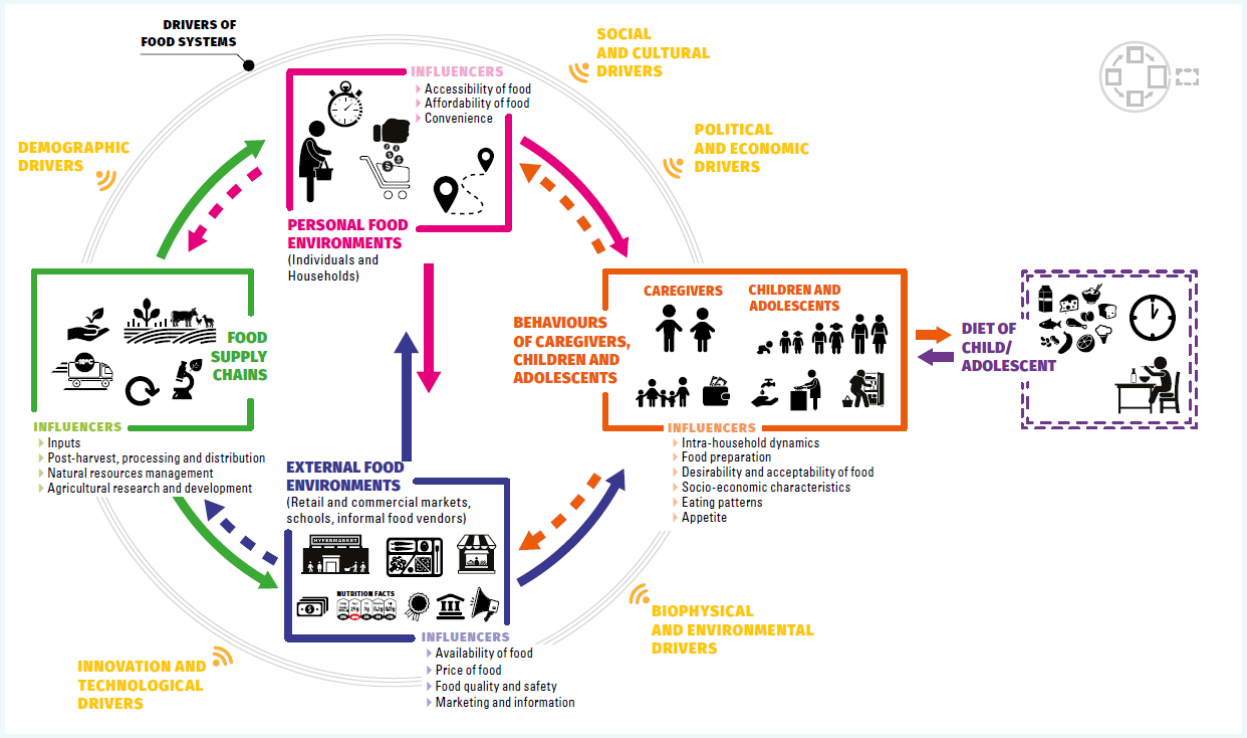


Figure 2. The *Innocenti* Framework for food systems and children's and adolescents' diets (UNICEF and GAIN 2019)

1.3 Caregivers shape breastfeeding and complementary feeding practices

1.3.1 Challenges to adequate IYCF practices

One common challenge to exclusive breastfeeding that often leads to premature introduction of complementary foods before six months of age is perceived breastmilk insufficiency. This has been identified as a challenge in the Democratic Republic of Congo (DRC) (Burns et al. 2016), Tanzania (Cooper et al. 2019), Ethiopia (Mekonnen et al. 2018), and Rwanda (Ahishakiye et al. 2019). In the DRC (Burns et al. 2016) and Tanzania (Cooper et al.

2019) mothers attributed their lack of breastmilk to not eating well and they fed complementary foods to minimize crying. In Ethiopia, participants perceived that women produced less breastmilk when they start to work in the field (Mekonnen et al. 2018).

Women's workload is another challenge to optimal child feeding practices, and especially to breastfeeding. This has primarily been identified through qualitative research. Women's workload has been identified as a challenge to breastfeeding in the DRC (Burns et al. 2016), Ethiopia (Mekonnen et al. 2018), and Rwanda (Ahishakiye et al. 2019) and to complementary feeding in Madagascar (Rakotomanana et al. 2020). In the DRC, interviewees voiced that when women work in the field they often leave their children in the care of family members or neighbors for hours, although some returned from the field to breastfeed their child every few hours (Burns et al. 2016). A review of literature on women's empowerment and child nutrition found that quantitative studies on associations between parental time allocation and child nutrition is extremely limited (Santoso et al. 2019).

Additionally, parental attitudes and beliefs about child feeding practices remain a challenge. In the DRC, women believed that children under six months of age should be given water when the weather is hot (Burns et al. 2016). A study in Uganda identified low knowledge on early initiation of breastfeeding immediately after birth, and on frequency of breastfeeding (Nankumbi and Muliira 2015). A challenge to adequate complementary feeding in Ethiopia was the belief that young children are unable to chew and digest flesh foods (Mekonnen et al. 2018), which could hinder parents from feeding nutritious animal-source foods if there is a lack of awareness on how to prepare those foods in such a way that is appropriate for young children. Similarly, women in Madagascar avoided feeding young children 'heavy foods' such as eggs and legumes (Rakotomanana et al. 2020), which could also deter children from consuming more diverse diets encompassing those nutritious foods.

Poverty and lack of purchasing power for nutritious foods are also challenges to appropriate child feeding. Adequate child feeding practices were hindered by lack of money for purchase of complementary foods in Madagascar (Rakotomanana et al. 2020) and Ghana (Armar-Klemesu et al. 2018), by household food insecurity in Malawi (Chintalapudi et al. 2018) and seasonal food insecurity in Ghana (Armar-Klemesu et al. 2018).

1.3.2 Enablers of adequate IYCF practices

On the other hand, increased parental nutrition knowledge can help improve the diets of young children. In many contexts, people are often aware of some appropriate child feeding practices. Knowledge on breastfeeding is high in many contexts including Ethiopia (Ambikapathi et al. 2021) and Kenya (Faye, Fonn, and Kimani-Murage 2019). Knowledge on complementary feeding was identified among mothers in Madagascar (Rakotomanana et al. 2020) and a basic knowledge and understanding of key nutrition and health concepts was voiced by caregivers in Ghana (Armar-Klemesu et al. 2018). Several studies have identified associations between mothers' nutrition knowledge and adequate feeding practices and nutritional status among children (Gewa and Chepkemboi 2016; Rakotomanana et al. 2020; Ambikapathi et al. 2021; Block 2007). One study in rural Ethiopia also found that men's nutrition knowledge was associated with higher dietary diversity among children (Ambikapathi et al. 2021), but there is a lack of evidence on the link between fathers' nutrition knowledge and children's diets. In addition, evidence suggests that women's social support from family, friends, or community health workers (Ickes et al. 2018; Ahishakiye et al. 2019), participation in village savings and loans (Mbiro and Ndlovu 2021; Ahishakiye et al. 2019), and self-efficacy (Zongrone et al. 2018) may be linked to improved child feeding.

Finally, some evidence suggests women's empowerment as indicated by their involvement in decision-making on household matters is associated with better nutritional status among children (Carlson, Kordas, and Murray-Kolb 2015). Additionally, qualitative data from the DRC suggests that women voiced that their husband sold the peanuts they cultivated, so women did not consume that food or benefit from the income that crop produced (Burns et al. 2016). However, in a review by Santoso et al. (2019) the authors identified that few studies have investigated associations between women's empowerment and IYCF practices. Of the studies that the authors identified, only seven examined breastfeeding outcomes, and most found null results for associations between various dimensions of women's empowerment and appropriate breastfeeding practices, with only 13% and 10% of the 46 associations tested across these studies being positively and negatively significant, respectively (Santoso et al. 2019). Ten studies examined links between women's empowerment and complementary feeding outcomes. These studies showed a more consistently positive association between women's empowerment and

appropriate complementary feeding outcomes with 32% and 5% of the 163 associations tested being positively and negatively significant, respectively (Santoso et al. 2019).

1.4 Conclusion

Optimal nutrition during the first 1,000 days (from conception until two years after birth) is important for long-term health and development. Among children under 2 years of age, infant and young child feeding (IYCF) practices are a proxy for estimating adequate nutrient intake at a population level. At this young age, caregiver behaviors mediate the effects of the broader food environment on children's diets. In addition to mothers, fathers also make choices that influence the wellbeing of their families, but few studies quantify how fathers or how both parents jointly shape IYCF practices. Qualitative evidence suggests that parental attitudes on breastfeeding and complementary feeding can enable or hinder appropriate IYCF practices in various contexts. Challenges often include perceived breastmilk insufficiency, women's time burden with work, lack of purchasing power for nutritious complementary foods, and lack of cooperation between partners on household decisions. Although quantitative evidence suggests that mothers' perceived social support and nutrition knowledge are linked to improved diets for children, few studies investigate fathers' influence. In addition, literature on women's empowerment and child nutrition often investigate links between women's decision-making power and the child anthropometric outcomes. There is a lack of evidence on the link between women's empowerment, particularly as indicated by improved communication and joint decision-making between partners, in achieving optimal breastfeeding and complementary feeding practices.

CHAPTER 2. INTRODUCTION

2.1 Background

Optimal nutrition during the first 1000 days (from conception until two years after birth) is important for children's long-term health and development (Black et al. 2013). However, undernutrition among young children remains a challenge. Globally, it is estimated that 22% of children under five years were stunted in 2020 (FAO, IFAD, UNICEF, WFP and WHO 2021), a sign that children are not developing well (UNICEF 2019). In Tanzania, the prevalence of stunting among children under five years was even higher than the global average, at 32% in 2018 (Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland] et al. 2018). Inadequate infant and young child feeding (IYCF) practices contribute to undernutrition (UNICEF 2019). Although adherence to optimal IYCF practices in Tanzania has improved in recent years, adherence remains inadequate: only 58% of infants under six months are exclusively breastfed, and only 35% of children six to 23 months achieve minimum dietary diversity (consume at least 4 of 7 food groups over one day) (MoHCDGEC) [Tanzania Mainland] et al. 2018).

It has been conceptualized that a person's food acquisition and consumption is shaped by the external and personal domains of their food environment, where they interact with food sources within the broader food system (Turner et al. 2019). For young children, the behaviors of caregivers mediate the effects that the broader food environment has on their diets (Raza et al. 2020), and both women and men play key roles in their families that contribute to children's wellbeing (Engle 1997). The *Innocenti* Framework for food systems and children's and adolescents diets suggests that caregivers influence the diets of children through intra-household dynamics, food preparation, desirability and acceptability of food, socio-economic characteristics, eating patterns, and appetite (Raza et al. 2020). However, there is a lack of empirical evidence characterizing the effects that the family food environment has on child diets in specific contexts or identifying the multi-faceted and inter-related mechanisms through which both mothers and fathers shape child diets.

It is well known that mothers' nutrition knowledge is associated with adequate feeding practices and nutritional status among children (Gewa and Chepkemboi 2016; Rakotomanana et

al. 2020; Ambikapathi et al. 2021; Block 2007), but very few studies investigate fathers' nutrition knowledge (Ambikapathi et al. 2021). Similarly, qualitative studies on caregivers' attitudes, beliefs, and perceived challenges and enablers related to child feeding have primarily engaged mothers (Burns et al. 2016; Nankumbi and Muliira 2015; Mekonnen et al. 2018; Rakotomanana et al. 2020), with few studies also engaging fathers (Chintalapudi et al. 2018; Ahishakiye et al. 2019; Faye et al. 2019).

There is also some evidence that women's social support from family and friends (Ickes et al. 2018), participation in village savings and loans (Mbiro and Ndlovu 2021), self-efficacy (Zongrone et al. 2018), and time use may influence child feeding, but the effects of these resources may vary by context and have not all been well-characterized in rural Tanzania. Additionally, studies on how these facets of men's resources influence child nutrition are extremely limited. Finally, although qualitative evidence from central and east Africa suggests that women's time burden with work is a challenge to optimal breastfeeding (Burns et al. 2016) and complementary feeding (Rakotomanana et al. 2020), quantitative studies on women's time allocation in relation to child nutrition are nearly non-existent (Santoso et al. 2019). Women's workload (including both domestic and income-generating responsibilities) may be greater than men's workload in some contexts, which may hinder child nutrition. In this paper we define parental personal resources as time, perceived social support (from a special person, family, or friends), household savings, and self-efficacy over provision of a diverse or a nutritious child diet.

In addition to each parent's knowledge, attitudes, and personal resources, it is also crucial to consider the effects that a couple's relationship dynamics (encompassing communication and decision-making) may have on child nutrition and health. In many communities in the world, men are often primarily responsible for many household decisions, while women are often primarily responsible for childcare. Open communication and joint decision-making between parents over various household topics may benefit child wellbeing since both parents may have complementary knowledge and skills. There is some evidence that women's involvement in household decision-making is associated with improvements in child nutritional status (Carlson et al. 2015), but there is a lack of evidence on whether couple's communication frequency or quality is associated with child nutrition. Additionally, few studies have investigated how

women's empowerment is associated with IYCF practices (Santoso et al. 2019) or with child nutritional outcomes at varying ages (Carlson et al. 2015).

2.2 Hypothesis and Study Aims

In this paper, we propose the idea that a child's family food environment is the intersection between their caregivers' personal food environments, behaviors, and relationships with one another. To address the literature gaps identified, we investigate how mothers, fathers, and couples' relationships influence exclusive breastfeeding and child dietary diversity in rural Mara Tanzania using mixed-methods data from the baseline evaluation and formative research activities of a randomized control trial. We hypothesize that nutrition knowledge, support from family and friends, women's lighter workloads, women's awareness that the household has savings, and joint couples' communication and decision-making will help enable appropriate child feeding practices. Specifically, we aim (1) to identify how nutrition knowledge, attitudes and beliefs, and personal resources of both mothers and fathers relate to IYCF practices, and (2) to quantify how couple's communication and decision-making dynamics relate to IYCF practices.

CHAPTER 3. METHODS

3.1 Study design and quantitative data collection

This sub-study employed a mixed-methods approach drawing from quantitative baseline data and qualitative formative research from the Engaging Fathers for Effective Child Nutrition and Development in Tanzania (EFFECTS) trial (Clinical Trials Identifier: NCT03759821). The detailed quantitative and qualitative EFFECTS study protocol has been reported elsewhere (Gunaratna and EFFECTS Study Investigators, n.d.). In short, the EFFECTS project was a cluster randomized control trial (clustered at the village level) which was conducted in the region of Mara, in northern Tanzania. This project promoted optimal nutrition and early child development among infants and young children using social and behavior change interventions delivered by community health workers to mothers and fathers. The primary outcomes were child dietary diversity over 24 hours (WHO 2010) which was assessed using a food frequency questionnaire, and early child development which was assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III) (Bayley 2006).

Eighty villages within the districts of Musoma and Butiama were randomly selected, and twelve households within each village were randomly selected for participation in the study (n = 960 households). Households were eligible for inclusion in the EFFECTS trial if the household had a child between 0-18 months of age at enrollment, the child had a mother and a father who lived together for at least 10 months a year, the parents and child intended to reside in the village for the duration of the intervention, the mother and father (in study arms that engaged fathers) were willing to participate in peer group meetings, and both the mother and the father provided informed consent for themselves and for their child to participate in the study. Enrollment of households occurred between October 2018 and May 2019. For most households, baseline data was collected between December 2018 and February 2019, while baseline data on a subset of households was collected in May 2019 due to administrative challenges. Thirty households which were lost to follow-up between enrollment and baseline data collection were replaced to ensure there were twelve households per village. Surveys were administered in Kiswahili and data was collected using Open Data Kit on tablets by a trained team. Institutional Review Boards at the Harvard T.H. Chan School of Public Health (through which Purdue University established

a reliance agreement), the National Institute of Medical Research, Tanzania, and at Project Concern International approved the study.

3.2 Quantitative data analysis

3.2.1 Outcome variables

This paper presents the outcomes of exclusive breastfeeding among children under six months of age (n = 189), and of 24-hour and 7-day child dietary diversity among children 6-23 months (n = 764) and 9-23 months (n = 597), based on their mother's responses to the survey. Exclusive breastfeeding is recommended the first 6 months of life after birth (UNICEF 2003) and is defined as the consumption of only breastmilk and of no other food or drink (not even water) (WHO and UNICEF 2021). Thus, we measured exclusive breastfeeding as the proportion of children under six months that did not consume any other liquids besides breastmilk yesterday during the day or night, did not eat any solid or semi-solid or soft foods yesterday during the day or night, and had not yet consumed any other solids or liquids besides breastmilk. Among children 6-23 months of age, consumption of a variety of foods is recommended to meet nutrient needs (Pan American Health Organization 2003). We measured dietary diversity as the number of food groups out of seven a child consumed yesterday or in the past week. Mothers were administered a 96-item food frequency questionnaire (FFQ) (similar to this FFQ in Tanzania – Bellows et al. 2020) that queried whether a child consumed each of those food items in the past day or week. These food items were aggregated into seven food groups according to WHO recommendations – (1) grains, roots and tubers, (2) legumes and nuts, (3) dairy products (milk, yogurt, cheese), (4) flesh foods (meat, fish, poultry and liver/organ meats), (5) eggs, (6) vitamin-A rich fruits and vegetables, and (7) other fruits and vegetables (WHO 2007).

3.2.2 Independent variables

The parental factors we investigated as potential predictors of exclusive breastfeeding consisted of mothers' and fathers' knowledge of exclusive breastfeeding and of breastfeeding support, time spent on work away from home, social support, and reports of household savings, as well as both parents' reports of couple's communication frequency, mothers' report of couple's communication quality, and both parents' reports of women's involvement in household

decision-making. Knowledge of exclusive breastfeeding was measured as the number of recommended practices for which the parent expressed awareness (scale of 0-3). These three items queried about knowledge of the meaning of exclusive breastfeeding, breastmilk at birth, and the recommended length of exclusive breastfeeding (Macías and Glasauer 2014). Knowledge of breastfeeding support assessed parents' knowledge of four practices that can help mothers maintain their milk supply (breastfeed exclusively on demand, manually express breastmilk, have good nutrition, and drink enough liquids) (Macías and Glasauer 2014) and the number of recommended practices that were mentioned were quantified on a scale of 0-4.

We queried about mothers' and fathers' time spent on productive and domestic tasks by adapting the International Food Policy Research Institute's Women's Empowerment in Agriculture (WEAI) tool. Participants were asked whether or not they spent any time in the last seven days engaging in one of fourteen activities, and if they did, how much time per day they typically spent engaging in that activity. Time over twelve hours per day on one activity was considered to be an incorrect data entry, and thus re-classified as minutes. Activities of income-generating work and household chores that are typically conducted away from home in the local context were aggregated into a measure of time spent on work away from home. Thus, we measured time spent on work away from home as the number of hours per day that participants typically spent fetching water, washing clothes / laundry, going to the market, foraging / collecting firewood, agricultural work, and off-farm work / business. Typical time spent on work away from home of more than 17 hours per day were considered implausible values and recoded as 17 hours.

We assessed social support using the Multidimensional Scale of Perceived Social Support (MSPSS) which includes 12 items that identify social support from a special person, family, and friends (Zimet et al. 1988). Response options were shortened from a 7-point to a 5-point Likert scale ("strongly disagree" to "strongly agree") as has been validated in other East African contexts including Malawi and Uganda (Stewart et al. 2014; Nakigudde et al. 2009). We measured overall social support as the average score of the 12 item scale (Zimet et al. 1988), then computed a binary indicator of low (average overall score of 1 to 3.9 across) versus high overall social support (average score of 4 to 5). Whether or not the household currently had any savings was measured using three binary indicators. These indicators included the proportion of mothers, of fathers, and of couples (where both parents answered "yes" among households in

which both parents responded to this question) who reported that the household currently has savings.

The three aspects of couple's relationship dynamics that we measured (couple's communication frequency, quality, and women's involvement in decision-making) each consisted of eight items which covered the household topics of (1) income and expenses, (2) which foods to purchase for household consumption, (3) which crops to grow during the upcoming planting season, (4) how much harvest to sell at the market and how much to keep for home consumption, (5) how the respondent's cash earnings are used, (6) how the partner's cash earnings are used, (7) livestock production and what to sell and what to keep for household consumption (meat, eggs, milk), and (8) who should get the animal-source foods (e.g. chicken, beef, fish, eggs) in the household. Response options to items on couple's communication frequency and quality ranged from "often" to "never" on a 4-point Likert scale, and the options of "don't know" and "refused to answer" were recoded as missing. We measured mothers' and fathers' reports of couple's communication frequency as the number of topics (out of 8) that participants reported often communicating about with their partner. Similarly, we quantified mothers' reports of couple's communication quality as the number of topics in which mothers reported often feeling like their opinions were taken seriously when discussing them with their partner, and these questions were not asked to fathers. Questions on who made decisions on household matters were adapted from the Bandebereho trial in Rwanda and included the response options of "you," "your partner," "both have the same say," "someone else," "don't know," and "refused to answer" (Doyle et al. 2018). The latter two response options were recoded as missing. We computed women's involvement in decision-making as the number of topics in which participants reported that the mother makes final decisions independently or jointly with her partner.

All independent variables analyzed as potential predictors of exclusive breastfeeding were also quantified in relation to the outcome of dietary diversity except for parents' knowledge of exclusive breastfeeding and of breastfeeding support. In addition to the previously mentioned determinants, additional factors investigated as predictors of dietary diversity consisted of mothers' and fathers' knowledge of nutritious food groups, and their self-efficacy to provide their child with a diverse and nutritious diet.

Parents' knowledge of nutritious food groups was assessed using two measures – knowledge of ways to make porridge more nutritious and knowledge of foods good for child growth and development. Enumerators asked parents to describe some ways to make porridge more nutritious or better for a child's health and the response options included various food groups, "don't know," and "other" (Macías and Glasauer 2014). Enumerators selected a food group if a participant mentioned a food in that category. We used a slightly adapted version of the FAO tool where the phrasing of the question was revised to be more applicable to the local context (e.g., we used the term "porridge" instead of the more specific term "rice porridge"), and the list of food groups was expanded from five to eight. Similarly, enumerators asked parents to mention foods or food groups that a child should eat for good growth and development, and the same response options were included for this question as previously described for enriching porridge. In this paper, parental knowledge of ways to make porridge more nutritious, and parental knowledge of foods good for child growth and development were each measured as the total number of food groups out of seven that participants mentioned in response to each of these questions. The seven food groups included in these scores of parental nutrition knowledge paralleled the seven food groups included in the child dietary diversity scores as previously listed (WHO 2007).

Finally, self-efficacy was assessed by asking participants to rate their agreement with each of the following two statements – "I am confident in my ability to provide my child with a diverse diet" and "I am confident in my ability to provide my child with a nutritious diet." Response options ranged from "strongly disagree" to strongly agree" on a 5-point Likert scale. Since some categories only included a few responses, we computed measures of mothers' and fathers' self-efficacy into binary indicators of high self-efficacy ("agree" and "strongly agree") versus low self-efficacy (the lower three categories).

3.2.3 Statistical analysis

We used mixed-effects logistic and linear regressions to quantify associations between independent variables of interest and the outcomes of exclusive breastfeeding and child dietary diversity, respectively. Univariable adjusted analyses included study design characteristics, demographic covariates, and each independent variable of interest in a separate model. Multivariable adjusted analyses included study design characteristics, demographic covariates,

and multiple independent variables of interest one model. Statistical analyses were conducted in Stata/SE version 16.1. Results were considered statistically significant at a p-value smaller than 0.05.

All models accounted for the study design characteristics of clustering at the village level as a random effect and of district as a fixed effect. Demographic covariates in analyses of exclusive breastfeeding included age of child in months (rounded to one decimal), sex of child, education of both parents, age of both parents, marital relationship (monogamous / polygamous), survey group (delayed / on time data collection), household wealth index, household size (number of people residing within household), and a missing indicator for household size. The mean of the sample for household size was imputed to the households with missing data for this characteristic. The wealth index was computed as quintiles from principle component analysis scores encompassing land ownership, tropical livestock units, household assets, and improved toilet, roof, floor, and wall. In addition to these demographic covariates, the analyses of child dietary diversity also included breastfeeding in the previous day (yes / no) and distance to market (less than 30 minutes / more than 30 minutes to get to the market). We also conducted a sensitivity analysis adding household food insecurity status (Coates, Swindale, and Bilinsky 2007) to multivariable models for both exclusive breastfeeding and child dietary diversity.

Moderate collinearity was identified between some demographic covariates (e.g., mother's and father's age) but not between demographic covariates and predictors of interest. Since collinearity between two variables inflates the standard errors of those two variables but not of other variables in the model (Lindner, Puck, and Verbeke 2020), these demographic characteristics were retained in analyses. Multivariable models included most predictors of interest that were included in univariable adjusted analyses as previously described, except when multicollinearity between predictors was identified. Father's self-efficacy about providing a nutritious diet, couple's joint report of having household savings, and mother's report of couple's communication quality were excluded from multivariable models because those predictors had variance inflation factors (VIFs) above 2.5, which is considered by some as indicative of considerable collinearity (Johnston, Jones, and Manley 2018). Pairwise Pearson correlation coefficients also indicated that each of those three predictors was moderately correlated (above 0.55) with at least one other variable in the model. Mother's self-efficacy about providing a nutritious diet was also excluded from the multivariable models because it was moderately

correlated (Pearson correlation coefficient of 0.61) with her report of self-efficacy to provide a diverse diet. After removing the multicollinear variables, none of the VIFs for predictors of interest (i.e., parental determinants that are not demographic covariates) were above 2.5.

3.3 Qualitative data collection

Participants from two villages in each district (Musoma and Butiama) were purposely recruited to participate in formative research activities. Parents were eligible for inclusion if they had a child 6-36 months of age, the father planned to reside in the same home/compound as the female partner and child for at least 10 months of the year, and if they provided informed consent. Qualitative data in this sub-study drew from eight focus group discussions (FGDs) which included pile sorting exercises with food image cards. Four pile sorting FGDs were conducted with mothers and four with fathers between July-August 2018 in Kiswahili, with 7 to 8 participants per group totaling 31 mothers and 30 fathers. The mothers and fathers in FGDs were not dyads of parents from the same household.

These semi-structured interviews (interview guide in Appendix Table A.1) covered the topics of perceptions of foods for children of different ages (0-5, 6-8, and 9-23 months); knowledge, beliefs, attitudes, challenges, and practices related to breastfeeding and complementary feeding; food preparation; affordability of foods; sources to procure food; and roles of household members related to obtaining food. Participants had the opportunity to sort a pile of approximately 65 food image cards (examples of food image cards in Appendix Figure A.1) together as a group in response to several of the prompts throughout the interview. For example, in response to a question about which foods are considered good to give to children 6-8 months of age, focus group participants could set aside images of food items and describe why they consider those foods good to give to children of that age.

3.4 Qualitative data analysis

The eight focus group discussions that included pile sorting exercises were transcribed, translated, quality checked, and coded line-by-line (codebook in Appendix Table A.2) for emerging themes using the software MAXQDA 2020. The codebook was developed based on Turner's food environment framework (Turner et al. 2019), the topics of questions in the

interview guide, and with the intent to identify parents' perceptions of food items and drivers of breastfeeding and complementary feeding practices. During the initial stages of analysis, five research team members including the author met regularly as a qualitative research team to discuss codebook development and adaptation. Three team members including the author coded one transcript of a pile sorting focus group discussion with fathers using an initial version of the codebook, and conversations about this experience among the qualitative research team informed initial codebook adaptation. To further inform codebook development, the author also coded two transcripts of pile sorting focus group discussions with mothers, two in-depth interviews with mothers, and two in-depth interviews with fathers, continuing to discuss the process with the qualitative research team on a regular basis until a final version codebook was formed. The three transcripts of FGDs that were previously coded with an older version of the codebook were recoded using the final version to ensure consistency among all eight FGDs included in this analysis. Thematic analysis was used to identify how the qualitative data supported, explained, or contradicted the quantitative findings. In addition, both content and thematic analysis were used to identify mothers' and fathers' perceptions of foods they considered appropriate or inappropriate to feed children of different ages.

CHAPTER 4. RESULTS

4.1 Demographics, setting characteristics, and IYCF practices

Similar demographic profiles were observed between participants in the EFFECTS trial and those in the EFFECTS formative research pile sorting focus group discussions. Table 1 shows characteristics of the EFFECTS trial population at baseline. Mothers (median age of 29 years) were typically younger than fathers (median age of 37 years). Both parents had similar low levels of education. Completion of primary school was the highest level of schooling for most mothers (82%) and fathers (77%), although completion of at least some secondary schooling or higher was more common among fathers (13%) than mothers (8%). Most couples (82%) reported being in a monogamous relationship. The median household size was seven people. The prevalence of food insecurity was high. Half (50%) of the households were severely food insecure and only 13% were food secure. Yearly household expenditures were low at a median of 1.7 million (IQR: 1.1, 2.8) Tanzanian shillings (approximately $754 US dollars based on the exchange rate in March 2022). Even though most (69%) households lived within 30 minutes of a market, these were rural communities and agriculture was a primary livelihood. Among the 86% of households who owned land, the median land size was three acres (IQR: 2, 5). Almost none (1%) of the households had running water. Most households (80%) had an improved roof; however, it was less common for households to have an improved floor (22%) or improved wall (40%). About half (49%) of the participating children were female, and children's median age was 11 months.

Appendix Table A.3 shows the demographic characteristics of parents who participated in focus group discussions. As mentioned previously, these were not dyads of parents within the same household. Most of the mothers (71%) and fathers (90%) discontinued schooling after completing primary school, similarly to the EFFECTS trial population, and more mothers (19%) than fathers (10%) had some secondary schooling or higher. However, 9% of mothers either did not attend school or had discontinued schooling after completing some primary school, although all of the fathers had completed some primary school or higher. Nearly all parents (97% of mothers and 93% of fathers) were farmers, reported monthly income was of low at 20 (among fathers) to 25 (among mothers) thousand Tanzanian shillings ($8.62 to $10.78 US dollars),

participants generally reported living about 30 (among fathers) to 60 (among mothers) minutes away from a market (most likely walking since that is the primary mode of transportation in this context), and the median land size was of 2.3 (among mothers) to 2.8 (among fathers) acres. About half of the mothers (55%) and over half of the fathers (63%) interviewed had a young female child, and mothers and fathers had children about a year and a half old (median age of 17 or 18 months of age, respectively).

Table 1 also shows children's health, anthropometric, breastfeeding, and dietary outcomes. Child illness and stunting were prevalent. Sixty-three percent of children had an illness in the past two weeks, and 28% were stunted. However, only 10% of children were underweight and 2% wasted. Some recommended breastfeeding practices (WHO 2007) were achieved by the vast majority of children: nearly all (99%) children were breastfed within the first hour after birth and most (90%) children 12 to 15 months of age continued to breastfeed. Among children nine to 23 months old, prevalence of breastfeeding in the previous day decreased but remained somewhat high at 77%. However, less than half (44%) of the infants under 6 months of age were exclusively consuming breastmilk, indicating that complementary foods were often introduced before the recommended age. Following recommendations (WHO 2007), most infants six to eight months (91%) were receiving complementary foods and most young children six to 23 months (73%) achieved minimum meal frequency. Nevertheless, rates of achieving minimum dietary diversity were suboptimal with only 30% of children six to 23 months old consuming at least five of eight food groups (7 food groups and breastmilk) (WHO and UNICEF 2021). Specifically, of the seven food groups that contribute to dietary diversity (WHO 2007), children six to 23 months old consumed a median of only three food groups in the previous day but a somewhat more diverse diet of five food groups in the past week.

Table 1. Demographic characteristics and IYCF practices among EFFECTS trial participants at baseline

	Demographic characteristics and IYCF practices	Median (Q1, Q3) or Percent (n/N)
Parental characteristics	Age of mother (years)	29 (24, 35)
	Age of father (years)	37 (31, 45)
	Education of mother (%)	
	No school	6% (49/890)
	Pre-primary to some primary and other literacy programs	5% (41/890)
	Completed primary	82% (728/890)
	Some secondary to completed university	8% (72/890)
	Education of father (%)	
	No school	3% (29/900)
	Pre-primary to some primary and other literacy programs	7% (66/900)
	Completed primary	77% (691/900)
	Some secondary to completed university	13% (114/900)
	Couples in a monogamous relationship (%)	82% (787/957)
Household characteristics	Number of household members	7 (5, 8)
	Household food security status[a] (%)	
	Food secure	13% (123/957)
	Mildly food insecure	15% (140/957)
	Moderately food insecure	23% (220/957)
	Severely food insecure	50% (474/957)
	Yearly household expenditures (millions of Tanzanian shillings)	1.7 (1.1, 2.8)
	Households within 30 min of a market (%)	69% (660/957)
	Households that own land (%)	86% (786/913)
	Total land owned among households that own land (acres)	3 (2, 5)
	Households with running water (%)	1% (10/913)
	Households with an improved floor (%)	22% (202/913)
	Households with an improved wall (%)	40% (365/913)
	Households with an improved roof (%)	80% (728/913)
Child characteristics	Female children (%)	49% (473/958)
	Child age (months)	11 (7, 17)
	Any illness during past 2 weeks (diarrhea, coughing, vomiting, or fever) (%)	63% (599/957)
	Underweight[b] (WAZ < -2 SD, %)	10% (96/944)
	Stunted[b] (HAZ < -2 SD, %)	28% (260/942)
	Wasted[b] (WHZ < -2 SD, %)	2% (19/944)
Breastfeeding practices	Early initiation of breastfeeding within 1 hour of birth[c] (%)	99% (833/844)
	Exclusive breastfeeding[d] (% among children <6 months)	44% (83/189)
	Children 12-15 months old who continued breastfeeding at 1 year[e] (%)	90% (153/170)
	Children <6 months who were breastfed yesterday (%)	99% (187/189)
	Children 6-8 months who were breastfed yesterday (%)	98% (164/167)
	Children 9-23 months who were breastfed yesterday (%)	77% (446/583)
Complementary feeding practices	Children 6-8 months receiving solid, semi-solid or soft foods[e] (%)	91% (152/167)
	Minimum meal frequency in the previous day[e, f] (%)	73% (559/763)
	Minimum dietary diversity (≥5 of 8 food groups including breastmilk) during the previous day[c, f]	30% (228/764)
	Dietary diversity (number of food groups out of 7) during previous day[e, f]	3 (2, 4)
	Dietary diversity (number of food groups out of 7) during previous 7 days[e, f]	5 (4, 5)

[a] Household food security status: Based on Household Food Insecurity Access Scale (HFIAS) (Coates et al. 2007)
[b] WAZ: weight-for-age Z-score; HAZ: height-for-age Z-score; WHZ: weight-for-height Z-score (WHO 2019).
[c] Following WHO and UNICEF 2021 recommendations
[d] Proportion of children under six months who did not consume any other liquids, nor solid, semi-solid, or soft foods yesterday besides breastmilk, and who had not yet consumed any other solids or liquids.
[e] Following WHO 2007 recommendations
[f] Meal frequency and dietary diversity metrics are among children 6-23 months.

4.2 Mothers' and fathers' nutrition knowledge, personal resources, and relationship as a couple

4.2.1 Parental knowledge and attitudes about breastfeeding

Among the EFFECTS participants at baseline, parental knowledge of exclusive breastfeeding was high (median score of 3 out of 3 for each parent) among both parents (Table 2). Specifically, the vast majority of mothers (90%) and fathers (81%) accurately defined exclusive breastfeeding, and nearly all mothers (97%) and fathers (93%) reported knowing that breastmilk is the first food a newborn should receive (Table 2). Although both parents had similar high levels of knowledge for those two questions, more mothers (93%) than fathers (73%) reported that from birth to six months was the recommended duration for exclusive breastfeeding (Table 2).

In contrast to the high levels of knowledge about exclusive breastfeeding, parental knowledge of ways to maintain breastmilk supply (i.e., of breastfeeding support) was low among mothers (median score of 2 out of 4) and even lower among fathers (median score of 1) (Table 2). Specifically, parents rarely (less than 10%) reported knowing about breastfeeding exclusively on demand or about manually expressing breastmilk as ways to maintain breastmilk supply (Table 2). Conversely, both mothers (71%) and fathers (76%) frequently reported having good nutrition as a way to maintain breastmilk supply (Table 2). Interestingly, most mothers (76%) had knowledge about drinking enough liquids, but less than a third of fathers (29%) reported knowledge of the importance of hydration for breastmilk supply (Table 2). Similarly, knowledge of continued breastfeeding until a child is 24 months old or more was more prevalent among mothers (71%) than fathers (45%) (Table 2). Although couples often agreed about some recommended practices such as about breastmilk as the only first food a newborn should receive (91% agreement), couples did not often agree about other practices such as about a mother having good nutrition as a way to maintain breastmilk supply (55% agreement) even though knowledge of that practice was high overall among both mothers and fathers (Table 2).

Table 2. Parental knowledge of specific aspects of exclusive breastfeeding and ways of maintaining breastmilk supply

Parental knowledge of breastfeeding	Mothers (n=956)	Fathers (n=913)	Couples[a] (n=913)
Knowledge of exclusive breastfeeding (score of 0-3)	3 (3, 3)	3 (2, 3)	
Exclusive breastfeeding means that the infant gets only breastmilk and no other liquids or foods	90%	81%	73%
Breastmilk is the only first food that a newborn baby should receive	97%	93%	91%
A baby should receive nothing more than breastmilk from birth to six months	93%	73%	69%
Knowledge of ways that a mother can keep up her milk supply (i.e, knowledge of breastfeeding support) (score of 0-4)	2 (1, 2)	1 (1, 1)	
Breastfeeding exclusively on demand	9%	3%	0%
Manually expressing breastmilk	8%	1%	0%
Having a good nutrition/eating well/having a healthy or diversified diet	71%	76%	55%
Drinking enough liquids during the day	76%	29%	24%
Knowledge of continued breastfeeding			
It is recommended that a woman should continue to breastfeed her child until the child is 24 months old or more	71%	45%	35%

Note. Values are presented as percent or median (Q1, Q3).

[a] Couples indicates that both parents within the same household expressed knowledge of the recommended practice.

The qualitative findings parallel the quantitative results for parental knowledge of exclusive breastfeeding. Mothers and fathers knew that exclusive breastfeeding was recommended; however, mothers mentioned this recommendation more frequently than fathers. A twenty-year-old mother said that "they [mothers] are advised that they should breastfeed for six months without giving anything to a child." Some mothers linked exclusive breastfeeding to disease prevention and the promotion of health. A thirty-two-year-old mother stated that, "when a child breastfeeds mother's milk, he gets good health, and he cannot get worms as easily." Similarly, some fathers also had knowledge about exclusive breastfeeding. A thirty-two-year-old father said, "in general children under 6 months are not supposed to be given other food, but after six months mothers can prepare millet or nutritious porridge to give the child energy." Despite awareness of exclusive breastfeeding, a few mothers and fathers expressed that infants need other foods in addition to breastmilk, such as water or cow's milk. A forty-two-year-old father stated that "breastfeeding for 0-6 months is not normal because the child is getting older and he should be given food that is nutritious, especially porridge-like foods." While parents in the community, especially mothers, were aware of the recommendation to exclusive breastfeed for six months, several voiced concerns that breastmilk alone was not sufficient for the whole six months.

4.2.2 Parental knowledge and attitudes about complementary foods

Parental knowledge of dietary diversity was low among the EFFECTS trial participants at baseline. When asked about ways to make porridge more nutritious or better for a child's health, both mothers and fathers reported knowledge of a median of 3 (IQR: 2, 3) out of seven food groups (Table 3). Mothers' knowledge of foods that a child should eat for good growth and development was slightly higher at a median of 4 food groups (IQR: 3, 5), but father's knowledge remained at 3 food groups (IQR: 2, 4) in response to this question as well (Table 3). Children six to eight months old consumed 2 food groups (IQR: 1, 3) in the previous day and 2 food groups (IQR: 1, 4) in the past week (Table 3). Children nine to 23 months old consumed somewhat more diverse diets at 3 food groups (IQR: 2, 4) in the previous day and 5 food groups (IQR: 4, 5) in the past week (Table 3).

More specifically, we also quantified parental nutrition knowledge and children's consumption of each food group at baseline (Table 3). Staples (grains, roots, and tubers) and legumes and nuts were mentioned by most parents and were the two food groups most commonly reported both as ways to make porridge more nutritious (i.e., to enrich it), and as good for child growth and development. The food groups least commonly reported by mothers and fathers as ways to enrich porridge were other fruits and vegetables (4% among mothers, 2% among fathers), eggs (5%, 5%), vitamin A-rich fruits and vegetables (11%, 8%), and flesh foods (20%, 24%), respectively. The food group least commonly reported as good for child growth and development was eggs by both mothers (21%) and fathers (16%). Knowledge among mothers (58%) was higher than among fathers (40%) about dairy to enrich porridge. Knowledge among mothers was also higher than among fathers about foods good for growth, including flesh foods (54% among mothers, 42% among fathers), dairy (65%, 46%), legumes and nuts (78%, 63%), vitamin A-rich fruits and vegetables (49%, 32%), and other fruits and vegetables (58%, 28%), respectively. Agreement between couples about food groups to enrich porridge and foods for growth was much lower than the overall reports from mothers and fathers, suggesting that often perhaps only one of the parents had knowledge of a food group.

Concerning children's consumption of food groups, staples was the most frequently consumed food group in the previous day by children six to eight (75%) and nine to 23 months (95%). Eggs and legumes and nuts were the least frequently consumed food groups in the previous day by children six to eight (1% for eggs, 8% for legumes and nuts) and nine to 23

months (2% for eggs, 18% for legumes and nuts), even though legumes and nuts were a food group that many parents were knowledgeable about. A higher proportion of children generally consumed each food group in the previous week than in the previous day, especially among older children, and diets of older children (nine to 23 months) were more diverse than those of younger children (six to eight months). For most food groups besides dairy, the proportion of children consuming that food group drastically increased, and in many cases approximately doubled, from six to eight to nine to 23 months of age.

Table 3. Parental knowledge of nutritious food groups and children's consumption of food groups by age

Food groups	Parental nutrition knowledge about …						Children's consumption of food groups					
	... ways to make porridge more nutritious or better for a child's health			... foods or food groups that a child should eat for good growth and development			0-5 months[b] (n = 189)		6-8 months (n = 167)		9-23 months (n = 597)	
	Mothers (n=956)	Fathers (n=913)	Couples[a] (n=913)	Mothers (n=956)	Fathers (n=913)	Couples[a] (n=913)	1-day	7-day	1-day	7-day	1-day	7-day
Overall score (number of food groups out of 7)	3 (2, 3)	3 (2, 3)	-	4 (3, 5)	3 (2, 4)	-	-	-	2 (1, 3)	2 (1, 4)	3 (2, 4)	5 (4, 5)
Flesh foods	20%	24%	6%	54%	42%	24%	3%	5%	23%	38%	56%	87%
Dairy	58%	40%	24%	65%	46%	31%	35%	38%	38%	46%	34%	47%
Eggs	5%	5%	1%	21%	16%	4%	0%	1%	1%	4%	2%	14%
Legumes and nuts	91%	85%	77%	78%	63%	50%	3%	6%	8%	17%	18%	48%
Grains, roots, tubers	88%	89%	79%	87%	90%	78%	34%	37%	75%	81%	95%	98%
Vit. A rich fruits and vegetables	11%	8%	1%	49%	32%	16%	5%	8%	25%	41%	46%	82%
Other fruits and vegetables	4%	2%	0%	58%	28%	17%	4%	8%	35%	46%	69%	89%

Note. Values are presented as percent or median (Q1, Q3).

[a] Couples indicates that both parents within the same household had knowledge of the recommended practice.

[b] Since it is recommended that children should be fed exclusively with breastmilk from birth to six months of age (WHO and UNICEF 2021), an overall dietary diversity score was not included for this age group. We included consumption of specific food groups among this age group to identify which foods were being introduced before the recommended age of six months.

Qualitative data provided insight into the attitudes and perceptions of parents about specific foods for children of varying ages (Appendix Table A.4). The perceptions of mothers and fathers about foods for children six to eight months were similar, although there were some differences between parents' perceptions. Both parents reported fish as appropriate but other meats as inappropriate to feed children six to eight months. Both parents also mentioned soft porridge and items from multiple food groups as good for young children of that age group including dairy (milk), legumes and nuts (groundnuts and beans), staples (rice, and Irish potatoes), vitamin A-rich fruits and vegetables (amaranth, mango, and papaya), and other fruits and vegetables (banana and other fruits). There was some disagreement among mothers about whether milk, groundnuts, and stiff porridge were appropriate for young children. Additionally, certain food items were mentioned more frequently by either mothers or fathers. Fathers believed that it was good to feed eggs to young children six to eight months of age, but that soda and juice were not appropriate. Mothers believed that maize, cassava, cassava leaves, guava, and tamarind were inappropriate for children at this age. Some mothers enriched porridge with groundnuts and other food items.

Both parents described several reasons why they considered certain foods appropriate for infants six to eight months including beliefs that those foods are nutritious, provide energy, increase blood, and are good for children's health and for the development of their bodies. For example, a 24-year-old mother of a two-and-a-half-year-old child voiced that "amaranths give good nutrition to a child." A forty-one-year-old father of a nearly one-and-a-half-year-old child explained that an infant six to eight months should be given "sorghum porridge mixed with milk [because] they give him/her energy and health," and a fifty-three-year-old father of a nearly two-and-a-half-year-old child explained that an infant six to eight months "should also be provided with fruits to protect his/her health." In addition, mothers believed that infants six to eight months should be fed foods that help them grow well and become stronger, provide vitamins, help with children's bowel movements, and are good for children's brain development. Fathers also described certain foods as appropriate for children six to eight months because they are available, because children desire to eat certain foods that are not often prepared for them, and because they provide fats and carbohydrates.

Both parents considered some foods with stiffer consistencies or bitter flavor inappropriate for young infants six to eight months of age. Mothers believed that infants of that

young age should not be fed certain foods with harder consistencies, such as meat, stiff sorghum porridge, maize, cassava, tamarind, and guava because infants at that age do not yet have teeth for chewing, are not ready to digest those foods, and may become constipated. For instance, a twenty-year-old mother of a child six months of age voiced that "the child [six to eight months] cannot digest hard foods yet like ugali (stiff porridge) [or] meat." Similarly, fathers believed that guava (due to its hard seeds) and millet stiff porridge caused constipation and hard stools, and that meat, certain vegetables (e.g., spinach), and tamarind were inappropriate because children six to eight months of age did not yet have teeth for chewing. In addition, certain foods (e.g., African eggplant and jute mallow) were avoided due to their bitter flavor. A twenty-three-year-old mother of a one-year-old child explained that "a child… cannot eat African eggplant because the child will find it bitter in his mouth," and a thirty-two-year-old father of a child nine months of age expressed that "children should not eat jute mallow - it's bitter."

Other reasons foods were considered inappropriate were also described by either mothers or fathers. Mothers explained that certain foods were avoided because they believed those foods (cooking oil and sugar) cause the child to get sick frequently, because it (cassava leaves) causes gas in the stomach, or because infants were not accustomed to them (peppers, Chinese vegetable, and insects). Fathers expressed food safety concerns about soda and juice due chemicals, and about cabbage due to insecticides. A twenty-one-year-old father of a child seven months of age voiced that "fluids like soda are not good to give to children because they have chemicals and the child's liver cannot filter the poison in the soda." A twenty-five-year-old father of a one-and-a-half-year-old child explained that "cabbage and juice are not good for children because they are mixed with different chemicals...; if I explain about cabbages, they spray insecticides."

Nevertheless, some parents described that some of these foods that were considered inappropriate due to stiff consistencies or bitter flavor can be prepared in a way that makes them appropriate for young infants. When asked whether there is a way to prepare these foods so that a child six to eight months of age can eat them, a thirty-seven-year-old mother of a child six months of age explained that "I can take maize, sorghum, groundnuts, and sardines… to a milling machine… to get flour for making the child's porridge." Some mothers explained that guava can be made appropriate for infants by removing the seeds, peeling the outside layer, and stirring it so the child can drink it. Along with this idea of preparing foods with harder consistencies in a way that is appropriate for infants to eat, a forty-one-year-old father of a child

nearly one-and-a-half years of age explained that infants six months and older can be given meat if it is “highly boiled and softened,” and that soft meats such as liver can be chosen. Regarding foods considered to have bitter flavor, a twenty-three-year-old mother of a one-year-old child explained that if African eggplant is given to infants, "it must be mixed with small fish, mixed with amaranths, and mixed with milk." A thirty-year-old father of a two-and-a-half-year-old child described that “jute mallow is good; if you cook it well children like it, and it is not bitter.”

Parents rarely considered food items inappropriate for older children nine to 23 months of age (Appendix Table A.4). Greater acceptability of flesh foods for older children was notable among both parents. Mothers in all FGDs mentioned fish as appropriate for older children, fathers frequently mentioned a wider range of flesh foods as appropriate (fish, meat, and chicken), and meat was no longer frequently described as inappropriate by either parent. Both mothers and fathers also expressed greater acceptability of a wider range of staple food items, of sugar, and of stiff porridge for older children than for younger children. Some mothers considered soup as appropriate and some fathers considered juice appropriate for older children, which was not a common pattern for younger children.

Mothers’ reasons for considering certain foods appropriate for older children nine to 23 months of age included beliefs that those foods provide strength, energy, nutrients, vitamins, minerals, or fat, are tasty, and help the child have soft bowels. For example, a twenty-one-year-old mother of a child a little over two years of age voiced that “these foods are acceptable because they provide energy.” A twenty-four-year-old mother of a two-and-a-half-year-old child expressed that she “sorted fish… [because] it has nutrients” and that “potatoes are tasty.” A twenty-three-year-old mother of a one-year-old child described that papaya is “useful in… softening the child’s bowels.” Fathers’ reasons for considering certain foods appropriate for children of this age group included children’s preferences, availability of foods, and beliefs that certain foods provide energy, vitamins, and protein, are nutritious, are good for children’s health, growth, and blood, and help the child have soft feces and protect the child’s body. A twenty-seven-year-old father of a one-year-old child explained that “children like beans a lot… [and] they eat banana… after meals… [because it] is available in this community,” and a thirty-year-old father of a child one year and eight months of age explained that “Irish potatoes can also be eaten by a child 9-23 months; it helps the child to have soft feces.” Several parents expressed that

no foods are inappropriate for children nine to 23 months of age to eat, although some still considered certain foods with harder consistencies inappropriate even for these older children.

4.2.3 Parental self-efficacy, time use, social support, and household savings

We also used baseline quantitative data to measure mothers' and fathers' reports of their personal resources of self-efficacy about nutrition, time use, social support, and household savings (Table 4). Most mothers had high self-efficacy about their ability to provide their child with a diverse diet (63%) and with a nutritious diet (70%), while half of the fathers had high self-efficacy about provision of a diverse diet (49%) and of a nutritious diet (50%). Mothers (median of 9 hours; IQR: 6, 12) reported spending more time on work away from home than fathers (6 hours; IQR: 4, 9). Fewer mothers (47%) than fathers (66%) reported having high overall social support. A similar proportion of mothers (41%) and fathers (38%) reported that their household had savings at the time of data collection, but agreement between partners within the same household was low as less than a fifth of couples (18%) agreed that their household had savings at that time.

4.2.4 Couples' relationship dynamics

We also quantified parents' reports of couple's communication and relationship dynamics pertaining to eight household topics at baseline (Table 4). Mothers reported often communicating with their partner concerning a median of four of eight topics (IQR: 2, 7), while fathers' report of couple's communication frequency was higher at six topics (IQR: 4, 8). Mothers reported often feeling like their opinions were taken seriously when discussing four topics (IQR: 1, 6) with their partner. Mothers were not often involved in final decisions over household matters. The number of topics in which participants reported that the woman makes final decisions independently or jointly with her partner were 2 topics (IQR: 1, 3) according to mothers and three topics (IQR: 1, 7) according to fathers.

Table 4. Descriptive statistics of parental personal resources and couple's relationship dynamics

Independent variables		Median (Q1, Q3) or Percent (n/N)	
		Mothers	Fathers
Self-efficacy about nutrition	Confidence in own ability to provide child with a diverse diet (% agree or strongly agree)	63% (605/956)	49% (443/913)
	Confidence in own ability to provide child with a nutritious diet (% agree or strongly agree)	70% (668/956)	50% (453/913)
Time spent on work away from home	Time spent on work away from home (typical number of hours / day)	9 (6, 12)	6 (4, 9)
Social support	High overall social support from a special person, family, and friends (% with average score of 4-5 on a scale of 1-5)	47% (444/952)	66% (603/913)
Household savings	Household currently has savings (%)	41% (389/956)	38% (346/913)
		Couple's report: 18% (164/913)	
Couples' communication frequency	Number of topics out of 8 often communicated about with their partner	4 (2, 7)	6 (4, 8)
Couples' communication quality	Number of topics out of 8 in which mothers felt like their opinions were often taken seriously when discussing them with their partner	4 (1, 6)	-
Women's involvement in decision-making	Number of topics out of 8 in which the mother makes final decisions independently or jointly with her partner	2 (1, 3)	3 (1, 7)

[a] Couples indicates that both parents within the same household reported that the household had savings at the time they were interviewed.

4.3 Drivers of breastfeeding practices within the family food environment

4.3.1 Drivers of exclusive breastfeeding identified from quantitative data

Table 5 shows results from mixed-effects logistic regressions (univariable adjusted and multivariable models) of associations between parental independent variables and exclusive breastfeeding among children from birth to six months of age. In the univariable adjusted models, mothers' time spent on work away from home (odds ratio [OR]: 0.88; p = 0.01), father's report of couple's communication frequency (OR: 0.84; p = 0.04), and father's report of women's involvement in final decision-making (OR: 0.84; p = 0.01) were significantly associated with lower odds of exclusive breastfeeding. Both parents' knowledge of exclusive breastfeeding and of breastfeeding support, father's time spent on work away from home, both parents' reports of social support and household savings, and mother's report of communication frequency, quality, and of her involvement in final decision-making were not significantly associated with exclusive breastfeeding in the univariable adjusted models.

The multivariable model (Table 5) yielded similar results as the univariable adjusted models for all predictors except for father's report of communication frequency and mother's report of her involvement in decision-making. The negative association between father's report of couple's communication frequency and exclusive breastfeeding became insignificant in the multivariable model (p = 0.07). Conversely, mother's report of her involvement in final decisions over household matters became significantly associated with higher odds of exclusive breastfeeding in the multivariable model.

Appendix Table A.6 shows results from the sensitivity analysis in which household food security status was added as a covariate to the multivariable model. Households experiencing mild (OR: 0.08; p = 0.006), moderate (OR: 0.12; p = 0.012), or severe food insecurity (OR: 0.14; p = 0.016) were significantly less likely to have exclusively breastfeed infants compared to food secure households. Specifically, 77% of infants under six months in food secure households were exclusively breastfed, but only 39% of infants of that age in severely food insecure households engaged in this recommended practice. When food security was included in the model, mother's time spent on work away from home (OR: 0.87; p = 0.04) and father's report of women's involvement in final decisions (OR: 0.78; p = 0.003) remained significantly associated with lower odds of exclusive breastfeeding, as was observed in the other models. Mother's report of

couple's communication frequency became significantly associated with higher odds of exclusive breastfeeding (OR: 1.22; p = 0.03) in the multivariable model including food security status which did not occur in the previous models. On the other hand, father's report of couple's communication frequency became significantly associated with lower odds of exclusive breastfeeding (0.82; p = 0.049) once again in the multivariable model including food security status, which was similar to results from the univariable adjusted model but unlike the prior multivariable model. Mother's report of her involvement in decision-making was no longer significantly associated with odds of exclusive breastfeeding once food security status was accounted for.

Table 5. Associations between parental predictors and exclusive breastfeeding among children under six months

Independent variables		Reported by	Exclusive breastfeeding among children under 6 months of age (n=189)			
			Univariable Adjusted		Multivariable	
			Odds ratio (95% CI)	*p*	Odds ratio (95% CI)	*p*
Nutrition knowledge of breastfeeding	Knowledge of exclusive breastfeeding (score of 0-3)	Mothers	1.32 (0.59, 2.94)	0.50	0.96 (0.38, 2.40)	0.93
		Fathers	0.91 (0.58, 1.41)	0.66	0.63 (0.37, 1.09)	0.10
	Knowledge of ways to maintain supply of breastmilk, i.e., of breastfeeding support (score of 0-4)	Mothers	1.02 (0.63, 1.67)	0.92	1.21 (0.71, 2.06)	0.48
		Fathers	1.66 (0.84, 3.30)	0.15	1.79 (0.87, 3.70)	0.11
Time use	Time spent on work away from home (typical number of hours/day)	Mothers	0.88 (0.80, 0.97)	**0.01**	0.87 (0.77, 0.98)	**0.02**
		Fathers	0.96 (0.86, 1.06)	0.41	1.01 (0.90, 1.13)	0.91
Social support	High overall social support (% with average score of 4-5 on a scale of 1-5)	Mothers	1.62 (0.78, 3.36)	0.19	1.52 (0.67, 3.49)	0.32
		Fathers	0.86 (0.40, 1.83)	0.69	0.82 (0.35, 1.92)	0.65
Household savings	Household currently has savings (%)	Mothers	1.38 (0.63, 2.98)	0.42	1.21 (0.51, 2.85)	0.67
		Fathers	0.52 (0.24, 1.15)	0.11	0.59 (0.25, 1.40)	0.23
		Couples	0.89 (0.34, 2.37)	0.82	-	-
Couples' communication frequency	Number of topics out of 8 often communicated about with their partner	Mothers	1.08 (0.94, 1.24)	0.29	1.18 (1.00, 1.40)	0.06
		Fathers	0.84 (0.72, 0.99)	**0.04**	0.84 (0.70, 1.01)	0.07
Couples' communication quality	Number of topics out of 8 in which mothers felt like their opinions were often taken seriously when discussing them with their partner	Mothers	1.09 (0.95, 1.25)	0.21	-	-
Women's involvement in decision-making	Number of topics out of 8 in which the mother makes final decisions independently or jointly with her partner	Mothers	1.16 (1.00, 1.35)	0.06	1.21 (1.02, 1.44)	**0.03**
		Fathers	0.84 (0.73, 0.96)	**0.01**	0.82 (0.70, 0.95)	**0.01**

Note. Odds ratios (ORs) indicating the odds of exclusive breastfeeding: ORs above 1 indicate higher likelihood of exclusive breastfeeding, while ORs below 1 indicate lower likelihood of adherence to this recommended practice. Results are from mixed-effects logistic regressions. Univariable adjusted analyses included study design characteristics, demographic covariates, and each independent variable of interest in a separate model. Multivariable adjusted analyses included study design characteristics, demographic covariates, and multiple independent variables of interest in one model. All models accounted for the study design characteristics of clustering at the village level as a random effect and of district as a fixed effect. Demographic covariates included age of child in months (rounded to one decimal), sex of child, education of both parents, age of both parents, marital relationship (monogamous / polygamous), survey group (delayed / on time data collection), household wealth index, household size (number of people residing within household), and a missing indicator for household size.

4.3.2 Drivers of breastfeeding practices identified from qualitative data

Although parents are advised on the importance of exclusive breastfeeding for six months, not all engage in this practice due to challenges. Several mothers described issues with milk insufficiency and feeling like the child was not satisfied. They also connect milk supply with their own food insecurity. A twenty-two-year-old mother of a two-and-a-half-year-old child said mothers do not have, "…enough food; they do not eat and become full, so they are unable to make enough milk for a child to breastfeed and feel full." A few mothers expressed concerns about breastmilk quality and its link to diarrhea or the passing of diseases from the mother to the child. Mothers also discussed their time allocation with regard to childcare and work demands. A forty-one-year-old mother who is a farmer explained that a child "is not supposed to be given any other foods before he reaches six months… You go to the farm and a child has nothing to eat at home and you have left him. You are in a tough situation." Despite widespread knowledge about the exclusive breastfeeding recommendation, several felt that breastmilk was not enough as the infant grows older and expressed that porridge and cow's milk were important to add to the diet before the age of 6 months.

Fathers' responses were similar to those of the mothers. Some fathers knew their child was exclusively breastfed for six months and why this was important. For example, a forty-four-year-old father of a one-and-a-half-year-old child said that in "my family, the child from 0-6 months drank the mother's milk because it is the best quality… [From 6 months, we] gave him/her sorghum porridge, groundnuts, rice, sardines and beans." Many fathers were aware that exclusively breastfeeding for 6 months is not common. A twenty-nine-year-old father stated that a "mother cannot exclusively breastfeed the child for six months. They believe children will not grow up. So, they feed their children other foods because they believe it provides more energy." Fathers also discussed milk insufficiency. In the words of a twenty-five-year-old father, "because of hardship of life women don't have enough breastmilk to feed the child, as [a] result, children cry all the time and mothers prepare porridge to feed the child." A few fathers mentioned additional challenges including the mother's lack of proper nutrition, either the child or the mother having an illness, or the mother's time burden with activities or farm work away from home.

4.4 Drivers of complementary feeding practices within the family food environment

4.4.1 Drivers of one-day child dietary diversity identified from quantitative data

Table 6 shows results from mixed-effects linear regressions of predictors of dietary diversity in the previous day among children nine to 23 months of age. The parental determinants significantly associated with higher one day dietary diversity among this older age group of children in univariable adjusted models included mother's knowledge of ways to enrich porridge (0.13 food groups, $p = 0.01$), mother's self-efficacy about provision of a diverse diet (0.26 food groups, $p = 0.01$) and of a nutritious diet (0.21 food groups, $p = 0.04$), mother's social support (0.27 food groups, $p = 0.004$), mother's (0.21 food groups, $p = 0.03$) and couple's (0.29 food groups, $p = 0.03$) reports of having household savings, and mother's report of couple's communication frequency (0.07 food groups, $p < 0.001$) and quality (0.04 food groups, $p = 0.01$). Conversely, father's report of couple's communication frequency (-0.05 food groups, $p = 0.02$) was significantly associated with lower dietary diversity among these older children. Determinants not significantly associated with higher or lower one day dietary diversity among these older children in univariable adjusted models included father's knowledge of ways to enrich porridge, both parent's knowledge of foods for child growth and development, father's self-efficacy about provision of a diverse and of a nutritious diet, both parent's time spent on work away from home, father's report of social support, father's report of having household savings, and both parent's report of mother's involvement in final decision-making.

The determinants of one day dietary diversity in univariable adjusted models among the broader age group of children six to 23 months old (Appendix Table A.5) were largely similar to those identified for the sub-sample of older children nine to 23 months old (Table 6). However, mother's self-efficacy about provision of a nutritious diet, couple's joint report of having household savings, and father's report of couple's communication frequency were no longer significantly associated with one day dietary diversity among this broader sample of children (Appendix Table A.5). On the other hand, father's report of women's involvement in final decisions (-0.04 food groups, $p = 0.03$) became significantly associated with lower one day dietary diversity among the broader age group (Appendix Table A.5).

Few associations remained statistically significant in the multivariable models of predictors of one day dietary diversity among children nine to 23 months of age (Table 6) and

children six to 23 months of age (Appendix Table A.5). Specifically, mother's knowledge of ways to enrich porridge (0.13 food groups, p = 0.02) and mother's report of couple's communication frequency (0.06 food groups, p = 0.001) remained significantly associated with more diverse diets in the previous day in the multivariable model among the older age group of children, as was observed in univariable adjusted models. In the multivariable model that quantified determinants of one day dietary diversity among the broader sample of children six to 23 months of age, mother's social support (0.26 food groups, p = 0.004) and mother's report of couple's communication frequency (0.06 food groups, p < 0.001) remained significantly associated with greater dietary diversity in the previous day. All other parental independent variables became or remained insignificantly associated with the number of food groups consumed in the previous day by either group of children in these two multivariable models. The same determinants of one day dietary diversity were significantly associated with children's diets in the sensitivity analysis that included household food security status (Appendix Table A.6) in each of the respective multivariable models (each age group of children) as those identified without it in the models.

4.4.2 Drivers of seven-day child dietary diversity identified from quantitative data

Based on results from univariable adjusted models, the determinants of dietary diversity in the previous week among older children nine to 23 months of age were mostly but not entirely similar to the determinants of diets in the previous day (Table 6). Mother's self-efficacy about provision of a diverse diet (0.23 food groups, p = 0.03), mother's social support (0.31 food groups, p = 0.002), mother's (0.29 food groups, p = 0.01) and couple's (0.39 food groups, p = 0.01) reports of having household savings, and mother's report of couple's communication frequency (0.06 food groups, p = 0.003) and quality (0.06 food groups, p = 0.001) remained associated with higher dietary diversity in the previous week, as they were with diets in the previous day. However, mother's knowledge of foods for child growth and development (0.14 food groups, p < 0.001) was a significant predictor of greater seven-day dietary diversity but not of one day dietary diversity, while mother's knowledge of ways to enrich porridge was a significant predictor of greater one day diets but not of seven day diets. Similarly, mother's report of women's involvement in final decision-making (0.06 food groups, p = 0.01) became significantly associated with greater dietary diversity in the previous week, while mother's self-

efficacy about provision of a nutritious diet and father's report of couple's communication frequency were no longer associated with higher or lower dietary diversity (respectively) in the previous week.

The factors identified as determinants of seven-day dietary diversity in univariable adjusted models among the broader sample of children six to 23 months old (Appendix Table A.5) were largely similar those factors identified among the older group of children nine to 23 months of age (Table 6). However, mother's self-efficacy about provision of a diverse diet was not associated with seven-day dietary diversity among the broader age group of children in the univariable adjusted analysis.

Among older children nine to 23 months old, few determinants remained significantly associated with seven-day dietary diversity in the multivariable model (Table 6). However, among the broader sample of children six to 23 months old a few more determinants remained significantly associated with seven-day dietary diversity (Appendix Table A.5). The only determinants of higher dietary diversity in the previous week based on the multivariable model among the older age group of children nine to 23 months were mother's knowledge of foods for child growth and development (0.10 food groups, $p = 0.01$), and mother's report of couple's communication frequency (0.05 food groups, $p = 0.02$). Similarly, among the broader age group of children six to 23 months of age mother's knowledge of foods for child growth and development (0.11 food groups, $p = 0.01$) and mother's report of couple's communication frequency (0.06 food groups, $p = 0.01$) also remained significantly associated greater seven-day dietary diversity in the multivariable model among the broader sample of children six to 23 months. In addition, mother's time spent on work away from home (0.03 food groups, $p = 0.03$), mother's social support (0.28 food groups, $p = 0.01$), and mother's report of her involvement in final decisions (0.08 food groups, $p = 0.004$) were also associated with greater seven-day dietary diversity in the multivariable model. All other parental independent variables in these two multivariable models became or remained insignificantly associated with the number of food groups consumed by each of these groups of children in the past week. The same determinants of seven-day dietary diversity were significantly associated with children's diets in the sensitivity analysis that included household food security status (Appendix Table A.6) in each of the respective multivariable models (each age group of children) as those identified without it in the models.

Table 6. Associations between parental predictors and dietary diversity among children 9-23 months

Independent Variables		Reported by	Dietary diversity out of 7 food groups among children 9-23 months of age (n= 597)							
			1-Day Univariable Adjusted		1-Day Multivariable		7-Day Univariable Adjusted		7-Day Multivariable	
			Coef. (95% CI)	***p***	**Coef. (95% CI)**	***p***	**Coef. (95% CI)**	***p***	**Coef. (95% CI)**	***p***
Nutrition knowledge of 7 food groups	Knowledge of ways to make porridge more nutritious	Mothers	0.13 (0.03, 0.23)	**0.01**	0.13 (0.02, 0.24)	**0.02**	0.09 (-0.02, 0.20)	0.11	0.06 (-0.06, 0.18)	0.34
		Fathers	0.03 (-0.06, 0.13)	0.50	0.08 (-0.03, 0.20)	0.17	0.10 (-0.01, 0.20)	0.07	0.10 (-0.03, 0.22)	0.13
	Knowledge of foods that a child should eat for good growth and development	Mothers	0.01 (-0.06, 0.08)	0.81	-0.03 (-0.10, 0.04)	0.40	0.14 (0.06, 0.21)	**<0.001**	0.10 (0.02, 0.18)	**0.01**
		Fathers	0.00 (-0.07, 0.06)	0.96	-0.05 (-0.13, 0.02)	0.15	0.03 (-0.04, 0.10)	0.35	-0.02 (-0.10, 0.06)	0.61
Self-efficacy about nutrition	Confidence in own ability to provide child with a diverse diet (% agree or strongly agree)	Mothers	0.26 (0.07, 0.45)	**0.01**	0.16 (-0.03, 0.36)	0.10	0.23 (0.02, 0.43)	**0.03**	0.18 (-0.03, 0.39)	0.09
		Fathers	0.01 (-0.18, 0.21)	0.88	-0.0002 (-0.19, 0.19)	1.00	0.06 (-0.15, 0.26)	0.60	0.04 (-0.17, 0.24)	0.73
	… with a nutritious diet (% agree or strongly agree)	Mothers	0.21 (0.01, 0.4)	**0.04**	-	-	0.13 (-0.09, 0.34)	0.25	-	-
		Fathers	0.07 (-0.12, 0.26)	0.47	-	-	0.00 (-0.21, 0.21)	0.99	-	-
Time use	Time spent on work away from home (typical number of hours/day)	Mothers	0.00 (-0.02, 0.03)	0.67	0.01 (-0.01, 0.03)	0.31	0.01 (-0.01, 0.03)	0.39	0.02 (-0.01, 0.04)	0.19
		Fathers	0.01 (-0.02, 0.03)	0.51	0.01 (-0.02, 0.03)	0.56	-0.01 (-0.03, 0.02)	0.70	-0.01 (-0.03, 0.02)	0.56
Social support	High overall social support (% with average score of 4-5 on a scale of 1-5)	Mothers	0.27 (0.09, 0.45)	**0.004**	0.18 (-0.004, 0.37)	0.06	0.31 (0.11, 0.50)	**0.002**	0.20 (-0.01, 0.40)	0.06
		Fathers	0.01 (-0.19, 0.21)	0.91	0.0004 (-0.20, 0.20)	1.00	-0.18 (-0.39, 0.04)	0.11	-0.17 (-0.39, 0.05)	0.12

Table 6. Associations between parental predictors and dietary diversity among children 9-23 months (continued)

Independent Variables		Reported by	Dietary diversity out of 7 food groups among children 9-23 months of age (n= 597)							
			1-Day Univariable Adjusted		1-Day Multivariable		7-Day Univariable Adjusted		7-Day Multivariable	
			Coef. (95% CI)	*p*	Coef. (95% CI)	*p*	Coef. (95% CI)	*p*	Coef. (95% CI)	*p*
Household savings	Household currently has savings (%)	Mothers	0.21 (0.02, 0.41)	**0.03**	0.12 (-0.07, 0.32)	0.22	0.29 (0.09, 0.50)	**0.01**	0.18 (-0.03, 0.39)	0.10
		Fathers	0.15 (-0.05, 0.35)	0.15	0.10 (-0.09, 0.30)	0.30	0.07 (-0.15, 0.29)	0.54	0.06 (-0.16, 0.27)	0.61
		Couples	0.29 (0.03, 0.55)	**0.03**	-	-	0.39 (0.11, 0.67)	**0.01**	-	-
Couples' communication frequency	Number of topics out of 8 often communicated about with their partner	Mothers	0.07 (0.04, 0.10)	**<0.001**	0.06 (0.02, 0.09)	**0.001**	0.06 (0.02, 0.09)	**0.003**	0.05 (0.01, 0.08)	**0.02**
		Fathers	-0.05 (-0.09, -0.01)	**0.02**	-0.04 (-0.08, 0.002)	0.06	-0.04 (-0.08, 0.00)	0.07	-0.03 (-0.08, 0.01)	0.13
Couples' communication quality	Number of topics out of 8 in which mothers felt like their opinions were often taken seriously when discussing them with their partner	Mothers	0.04 (0.01, 0.08)	**0.01**	-	-	0.06 (0.02, 0.09)	**0.001**	-	-
Women's involvement in decision-making	Number of topics out of 8 in which the mother makes final decisions independently or jointly with her partner	Mothers	-0.003 (-0.05, 0.04)	0.87	0.002 (-0.04, 0.05)	0.91	0.06 (0.01, 0.11)	**0.01**	0.05 (-0.001, 0.10)	0.06
		Fathers	-0.03 (-0.06, 0.00)	0.06	-0.01 (-0.05, 0.02)	0.40	-0.01 (-0.04, 0.03)	0.67	0.01 (-0.03, 0.04)	0.76

Note. Coefficients indicate the number of food groups. Results are from mixed-effects linear regressions. Univariable adjusted analyses included study design characteristics, demographic covariates, and each independent variable of interest in a separate model. Multivariable adjusted analyses included study design characteristics, demographic covariates, and multiple independent variables of interest in one model. All models accounted for the study design characteristics of clustering at the village level as a random effect and of district as a fixed effect. Demographic covariates included age of child in months (rounded to one decimal), sex of child, education of both parents, age of both parents, marital relationship (monogamous / polygamous), survey group (delayed / on time data collection), household wealth index, household size (number of people residing within household), a missing indicator for household size, breastfeeding in the previous day (yes / no), and distance to market (less than 30 minutes / more than 30 minutes to get to the market).

4.4.3 Drivers of complementary feeding practices identified from qualitative data

Knowledge was both a facilitator and a barrier to appropriate complementary feeding, as described in the section about parental knowledge and attitudes about complementary foods. Parents considered certain foods appropriate to feed children because they are nutritious, provide energy, are good for child growth and development, help promote improved health, are available, and are desired by children. However, lack of awareness on how to prepare certain nutritious complementary foods in a way that is appropriate for children six to eight months may limit child dietary diversity at this younger age.

A challenge to appropriate complementary feeding described by both parents was the inability to afford certain foods. When asked to describe the common challenges with accessing, preparing, and feeding complementary foods, a twenty-two-year-old mother of a two-and-a-half-year-old child voiced that “people can’t afford to buy these foods to prepare for the child.” A forty-two-year-old mother of an eight-month-old infant expressed that “the current challenge is poverty, not having money; we would like to give nutritious foods to our children, but we are poor." A thirty-five-year-old mother of a three-year-old child specified that “the challenge I face at my home is that I fail to get eggs and I don’t keep chicken, so I can’t get eggs to give to my child.” Similarly, fathers also described affordability and economic challenges as barriers to appropriate child feeding. A twenty-five-year-old father of a one-and-a-half-year-old child explained that “hardship of life causes parents to fail to provide nutritious food to their children; if they can get these foods, children will have good health and grow well,” and a forty-year-old father of a two-year-old child explained that certain foods are not available “because of the low economy.” Additionally, some fathers voiced that food preparation depends on family income.

Decision-making dynamics and division of labor between could be either an enabler or a challenge to appropriate complementary feeding. A twenty-two-year-old mother explained that “you sit and plan together, both of you, so that you can advise each other as a family which food should be sold, and which food should remain for household consumption.” However, a thirty-eight-year-old mother voiced that lack of collaboration between parents can lead to food insecurity: “All the foods that we are growing are suitable for selling if you have enough food for your family and you have agreed with your husband… Because as a mother in your family, you have a budget that if I balance this food it will sustain me until a certain month, but when the father messes up this plan even three months will not pass and you will enter a food scarcity

period.” Additionally, a twenty-nine-year-old father voiced the importance of collaboration between parents: “It’s difficult for a single parent… [because that] parent has all the responsibilities... It’s better for all parents to work together so that children can get food at the right time.”

CHAPTER 5. DISCUSSION

In this study we used mixed methods to identify how mothers' and fathers' knowledge and personal resources, as well as couples' communication and decision-making dynamics shape the practices of exclusive breastfeeding and dietary diversity among young children in rural Mara, Tanzania. We used qualitative data from focus groups to identify both parents' attitudes and beliefs on breastfeeding and complementary feeding, and to identify challenges and enablers that drive these IYCF practices. We used cross-sectional quantitative data to identify how both parents' nutrition knowledge, personal resources (i.e., self-efficacy, time, social support, and household savings), and perceptions of couples' communication and decision-making dynamics relate to optimal IYCF practices. At baseline, the practices of exclusive breastfeeding among infants under six months of age and of dietary diversity among children six to 23 months were suboptimal, though older children nine to 23 months of age consumed several more food groups than younger children six to eight months (5 vs. 2 food groups, respectively, over one week). In the following sections we discuss drivers of exclusive breastfeeding and of complementary feeding, recommendations for future interventions, methodological considerations, strengths and limitations of this study, and conclusions.

5.1 Drivers of exclusive breastfeeding within the family food environment

In brief, we found that parental knowledge of exclusive breastfeeding was high, while knowledge of ways to maintain breastmilk supply was low. When women were more empowered, indicated by their reports of greater spousal communication over various household decisions (including income, expenses, crops, food purchases, and livestock), they were more likely to exclusively breastfeed their child after accounting for the effects of household food security status. However, challenges of perceived milk insufficiency, food insecurity, and women's time burden away from home fetching water and fuel, going to the market, and engaging in income-generating work limit their ability to follow this recommended practice.

Similarly, in a study conducted in rural India, women with higher financial autonomy were significantly more likely to exclusively breastfeed their children 3-5 months of age, but other dimensions of autonomy (e.g., mobility, non-acceptance of domestic violence, experience

of domestic violence, and household and child-related decision-making) were not associated with this practice (Shroff et al. 2011). Women who were more involved in household decision-making had infants who were less wasted and less underweight (Shroff et al. 2011). However, in a study conducted in 36 developing countries, increases in women's status were typically negatively associated with measures of breastfeeding (Smith et al. 2003). A possible explanation for the findings from this latter study is that these women may have spent more time away from children, such as if they were employed (Carlson et al. 2015).

Additionally, in a review of the role of women's empowerment in child nutrition outcomes, only seven studies were identified that examined breastfeeding outcomes, and findings were mixed (Santoso et al. 2019). Of the 46 associations that were tested between various measures of women's empowerment and breastfeeding outcomes, only 13% and 10% significant positive and negative associations were identified, respectively (Santoso et al. 2019). These mixed findings could be because different dimensions of women's empowerment were evaluated. It is possible that women's empowerment in the context of greater communication between partners over household decisions may indicate an environment with greater cooperation and support between partners, which may be more conducive to a woman's ability to exclusively breastfeed. However, if a woman's empowerment in a broader sense is measured in such a way that includes broader societal factors such her employment status, it may have a negative effect on breastfeeding if she is spending less time with her child.

We found that among focus group participants in our study, knowledge of exclusive breastfeeding was common among fathers and especially among mothers. Data from the EFFECTS quantitative baseline survey paralleled these findings: Both parents typically had high overall knowledge of exclusive breastfeeding, though more mothers than fathers reported knowledge of the recommended duration of this practice until six months (93% vs. 73%). However, both parents had lower overall knowledge of breastfeeding support, and considerably more mothers than fathers were specifically aware of the importance of drinking enough liquids for breastmilk production (76% vs. 29%). Nevertheless, regression results suggested that parental knowledge on exclusive breastfeeding and breastfeeding support were not significantly associated with the practice of exclusive breastfeeding. These null results could in part be due to limited variation in scores for parental knowledge on breastfeeding, which was high for exclusive breastfeeding, and low for breastfeeding support. These results could also suggest that

knowledge of exclusive breastfeeding is not the only necessary factor to enable adherence to this recommended practice, and that other barriers exist.

Other studies indicate that knowledge of breastfeeding is also generally high in other contexts. In a qualitative study with 16 focus groups in Rwanda, Ahishakiye et al. (2019) found that participants were generally aware of the recommendation to exclusive breastfeeding for six months, but challenges related to everyday reality hindered adherence to optimal IYCF practices. Similarly, in a cross-sectional quantitative study Ambikapathi et al. (2021) found that men and women in rural Ethiopia had high knowledge on optimal breastfeeding practices. However, findings from the Democratic Republic of Congo indicate that several women interviewed believed that infants under six months should be given water when the weather is hot (Burns et al. 2016).

We found that the challenge to breastfeeding most frequently mentioned by both parents in focus groups was a perceived lack of breastmilk for the child to be satisfied, which some parents attributed to the mother not eating enough to be satisfied. A few parents mentioned other challenges such as mothers' time burden with farm work outside the home or concerns about transmission of illness via breastmilk. Quantitative results from the EFFECTS baseline survey parallel some of these findings. Less than half of infants in severely food insecure households were exclusively breastfed, while more than three quarters of those in food secure households were; mothers in food insecure households were significantly less likely to exclusively breastfeed their children for six months. Additionally, it is estimated that lactating women need approximately 330 to 400 additional calories each day compared to their pre-pregnancy calorie needs (U.S. Department of Agriculture and U.S. Department of Health and Human Services 2020). Thus, food insecurity seems to play a key role in a woman's likelihood of exclusive breastfeeding her infant, so here we rely on findings from analyses including household food security status in the model. Quantitative findings from our study further suggested that mothers who spent more time working outside the home were less likely to exclusively breastfeed their children. Generally, exclusive breastfeeding was not significantly associated with other parental determinants.

Similar challenges to breastfeeding have been identified in other studies. Perceived breastmilk insufficiency was also described as a challenge to recommended breastfeeding practices in the Democratic Republic of Congo (DRC), Ethiopia, Rwanda, and another study in

Tanzania (Burns et al. 2016; Mekonnen et al. 2018; Ahishakiye et al. 2019; Cooper et al. 2019). Additionally, in the DRC (Burns et al. 2016) and in another study that was also conducted in the Lake Zone of Tanzania (Cooper et al. 2019), interviewees linked breastmilk insufficiency to the mother not eating well (Cooper et al. 2019), as they did in our study. Additionally, women's workload was also identified as a reason for early introduction of complementary foods in the DRC (Burns et al. 2016), Kenya (Faye et al. 2019), and Rwanda (Ahishakiye et al. 2019).

5.2 Drivers of complementary feeding within the family food environment

Qualitative findings revealed that the main facilitator of appropriate complementary feeding was parental attitudes and beliefs that various nutritious foods were good for children's wellbeing. Reasons included beliefs that these foods were nutritious, had vitamins, were good for the child's growth, health and brain, and provided energy. The main challenges identified in our qualitative data were linked to affordability of nutritious foods and to attitudes and beliefs that certain nutritious foods were inappropriate for younger infants six to eight months due to concerns about certain foods being difficult to chew or digest, causing constipation, or having bitter flavor.

Similar parental attitudes and beliefs about nutritious foods have also been observed as both enablers and challenges in other contexts. Caregivers in Ghana expressed basic understanding and knowledge of key nutrition and health concepts, but some beliefs and nutrition knowledge gaps were also identified (Armar-Klemesu et al. 2018). Mothers in Madagascar also voiced that complementary foods give children energy, are good for child growth and health, and help the child's brain; however, they avoided feeding "heavy foods" such as eggs and legumes to children younger than one year because they believed these foods are difficult to digest and cause stomach ache (Rakotomanana et al. 2020). Finally, mothers in Ethiopia avoided feeding young children flesh foods because they believed children are too young to chew and digest these foods (Mekonnen et al. 2018). Lack of money to purchase nutritious complementary foods was also a challenge in Madagascar (Rakotomanana et al. 2020) and Ghana (Armar-Klemesu et al. 2018).

Overall, quantitative findings from our study indicated that mothers' knowledge of nutritious foods, mothers' social support, and mothers' report of couples' communication frequency and quality were the main factors that generally remained associated with higher child

dietary diversity in various analyses. We found that both parents had similar lower knowledge of nutritious foods to enrich porridge, though mothers had slightly higher knowledge than fathers of nutritious foods for child growth. In many households only one parent reported knowledge of a certain food group, and agreement between couples was low. Based on regression results in our study, we discovered that mothers' knowledge of food groups to enrich porridge was significantly linked to higher child dietary diversity over one day, while mothers' knowledge of food groups for child growth was significantly linked to higher child dietary diversity over one week. In the case of the latter, this finding indicates that mothers' knowledge of nutritious foods that are good for children's growth and development may be linked to children's consumption of some nutritious foods that are a less frequent part of their diet (e.g., consumed weekly but not daily). Similarly, nutrition knowledge was inadequate among women and men in Ethiopia on ways to make porridge more nutritious for children (2 of 5 food groups) (Ambikapathi et al. 2021). Additionally, households' (Hirvonen et al. 2017) and women's (Ambikapathi et al. 2021) nutrition knowledge were also associated with higher child dietary diversity in Ethiopia.

In addition, children in our study consumed significantly more diverse diets both daily and weekly when mothers felt more supported by people in their lives. This determinant had one of the greatest effect sizes compared to several other determinants: Women who experienced higher social support from individuals in their lives fed their children six to 23 months of age 0.26 food groups more each day compared to women who experienced lower social support. It is possible that these women may receive more emotional and practical support from their families and friends, which may enable them to feel more capable of adequately caring for their children. They may also be able to exchange ideas with other individuals in their lives, which may provide them with useful information related to child feeding. Likewise, mothers in Uganda with higher social support scores were more likely to feed their children diverse diets (Ickes et al. 2018). However, in another study conducted in Tanzania, Kaaya et al. (2016) found that perceived social support was not associated with underweight or stunting. This could be because anthropometric measures of nutritional status are more distal outcomes than child diets, and the former are not only a result of feeding practices, but also of other factors such as illnesses.

We also found that measures of women's empowerment or influence over household decisions were linked to better child diets in our study, although the effect size of food groups impacted was small (less than 0.10 food groups more per day or week). Children in our study

consistently consumed more diverse diets both daily and weekly when mothers reported more frequent and higher quality spousal communication over household decisions, but only weekly when mothers were more involved in final decision-making. In the case of the former, these findings suggest that improved communication between partners over household matters may be linked to children's consumption both of nutritious foods that are frequently consumed, and of foods that are less frequently consumed. Additionally, when both parents reported that the household had savings, children consumed almost half a food group more (0.39 food groups) each week compared to when one or neither of the parents reported household savings. We believe these findings suggest that a family environment with improved communication and cooperation between parents over household matters may enable better diets for children.

Findings from our study parallel the literature on this topic. According to a review by Santoso et al. (2019), only ten studies evaluated the role of women's empowerment in complementary feeding outcomes: Many of the 163 associations tested were positively significant (32%), while only a few (5%) were negatively significant (Santoso et al. 2019). Women's empowerment measures on child dietary diversity across the studies identified in that review had an average effect size of 0.04 food groups (Santoso et al. 2019). Thus, both this review and our study suggest that women's empowerment seems to generally have positive, though small, effects on child dietary diversity.

We also found that mothers' self-efficacy over provision of a diverse diet and mothers' independent report of having household savings were also significantly linked to higher child dietary diversity and had relatively large effect sizes (0.21 to 0.33) compared to other determinants, but associations were mostly insignificant after accounting for the effects of other independent variables in the multivariable models. In contrast, Zongrone et al. (2018) found that maternal self-efficacy for complementary feeding mediated and potentiated the effect of an intervention on children's consumption of green leafy vegetables over 24 hours, but did not mediate or potentiate the effect of the intervention on timely introduction of egg at six to eight months of age. Taken together, these findings could suggest that other factors such as women's self-efficacy may influence child diets, but that their effects may be less prominent than or masked by those of other factors after considering multiple determinants within the family food environment beyond demographic characteristics.

Finally, child dietary diversity was not associated with mothers' workload away from home in most models, nor with fathers' knowledge on nutritious foods nor with fathers' personal resources (i.e., self-efficacy over provision of a diverse or a nutritious diet, time use, social support, or having household savings). This could suggest that fathers' nutrition knowledge and personal resources may have a less direct influence on child dietary diversity than mothers' nutrition knowledge and personal resources in this context, perhaps since women are generally responsible for food preparation rural Tanzania. It is possible that fathers may not see the way in which nutrition knowledge translates into children's diets, but that educating fathers on nutrition and on how they can help enable better diets for children through their actions may still have beneficial effects on child diets. These findings could also be linked to the fact that child dietary diversity scores were computed based on surveys conducted with mothers. The null results we found for effects of fathers' nutrition knowledge on child dietary diversity contrast findings from Ethiopia which found that men's nutrition knowledge was significantly positively associated with higher dietary diversity among children (Ambikapathi et al. 2021).

5.3 Methodological considerations

5.3.1 Measurement of knowledge of complementary feeding

As previously described, in our study mothers' knowledge of foods to enrich porridge was linked to children's diets over one day, while mothers' knowledge of nutritious foods for child growth was linked to children's diets over seven days. This finding could inform the choice of which tool(s) to use to assess parental knowledge of complementary feeding depending on whether dietary diversity will be assessed over one day, one week, or both. Mothers' knowledge of ways to enrich porridge could be appropriate to use if a study is measuring improvements in child dietary diversity over 24 hours, but only in contexts where this complementary food is a daily part of children's diets. Mothers' knowledge of nutritious foods for child growth could be appropriate to use if data are being collected on child dietary diversity over 7 days since it may capture foods that are less frequently a part of the diet, and it is less context-specific tool.

5.3.2 Measurement of women's empowerment as indicated by couples' communication and decision-making dynamics

In our study, measures of greater spousal communication frequency and quality over household matters were linked to improved diets among children both daily and weekly, while women's involvement in final decision-making was only linked to children's diets weekly. These findings suggest that improved cooperation and communication between partners may be preferable to consistently achieve better diets for children. It is possible that a woman may have the ability to make and influence household decisions jointly with her partner if partners are in open communication with one another and take each other's opinions seriously, regardless of who the participant reports as making the *final* decision on various topics (perhaps due to cultural norms). Future studies should consider using and validating measures of spousal communication when investigating the role of women's empowerment in household decision-making for child nutrition.

5.3.3 Discrepancies between men and women's reports of couples' communication and decision-making dynamics and effects on children's IYCF practices

Both parents often answered survey questions in different ways for measures of knowledge, personal resources, and couple's relationship dynamics. For those first two categories of measures, low agreement between both parents' reports could be expected since those characteristics are specific to the individual. However, discrepancies between each partner's responses about couple's communication and decision-making dynamics over household matters were less intuitive. For instance, for some couples, the mother reported often communicating with her partner about less than five topics, while the father reported six, seven, or even eight topics. For other couples, the father reported often communicating about fewer topics and the mother reported several more topics. These discrepancies were also observed for the number of decisions women were involved in. Overall, fathers reported frequent spousal communication over more household topics than mothers did (6 vs. 4 out of 8 topics), and involvement of women in decision-making on more household topics than mothers did (3 vs. 2 out of 8 topics).

In addition, fathers' reports of spousal communication frequency and of women's involvement in decision-making over household topics sometimes had a negative effect on

optimal IYCF practices even though mothers' responses to the same questions had a positive effect. In our study, we observed this pattern of opposite directions of effects between men and women's reports in relation to exclusive breastfeeding for spousal communication frequency over household decisions in the multivariable model with food security, and for women's involvement in decision-making in the multivariable model without food security. We also observed this pattern in relation to one-day child dietary diversity for spousal communication frequency among the older sub-group of children. It is possible that participants' responses in our study may have been biased (consciously or subconsciously) by a desire to provide the answer they believed the interviewer would want to hear, or that that each parent perceived the question in a different way. In this paper, since we are interested in women's empowerment, we relied on mothers' reports of couples' relationship dynamics.

Similar to the findings from our study, Ghuman, Lee, and Smith (2006) found that across four of five Asian countries in their study, men's reports of higher women's empowerment were generally associated with higher child mortality, while women's self-report of higher empowerment were generally associated with lower child mortality. They also observed that response categories do not have the same meaning to men and women, and that levels of women's empowerment depended on whether the wife or the husband was the respondent (Ghuman et al. 2006).

5.4 Recommendations for future interventions

We believe there are several opportunities that future interventions should consider to address underlying determinants of exclusive breastfeeding and complementary feeding within the family food environment. These include increasing women's empowerment indicated by greater communication with her partner over household decisions, addressing parental knowledge gaps, reducing women's time burden with work (perhaps with increased help from men on household chores and with access to running water in the home), encouraging greater social support from family and friends, as well addressing underlying challenges of poverty and food insecurity. Together, these strategies may help lactating women stay hydrated, well-nourished, be able to breastfeed their child more often, and produce more breastmilk, which could prevent premature cessation of exclusive breastfeeding due to perceived milk insufficiency. These may also improve complementary feeding practices by promoting greater

nutrition knowledge, cooperation between couples, support between individuals, and ability to afford nutritious foods.

5.4.1 Increasing women's empowerment by promoting greater couples' communication and joint decision-making over household matters

First, interventions should consider encouraging greater communication and joint decision-making between parents over household topics. We found that women's empowerment as indicated by greater communication between couples over household matters and women's involvement in decision-making were linked to improved IYCF practices. Greater communication between parents over household decisions may indicate that both men and women have the empowerment, ability, or agency to make or influence decisions pertaining to their family, finances, and food. A family environment in which both parents' knowledge, experiences, and perspectives are taken into consideration and valued may be more conducive to achieving optimal breastfeeding and complementary feeding practices since parents can bring complementary knowledge and skills. Encouraging greater cooperation and communication between partners may be more beneficial to child nutrition than solely seeking to improve women's decision-making power without considering whether decisions are being made jointly in the context of a healthy relationship with open and high quality communication between partners.

5.4.2 Addressing parental nutrition knowledge gaps

Second, interventions should consider addressing knowledge gaps on breastfeeding support and on nutritious food groups. Knowledge among fathers was considerably lower than among mothers on the importance of hydration for maintaining women's breastmilk production, and future interventions should consider educating fathers on this form of breastfeeding support. Greater awareness among men about this recommendation may enable them to better care for the child's mother by helping women stay hydrated. Additionally, knowledge of nutritious food groups was low among both parents in our quantitative survey, and qualitative findings suggested that attitudes and beliefs about certain foods were challenges to appropriate complementary feeding. Thus, educating both parents on recommended complementary food groups and addressing context-specific misconceptions may still be an opportunity for future

interventions. Programming efforts should also consider engaging men to provide them with more than an understanding of nutrition, but also work with them to show how through their actions they can tangibly enable better nutrition for children, perhaps through food preparation, child feeding, setting aside more money for food, and purchasing nutritious foods.

5.4.3 Promoting more gender-equitable distribution of workloads between parents

Third, interventions should consider promoting more gender-equitable distribution of workloads between parents. In the EFFECTS baseline population, women reported spending more time on domestic and income-generating work activities away from home than men (9 hours/day among women vs. 6 hours/day among men). For the specific activity of fetching water, women reported typically spending nearly 1hr/day on this activity compared to men who reported spending nearly 15min/day. Both qualitative and quantitative data from our study suggested that women's time burden with work seemed to be a challenge to adequate breastfeeding practices. Thus, greater involvement of men in various household domestic chores may lighten women's overall workload and allow her to be able to adequately breastfeed her child, as recommended.

5.4.4 Encouraging greater social support from family and friends

Fourth, developers and implementers of community-based interventions should be cognizant that women's perceived social support from a special person, family, or friends is strongly linked to greater child dietary diversity. It is possible that support from other individuals in a mother's life may allow for exchange of useful information, knowledge, and resources, and may emotionally and tangibly help her feel more capable of caring for her child. Those implementing interventions could consider encouraging participants to reach out to their family, friends, and communities to listen to, talk with, and help them as appropriate. Interventions that include peer groups may also benefit from including interactive activities that allow participants to get to know one another in the hopes that this may encourage them to develop genuine relationships of care and support for each other.

5.4.5 Increasing access to running water and promoting economic development

Fifth, nutrition-sensitive interventions should explore whether cross-sectoral collaborations to increase household access to running water and promote food security may help improve the diets of children. In the EFFECTS trial, only 1% of households had running water; thus, fetching water was a regular and time-consuming chore. One opportunity for future research could be to explore whether increased access to running water in the home may reduce women's time burden fetching water and allow them to have more time to care for and feed their children. Another opportunity for future research could be to explore whether economic development interventions aimed to improve livelihoods, incomes, and consequently food security may help enable women to maintain adequate breastmilk production. However, interventions must be careful to not increase women's already heavy workloads.

5.5 Strengths and limitations of this study

This study has several strengths. To our knowledge, this is the first study to introduce the concept of a child's family food environment. Based on previous literature, we hypothesized several dimensions through which mothers and fathers may shape children's diets, and we provided empirical evidence that characterizes multiple facets of the family food environment within a specific context. Our mixed methods approach also strengthens the quality of this study. We considered how qualitative findings might support, add to, complement, or contradict quantitative findings. Representative quantitative data allowed us to estimate associations between determinants and outcomes on a larger scale, while qualitative data helped infer pathways and potential causal links. We also included detailed qualitative data on parental perceptions of specific foods for children of different ages, which has not been well-characterized in the context of Mara. Another strength of our study is that we engaged fathers. Very few studies to date have engaged fathers, especially in quantitative surveys to determine how they may influence children's diets. Our study includes both qualitative and quantitative data from fathers.

Additionally, we helped fill a gap in the literature by evaluating the relationship between various measures of couples' relationship dynamics and women's empowerment with IYCF practices at varying ages. Specifically, we quantified associations between parental time

allocation and IYCF practices. Despite the existence of qualitative literature which identifies women's workload as a challenge to adequate IYCF practices, there is a lack of studies that quantify associations between parental time allocation and child nutrition outcomes, and our study helps fill this literature gap. We also measured women's empowerment not only as whether she makes decisions over household matters as other studies have done, but also as indicated by communication frequency and quality between couples over household matters.

The main limitation of our study is the cross-sectional design which only allows us to observe associations between determinants and outcomes. Thus, we were unable to draw causal conclusions from the quantitative findings in this study. Another limitation is that some of the versions of tools and measures we used (e.g., couples' communication and decision-making dynamics, time allocation) were adapted or are novel and have not been validated. Additionally, exclusive breastfeeding and child dietary diversity were measured based on mothers' reports of children's diets; thus, our assessment of IYCF outcomes was limited to what mothers knew and remembered that children had been fed. Finally, although the food frequency questionnaire encompassed a wide variety of food items specific to the local context, our assessment of dietary diversity was limited to the foods we queried about in the questionnaire, and it is possible that children may have also consumed other foods.

CHAPTER 6. CONCLUSION AND FUTURE DIRECTIONS

6.1 Key Messages

- Exclusive breastfeeding and complementary feeding were suboptimal in rural Mara, Tanzania.
- Both parents had high knowledge of exclusive breastfeeding, but less knowledge on maintaining breastmilk supply and nutritious complementary foods.
- Perceived lack of breastmilk, food insecurity, and mothers' time spent working outside the home on domestic and income-generating activities were challenges to exclusive breastfeeding, while mothers' report of spousal communication frequency over household matters was associated with greater likelihood of exclusive breastfeeding.
- Affordability of foods and parents' perceptions of foods appropriate for younger infants were challenges to optimal complementary feeding, while mothers' knowledge of nutritious foods, social support, and reports of spousal communication frequency and quality over household matters were associated with more diverse diets.
- Fathers' knowledge of breastfeeding, knowledge of nutritious foods, time spent on work away from home, self-efficacy, social support, and individual report of having household savings were not associated with IYCF practices.

6.2 Summary and Conclusion

In this study, we used a mixed methods approach to characterize how mothers, fathers, and couples jointly shape the family food environment of children under two years of age in rural Mara, Tanzania. We found that rates of exclusive breastfeeding and child dietary diversity were suboptimal due to various challenges, but that women's empowerment, particularly as indicated by improved spousal communication and joint decision-making, was linked to improved IYCF practices.

In focus groups, parents were generally aware of the recommendation to exclusively breastfeed. The main reason parents voiced for introducing complementary foods before six months was perceived breastmilk insufficiency, which some linked to the mother not eating enough. Other challenges included women's workload away from home or concerns about

breastmilk quality of about breastfeeding if the mother or child were ill. Parental attitudes seemed to both facilitate and hinder recommended complementary feeding practices. Both parents described that several nutritious complementary foods should be given because they believed those foods are nutritious, are good for the child's health, provide energy, and promote better growth and development. However, parents avoided feeding younger infants six to eight months certain nutritious foods with bitter taste (e.g., certain vegetables) or with harder consistencies (e.g., meat, certain fruits) due to concerns about those foods causing constipation or being difficult to chew or digest. Several parents voiced that the inability to afford certain foods was a challenge to appropriate complementary feeding.

Quantitative data suggested that knowledge of exclusive breastfeeding was generally high among both parents, but knowledge of ways to maintain breastmilk supply and of nutritious complementary foods was low, especially among fathers. Greater communication between partners on household decisions pertaining to agricultural production and finances was significantly linked to a higher likelihood of exclusive breastfeeding and higher child dietary diversity. However, children were less likely to be exclusively breastfed when their mothers spent more time on domestic and income-generating work away from home. Children consumed more diverse diets when their mothers had higher knowledge of nutritious foods, when their mothers perceived higher social support from their family and friends, and when both parents were aware of household savings. Fathers' reports of these determinants were generally not significantly associated with IYCF practices, although their reports of greater couples' communication and involvement of women in decision-making were sometimes negatively associated with optimal IYCF practices.

Promotion of women's empowerment in the form of better cooperation between partners may benefit children's diets, particularly by improving spousal communication and joint decision-making over household matters so that both parents' perspectives and skills can complement one another, and by lightening women's workloads. In addition, educating parents on adequate complementary feeding and building greater support from families and friends for mothers of young children may also improve adherence to recommended IYCF practices.

6.3 Future Directions

Further research is needed to determine whether the determinants we identified within the family food environment have a causal relationship with the outcomes of breastfeeding and complementary feeding. Specifically, longitudinal studies in the context of randomized control trials could help elucidate whether improved spousal communication and joint decision-making, lighter workloads among women, increased nutrition knowledge, and greater social support from family and friends improve adherence to recommended IYCF practices. In addition, improved context-specific metrics are needed to better capture spousal cooperation, communication, and joint decision-making as it pertains to the family food environment, and researchers should consider validating these tools not only among women, but also among men. Future studies should consider engaging men to encourage improved cooperation, communication, and joint decision-making between partners, to promote involvement of men in domestic tasks to lighten women's workload, and to educate both parents not only on nutrition recommendations, but also on strategies to change infant and young child feeding practices.

REFERENCES

Ahishakiye, Jeanine, Laura Bouwman, Inge D. Brouwer, Eric Matsiko, Margaret Armar-Klemesu, and Maria Koelen. 2019. "Challenges and Responses to Infant and Young Child Feeding in Rural Rwanda: A Qualitative Study." *Journal of Health, Population and Nutrition* 38(1):43. doi: 10.1186/s41043-019-0207-z.

Ambikapathi, Ramya, Simone Passarelli, Isabel Madzorera, Chelsey R. Canavan, Ramadhani A. Noor, Semira Abdelmenan, Dagmawit Tewahido, Amare Worku Tadesse, Lindiwe Sibanda, Simbarashe Sibanda, Bertha Munthali, Tshilidzi Madzivhandila, Yemane Berhane, Wafaie Fawzi, and Nilupa S. Gunaratna. 2021. "Men's Nutrition Knowledge Is Important for Women's and Children's Nutrition in Ethiopia." *Maternal & Child Nutrition* 17(1). doi: 10.1111/mcn.13062.

Armar-Klemesu, Margaret, Sarah Osei-Menya, Sawudatu Zakariah-Akoto, Alison Tumilowicz, James Lee, and Christine Hotz. 2018. "Using Ethnography to Identify Barriers and Facilitators to Optimal Infant and Young Child Feeding in Rural Ghana: Implications for Programs." *Food and Nutrition Bulletin* 39(2):231–45. doi: 10.1177/0379572117742298.

Bayley, Nancy. 2006. *Bayley Scales of Infant and Toddler Development—Third Edition: Administration Manual*. Third. San Antonio, TX: Harcourt Assessment.

Bellows, Alexandra L., Chelsey R. Canavan, Mia M. Blakstad, Dominic Mosha, Ramadhani A. Noor, Patrick Webb, Joyce Kinabo, Honorati Masanja, and Wafaie W. Fawzi. 2020. "The Relationship Between Dietary Diversity Among Women of Reproductive Age and Agricultural Diversity in Rural Tanzania." *Food and Nutrition Bulletin* 41(1):50–60. doi: 10.1177/0379572119892405.

Black, Robert E., Cesar G. Victora, Susan P. Walker, Zulfiqar A. Bhutta, Parul Christian, Mercedes de Onis, Majid Ezzati, Sally Grantham-McGregor, Joanne Katz, Reynaldo Martorell, and Ricardo Uauy. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *The Lancet* 382(9890):427–51. doi: 10.1016/S0140-6736(13)60937-X.

Block, S. A. 2007. "Maternal Nutrition Knowledge versus Schooling as Determinants of Child Micronutrient Status." *Oxford Economic Papers* 59(2):330–53. doi: 10.1093/oep/gpm001.

Burns, Jennifer, Jillian A. Emerson, Kimberly Amundson, Shannon Doocy, Laura E. Caulfield, and Rolf D. W. Klemm. 2016. "A Qualitative Analysis of Barriers and Facilitators to Optimal Breastfeeding and Complementary Feeding Practices in South Kivu, Democratic Republic of Congo." *Food and Nutrition Bulletin* 37(2):119–31. doi: 10.1177/0379572116637947.

Carlson, Gwen J., Katarzyna Kordas, and Laura E. Murray-Kolb. 2015. “Associations between Women’s Autonomy and Child Nutritional Status: A Review of the Literature: Women’s Autonomy and Child Nutrition.” *Maternal & Child Nutrition* 11(4):452–82. doi: 10.1111/mcn.12113.

Chintalapudi, Nainisha, Gloria Hamela, Innocent Mofolo, Suzanne Maman, Mina C. Hosseinipour, Irving F. Hoffman, and Valerie L. Flax. 2018. “Infant and Young Child Feeding Decision Making and Practices: Malawian Mothers’ and Fathers’ Roles in the Context of HIV.” *Journal of Human Lactation* 34(1):68–76. doi: 10.1177/0890334417719245.

Coates, Jennifer, Anne Swindale, and Paula Bilinsky. 2007. “Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide: Version 3: (576842013-001).”

Cooper, Chelsea M., Justine A. Kavle, Joyce Nyoni, Mary Drake, Ruth Lemwayi, Lemmy Mabuga, and Anne Pfitzer. 2019. “Perspectives on Maternal, Infant, and Young Child Nutrition and Family Planning: Considerations for Rollout of Integrated Services in Mara and Kagera, Tanzania.” *Maternal & Child Nutrition* 15(S1). doi: 10.1111/mcn.12735.

Doyle, Kate, Ruti G. Levtov, Gary Barker, Gautam G. Bastian, Jeffrey B. Bingenheimer, Shamsi Kazimbaya, Anicet Nzabonimpa, Julie Pulerwitz, Felix Sayinzoga, Vandana Sharma, and Dominick Shattuck. 2018. “Gender-Transformative Bandebereho Couples’ Intervention to Promote Male Engagement in Reproductive and Maternal Health and Violence Prevention in Rwanda: Findings from a Randomized Controlled Trial” edited by J. P. van Wouwe. *PLOS ONE* 13(4):e0192756. doi: 10.1371/journal.pone.0192756.

Engle, Patrice L. 1997. “The Role of Men in Families: Achieving Gender Equity and Suppor Ting Children.” *Gender & Development* 5(2):31–40. doi: 10.1080/741922351.

FAO, IFAD, UNICEF, WFP and WHO. 2021. *The State of Food Security and Nutrition in the World 2021. Transforming Food Systems for Food Security, Improved Nutrition and Affordable Healthy Diets for All*. Rome, FAO.

Faye, Cheikh Mbacké, Sharon Fonn, and Elizabeth Kimani-Murage. 2019. “Family Influences on Child Nutritional Outcomes in Nairobi’s Informal Settlements.” *Child: Care, Health and Development* 45(4):509–17. doi: 10.1111/cch.12670.

Fox, Elizabeth L., and Arnold Timmer. 2020. “Children’s and Adolescents’ Characteristics and Interactions with the Food System.” *Global Food Security* 27:100419. doi: 10.1016/j.gfs.2020.100419.

Gewa, Constance A., and Joan Chepkemboi. 2016. “Maternal Knowledge, Outcome Expectancies and Normative Beliefs as Determinants of Cessation of Exclusive Breastfeeding: A Cross-Sectional Study in Rural Kenya.” *BMC Public Health* 16(1):243. doi: 10.1186/s12889-016-2907-2.

Ghuman, Sharon J., Helen J. Lee, and Herbert L. Smith. 2006. “Measurement of Women’s Autonomy According to Women and Their Husbands: Results from Five Asian Countries.” *Social Science Research* 35(1):1–28. doi: 10.1016/j.ssresearch.2004.06.001.

Gunaratna, Nilupa S., and EFFECTS Study Investigators. n.d. “Engaging Fathers for Effective Child Nutrition and Development in Tanzania (EFFECTS): Study Protocol for a Five-Arm, Cluster-Randomized Trial.” *Submitted*.

Hirvonen, Kalle, John Hoddinott, Bart Minten, and David Stifel. 2017. “Children’s Diets, Nutrition Knowledge, and Access to Markets.” *World Development* 95:303–15. doi: 10.1016/j.worlddev.2017.02.031.

Ickes, Scott B., Michael Wu, Maia P. Mandel, and Alison C. Roberts. 2018. “Associations between Social Support, Psychological Well-being, Decision Making, Empowerment, Infant and Young Child Feeding, and Nutritional Status in Ugandan Children Ages 0 to 24 Months.” 14(e12483). doi: https://doi.org/10.1111/mcn.12483.

Johnston, Ron, Kelvyn Jones, and David Manley. 2018. “Confounding and Collinearity in Regression Analysis: A Cautionary Tale and an Alternative Procedure, Illustrated by Studies of British Voting Behaviour.” *Quality & Quantity* 52(4):1957–76. doi: 10.1007/s11135-017-0584-6.

Kaaya, Sylvia, Maria E. Garcia, Nan Li, Jeffrey Lienert, William Twayigize, Donna Spiegelman, and Mary C. Smith Fawzi. 2016. “Association of Maternal Depression and Infant Nutritional Status among Women Living with HIV in Tanzania: Maternal Depression and Infant Nutritional Status.” *Maternal & Child Nutrition* 12(3):603–13. doi: 10.1111/mcn.12154.

Lindner, Thomas, Jonas Puck, and Alain Verbeke. 2020. “Misconceptions about Multicollinearity in International Business Research: Identification, Consequences, and Remedies.” *Journal of International Business Studies* 51(3):283–98. doi: 10.1057/s41267-019-00257-1.

Macías, Yvette Fautsch, and Peter Glasauer. 2014. *Guidelines for Assessing Nutrition-Related Knowledge, Attitudes and Practices: KAP Manual*. Rome: FAO.

Mbiro, Kudakwashe A., and Thabo Ndlovu. 2021. “Impact of Women’s Participation on Village Savings and Loan on Children’s Nutritional Diversity in Rural Chimanimani in Zimbabwe.” *Jàmbá Journal of Disaster Risk Studies* 13(1). doi: 10.4102/jamba.v13i1.1043.

Mekonnen, Nakachew, Shifera Asfaw, Abebe Mamo, Yared Mulu, and Netsanet Fentahun. 2018. “Barriers and Facilitators of Child-Feeding Practice in a Small Sample of Individuals from Gozamin District, Northwest of Ethiopia: A Qualitative Study.” *BMC Nutrition* 4(1):25. doi: 10.1186/s40795-018-0233-z.

Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], Tanzania Food and Nutrition Centre (TFNC), National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), and United Nations International Children's Emergency Fund (UNICEF). 2018. *Tanzania National Nutrition Survey Using SMART Methodology (TNNS) 2018*. Dar es Salaam, Tanzania: MoHCDGEC, MoH, TFNC, NBS, OCGS, and UNICEF.

Nakigudde, Janet, Seggane Musisi, Anna Ehnvall, Eija Airaksinen, and Hans Agren. 2009. "Adaptation of the Multidimensional Scale of Perceived Social Support in a Ugandan Setting." 9(1):7.

Nankumbi, Joyce, and Joshua K. Muliira. 2015. "Barriers to Infant and Child-Feeding Practices: A Qualitative Study of Primary Caregivers in Rural Uganda." 33(1):11.

Pan American Health Organization. 2003. *Guiding Principles for Complementary Feeding of the Breastfed Child*. Washington, DC: World Health Organization.

Rakotomanana, Hasina, Deana Hildebrand, Gail E. Gates, David G. Thomas, Fanjaniaina Fawbush, and Barbara J. Stoecker. 2020. "Maternal Knowledge, Attitudes, and Practices of Complementary Feeding and Child Undernutrition in the Vakinankaratra Region of Madagascar: A Mixed-Methods Study." *Current Developments in Nutrition* 4(11):nzaa162. doi: 10.1093/cdn/nzaa162.

Raza, Ahmed, Elizabeth L. Fox, Saul S. Morris, Roland Kupka, Arnold Timmer, Nita Dalmiya, and Jessica Fanzo. 2020. "Conceptual Framework of Food Systems for Children and Adolescents." *Global Food Security* 27:100436. doi: 10.1016/j.gfs.2020.100436.

Santoso, Marianne V., Rachel Bezner Kerr, John Hoddinott, Priya Garigipati, Sophia Olmos, and Sera L. Young. 2019. "Role of Women's Empowerment in Child Nutrition Outcomes: A Systematic Review." *Advances in Nutrition* 10(6):1138–51. doi: 10.1093/advances/nmz056.

Shroff, Monal R., Paula L. Griffiths, Chirayath Suchindran, Balakrishna Nagalla, Shahnaz Vazir, and Margaret E. Bentley. 2011. "Does Maternal Autonomy Influence Feeding Practices and Infant Growth in Rural India?" *Social Science & Medicine* 73(3):447–55. doi: 10.1016/j.socscimed.2011.05.040.

Smith, Lisa C., Usha Ramakrishnan, Aida Ndiaye, Lawrence Haddad, and Reynaldo Martorell. 2003. "The Importance of Women's Status for Child Nutrition in Developing Countries: International Food Policy Research Institute (Ifpri) Research Report Abstract 131." *Food and Nutrition Bulletin* 24(3):287–88. doi: 10.1177/156482650302400309.

Stewart, Robert C., Eric Umar, Barbara Tomenson, and Francis Creed. 2014. "Validation of the Multi-Dimensional Scale of Perceived Social Support (MSPSS) and the Relationship between Social Support, Intimate Partner Violence and Antenatal Depression in Malawi." *BMC Psychiatry* 14(1):180. doi: 10.1186/1471-244X-14-180.

Turner, Christopher, Sofia Kalamatianou, Adam Drewnowski, Bharati Kulkarni, Sanjay Kinra, and Suneetha Kadiyala. 2019. "Food Environment Research in Low- and Middle-Income Countries: A Systematic Scoping Review." *Advances in Nutrition* nmz031. doi: 10.1093/advances/nmz031.

UNICEF. 2003. *Global Strategy for Infant and Young Child Feeding*. Geneva: WHO.

UNICEF. 2019. *The State of the World's Children 2019. Children, Food and Nutrition: Growing Well in a Changing World.* New York: UNICEF.

UNICEF, and GAIN. 2019. *Food Systems for Children and Adolescents*. UNICEF. doi: 10.36072/cp.3.

U.S. Department of Agriculture, and U.S. Department of Health and Human Services. 2020. *Dietary Guidelines for Americans, 2020-2025*. 9th ed.

WHO. 2007. *Indicators for Assessing Infant and Young Child Feeding Practices: Part 1 Definitions. Conclusions of a Consensus Meeting Held 6–8 November 2007 in Washington, DC, US*. Washington D.C, USA: World Health Organization.

WHO, and UNICEF. 2021. *Indicators for Assessing Infant and Young Child Feeding Practices: Definitions and Measurement Methods.* Geneva.

WHO, World Health Organization. 2010. *Indicators for Assessing Infant and Young Child Feeding Practices: Part 2 Measurement*.

WHO, World Health Organization. 2019. "WHO Anthro Survey Analyser: Quick Guide." 79.

Zimet, Gregory D., Nancy W. Dahlem, Sara G. Zimet, and Gordon K. Farley. 1988. "The Multidimensional Scale of Perceived Social Support." *Journal of Personality Assessment* 52(1):30–41. doi: 10.1207/s15327752jpa5201_2.

Zongrone, Amanda A., Purnima Menon, Gretel H. Pelto, Jean-Pierre Habicht, Kathleen M. Rasmussen, Mark A. Constas, Francoise Vermeylen, Adiba Khaled, Kuntal K. Saha, and Rebecca J. Stoltzfus. 2018. "The Pathways from a Behavior Change Communication Intervention to Infant and Young Child Feeding in Bangladesh Are Mediated and Potentiated by Maternal Self-Efficacy." *The Journal of Nutrition* 148(2):259–66. doi: 10.1093/jn/nxx048.

APPENDIX

Table A.1. Interview guide for focus group discussions with pile sorting exercises

Food Attributes Exercise
Mothers and Fathers

[For facilitator: *the objectives of this exercise are to understand (1) perceptions around food availability and access, (2) food preferences and priorities, and (3) food taboos among pregnant women and for children under 2 years of age. Based on a series of questions, participants will sort pictures of various foods sold in nearby markets and commonly grown or foraged in their community as a way of exploring perceptions of food availability and access, preferences, taboos, priorities. Please record which foods are placed in each category, and all comments and opinions made during the discussion. Ensure you audio record the session as well.]*

a. ***Introduction****: Good morning/evening. Thank you all for taking the time to be here today. My name is _____ and I am a Research Assistant for a project led by Project Concern International, Purdue University, and Harvard University. My role is to facilitate this group discussion. My assistant's name is _____ and she/he will be in charge of taking notes and making observations.*

b. ***Explanation****: The purpose of this group discussion is to better understand common perceptions, preferences, and practices around accessing and consuming a variety of foods available at the market and within the community. The information you provide will be very helpful for the EFFECTS project and the project team is very grateful for your time.*

c. ***Instructions****: Now I would like you all to introduce yourselves and share with us how many children you have and the age of your youngest. [Note that they have in common a child younger than 3 years.]*

You will be asked a series of questions, and you will then sort pictures into different categories as per my instructions. You will be asked to answer additional questions that relate to these foods and categories. We want everyone to feel free to say exactly what he or thinks, no matter what this may be. ***[Introduce ground rules].*** *Everything you say here will be kept confidential and anonymous, so no one will ever know what you personally said, only what the overall combined responses are. We will audio record this session but only the researchers will have access to the audio recording and only if the participants give permission to record.*

*[**For Facilitator**: At the end of **Part I** of the exercise, participants will be asked if they have suggestions for further card sorts they would like to do, and if they are willing, they will complete any additional card sorts. For **Part II,** participants will be asked a question to better understand household gender dynamics and how this might affect children's consumption of vegetables and animal-source foods.]*

PART I:

1. **Please sort (make a pile) of foods that are good to give children ages 0-5 months to eat.**
   - *Probe: Which foods are in this category? Why are these foods considered good to give?*
   - *Probe: Some women exclusively breastfeed, while others don't. Is exclusive breastfeeding (no water, foods, other liquids) common in your community? Why or why not?*

2. **Please sort foods that are good to give children ages 6-8 months to eat.**
   a. *Probe: Which foods are in this category? Why are these foods considered good to give?*
   b. *Probe: How are these foods commonly prepared for children age 6-8 months? Ask about consistency (liquid, runny, soft, semi-solid or solid) of the food preparation, ingredients, and how often one might give these foods.*
   c. *Probe: Describe common challenges with accessing, preparing, and feeding these foods to a child 6-8 months of age.*

3. **Please sort foods that should not be given to children ages 6-8 months.**
    a. *Probe: Which foods are in this category? What are the reasons for why these should not be given?*
    b. *Probe: At what age could these foods be given to the child?*
    c. *Probe: Are there ways that one could prepare these foods in a way that would make them suitable for children 6-8 months of age?*

4. **Please sort foods that are acceptable and important for children 9-23 months to eat.**
    a. *Probe: Which foods are in this category? What are the reasons for why these foods are acceptable and important?*
    b. *Probe: Does this change with the seasons?*
    c. *Probe: How are these foods commonly prepared for children age 9-23 months? Ask about consistency (liquid, runny, soft, semi-solid or solid) of the food preparation, ingredients, and how often one might give these foods.*
    d. *Probe: Describe common challenges with accessing, preparing, and feeding these foods to a child 9-23 months of age.*

5. **Please sort foods that young children ages 9-23 months should never eat.**
    a. *Probe: Which foods are in this category? What are the reasons for why these foods should not be given?*

6. **Please sort foods that are acceptable and important for pregnant women to eat.**
    a. *Probe: Which foods are in this category? Why are these foods acceptable and important?*
    b. *Probe: Which foods are not acceptable? Why?*

7. **Please sort foods that are acceptable and important for lactating women to eat.**
    a. *Probe: Which foods are in this category? Why are these foods acceptable and important to eat?*

8. **Please sort foods that lactating women should never eat.**
    a. *Probe: Which foods are in this category? Is there a period after delivery when certain foods are restricted? If so, which foods and for how long?*
    b. *Probe: Ask if beliefs are changing among younger women regarding foods that are good to eat or shouldn't be eaten during pregnancy and lactation. What is the result of the change, if there is a change?*

9. **Please sort foods that are good for sick children 6-23 months to eat.**
    a. *Probe: Which foods are in this category? Why are these foods good to give?*
    b. *Probe: What are some common feeding practices when children are sick?*

10. **Please sort foods that children typically eat when they transition to family foods.**
    a. *Probe: Which foods are in this category? At what age do children start to eat family foods from the family pot?*
    b. *Probe: Some children may eat at neighbors or relatives' households, others might not. How often would you say children aged 12-23 months eat at a neighbors or relative's household? What foods do they typically feed the child?*

11. **Please sort foods that are typically reserved for men to eat.**
    a. *Probe: Tell me why in your community there are foods that are typically reserved only for men.*
    b. *Probe: Some people might agree with this practice, while others might not. What do you think about this practice?*

12. **Please sort foods that are only found at the market and are affordable to eat on a daily basis.**
    a. *Probe: Which foods are in this category? Although these foods are found at the market and are affordable, do families typically buy them and eat them?*
    b. *Probe: Which ones do people in your community buy and eat more often? Tell me why.*

c. *Probe: Which ones do people in your community not buy and not eat very often? Tell me why.*
d. *Probe: Tell me about who typically goes to the market and buys these foods.*
e. *Probe: Tell me about who typically decides what is purchased at the market, and how much money to spend?*

13. Please sort foods that are too expensive for a family to eat on a daily basis.

a. *Probe: Which foods are in this category? Although these foods are found considered expensive, do some families still buy these foods?*
b. *Probe: Which types of families or households might buy these foods more often than other families?*

14. Please sort foods that people commonly grow or produce themselves to feed their families, including dairy products.

Food by food, probe:

a. *During which seasons and what is average scale of production?*
b. *How are these foods stored?*
c. *How many months do these foods last?*
d. *How do households typically prepare these foods for eating?*

15. Please sort foods that are commonly grown but sold and not eaten frequently by families.

a. *Probe: Which foods are in this category? What are some reasons for why these foods are sold and not eaten frequently by families?*
b. *Probe: How might families respond if they were asked to reserve more of these foods for home consumption?*

16. Please sort foods (greens) that are commonly foraged (even if not pictured here)

a. *Probe: Which ones are commonly eaten by children 6-23 months.*
b. *Probe: How are they prepared for children 6-23 months?*
c. *Probe: During which seasons (or when during the year) are these foods usually foraged?*
d. *Probe: What about the ones not commonly eaten by children 6-23 months of age. Explain why they are not fed to children.*

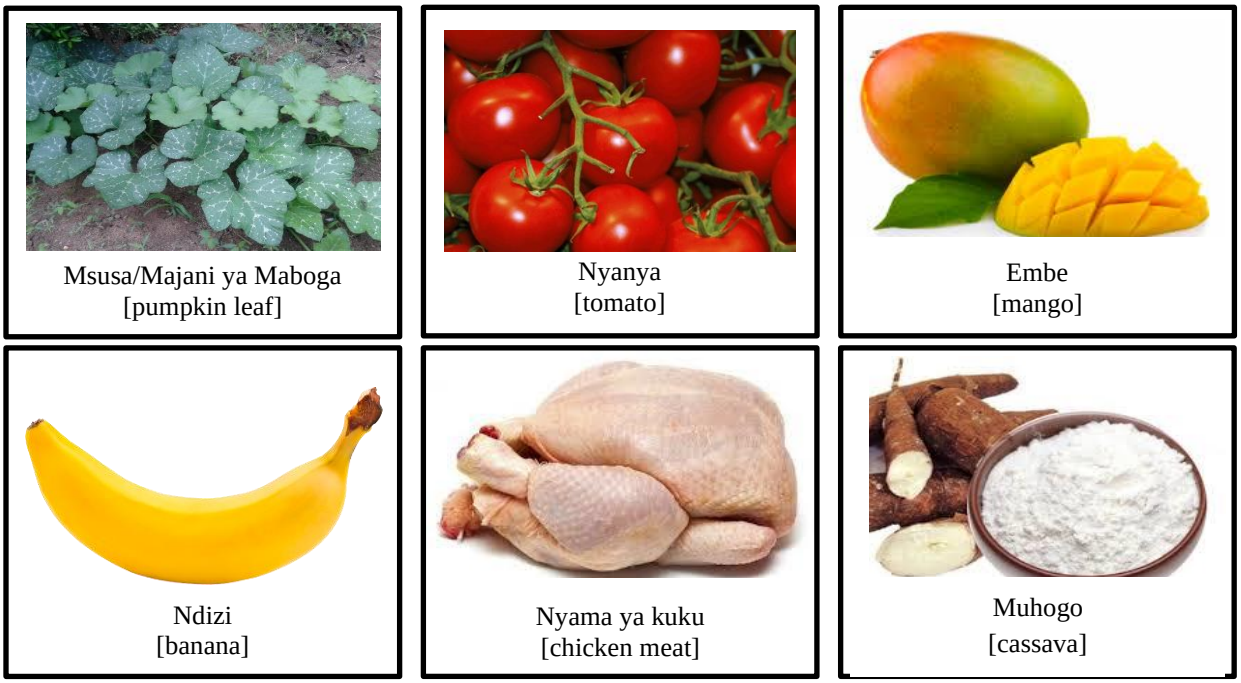
17. Discuss what other foods families and children eat that haven't yet been brought up.

a. *Probe: Where are they sourced?*
b. *Probe: When are they eaten?*
c. *Probe: Who eats them?*
d. *Probe: How are they prepared?*

PART II

Show the participants photos of common staple (for example, rice, wheat, sorghum), a common vegetable, an egg, and a piece of meat. **Ask**: If there were only one serving of meat, and one egg for the day, who in the family should get the serving of meat? Who should receive the egg? What are the reasons? **Note** how many different opinions there are among the group on who should get the animal source foods.

Conclusion*: Ask participants if they have any questions they'd like to ask or comments they'd like to make before concluding the session. Then, thank participants for their time and willingness to participate in this activity.*



Note. The English names of foods are included here for the readers' convenience, although the actual food image cards that participants used only contained the food images and Kiswahili names of foods. From left to right and top to bottom, the figure shows images of pumpkin leaf, tomato, mango, banana, chicken meat, and cassava.

Figure A.1 Examples of food image cards used during the pile sorting exercises in focus group discussions

Table A.2 Codebook used to analyze pile sorting focus group discussions

---

Household demographics: number and description of people living in household.

Respondents

- **Fathers**
- **Mothers**
- **Other**

Group Dynamics

- **Disagreement:** When participants express disagreement about something another participant said.

----------Developmental Stage----------

Child

- **0-6 months**
- **6-8 months**
- **9-23 months**
  - **12-24 months**: Code either 9-23 or 12-24 months. The latter comes up at the end in reference to illness.
- **2 years or older**

Mother

- **Pregnancy**: Pregnant women
- **Lactation**: Mothers who are breastfeeding

----------Foods----------

Food item

Amaranths
Avocados
Banana
Beans
Cabbage
Cassava
Cassava leaves
Cereals
Chicken
Coconut
Cucumber
Egg plant
Eggs
Fish
Flying insects: Termites, locus, or others
- **Flying ants**

Fruits: Other fruits not listed elsewhere
Groundnuts
Guava
Honey
Jute mallow
Kales
Leafy greens: Other leafy greens not listed elsewhere
Lemon or Lime
Lentils
Maize
Mangoes
Meat
Millet
Oil
Okra
Onion
Oranges
Passion
Pawpaw
Pineapples
Porridge
- **Stiff porridge**

Potatoes
- **Sweet potatoes**
- **Irish potatoes**

Pumpkin
Pumpkin leaves
Rice
Sardines
Soil: Geophagia
Sorghum
Soup
Spider plant
Sugar
Sweet potato leaves
Tamarind
Tangerine
Tomato
Ugali
Vegetables: Other vegetables not listed elsewhere
- **Slippery vegetables**
- **Chinese vegetables**

Watermelon
Wheat
Other food item

Beverage

Alcohol

Juice: Any fruit juices or other juices.

Milk

Soda

Tea

Water

Other beverage

Breastmilk

----------Food Perceptions----------

Food Perceptions:

Positive: Foods that are consumed and/or considered appropriate for any reason (organoleptic, economic, satiety, nutritious, convenience, cultural, or other reasons).

Negative: Foods that are avoided for any reason.

----------Reasons----------

Reasons

----------Reasons: Household Domain----------

Desirability: Preferences, acceptability, tastes, desires, attitudes, culture, knowledge and skills

Child organoleptic preference: The child's like or dislike of that food; organoleptic characteristics may or may not be specified (smells, flavors, textures, or feelings)

Family organoleptic preference: Another household member's like or dislike of that food; organoleptic characteristics may or may not be specified (smells, flavors, textures, or feelings)

Meal structure: How people combine foods and/or in what order they are consumed

Consistency: Texture and thickness (thick/thin, soft/hard, etc.)

Satiety: Foods that make the participant feel full

Education:

Knowledge: Accurate or inaccurate knowledge or beliefs about IYCF or WASH practices.

Source: From where/whom does knowledge or advice come from? (Customs, family, health professionals, etc.)

Healthy?: Nutrition knowledge or perceptions about what foods/beverages promote/deter healthy outcomes.

Sick child feeding: Preventive or coping strategies surrounding sick child feeding (specific foods fed or actions taken to prevent child illness or cope with it).

Breastfeeding:

Production determinants: Beliefs about factors affecting breastmilk production (foods eaten, time burden of work, or other factors).

Perceptions: Accurate or inaccurate knowledge or beliefs about breastfeeding.

Challenges: Challenges to breastfeeding (mother is not around the child enough because she is busy with responsibilities; breastmilk dries up; lack of knowledge of what it is or of its importance, etc.)

Practices: Is breastfeeding put into practice? How so (on demand, frequency)? Until what age does breastfeeding occur (exclusive or not exclusive)?

Exclusive breastfeeding: Crosstab this code with breastfeeding perceptions, challenges, and/or practices when specifically referring to exclusive breastfeeding.

Curiosity: Desire for education (nutrition or other training)

Convenience: Relative time and effort of preparing, cooking and consuming food product, time allocation

Meals:

Preparation: Mode of preparation (milling, cooking, boiling, fresh, etc.)

Who cooks: Who prepares the food?

Child feeding:

Who feeds: Who feeds the child?

Family foods: Whether the child eats the same food as the family, and/or at what age that occurs (what food).

How food is served:

Own bowl: Child's food is portioned separately.

Family bowl: Child's food is not portioned separately (they eat from the same pot).

Other way of serving food: For example, child eats off the mother's plate or shares a bowl with other siblings.

Other meal location: When there is mention of the child eating at neighbor's or relative's house.

Quantity: Amount fed to the child.

Frequency: Number of meals per day

Responsive feeding: Caregiver (parent or other) responds to child hunger or satiety cues (such as the child crying)

Meal customs: Who eats first? Who is given the preference to consume a food item if limited availability?

Initiation of complementary feeding: Beliefs and practices about initiation of complementary feeding. When? What is fed?

Time use: Caregiver's (mother or other's) time spent with other responsibilities as it impacts food allocation to the child (the mother is away working so the child goes to the neighbor's).

Time of day: Time of meals or relevant activities completed as it impacts child feeding.

Morning

Afternoon

Evening

Affordability: Purchasing power

Expensive: How expensive (not affordable) the product is to the individual.

Cheap: How cheap (affordable) the product is to the individual.

Income generation:

Comparative: Perceptions about how others' livelihoods or income generating activities affect food security, purchase power, and people's diets ("The civil servants can buy that food because they are employed").

Own income generating activities: Household's income generating activities or livelihoods in relation to food security or diet.

Who provides money: Who provides money/resources?

Food insecurity: Mention of meals skipped or concern about not having enough food.

Coping strategies: Affordability strategies (substitution expenditure, buying one item instead of the desired due to economic constraints)

Support network: Mention of a support network (family or friends) that helps them when in need

Accessibility: Physical distance, time, space and place, individual activity spaces, daily mobility, mode of transport

Water access: Convenience of accessing water (for consumption and other uses).

Procure: Where do food items come from?

Own production: Foods produced in their garden or farm for own consumption

Cash crop: Crops produced for sale

Gathering: Foods gathered

Market: Foods purchased

Purchaser: Who buys products (especially food)?

Which market

Gifting or Loans:

Informal: Money or food received as a gift or borrowed from family or friends.

Formal: Community services such as food aid or microfinancing loans to improve purchasing power of food.

----------Reasons: External Domain----------

Norms: Social and cultural norms (the father or father-in-law are fed a specific food first out of respect)

Roles: Roles of each family member/caregiver, especially as it impacts child feeding.

Caregivers: Mention of other caregivers such as siblings or grandparents.

Gender norms: Perceptions of men and women's roles in child-caring or of what should be consumed by each

Decision-making: Decision-making dynamics. Who (father, mother, sibling, other)? How?

Who decides what to purchase?

Communication: Communication styles between anyone.

Marital: Relationship communication between husband and wife

Special occasions: Holidays, visitors, and other reasons

Religion: Mention of religion or a religious group (~~e.g.:~~ how it impacts their actions or situation)

Gratitude: Mention of gratitude (being thankful)

Availability: Presence of a food vendor or product

Availability: Presence or absence of a food item in that region

Water availability: What water is available? Are purification mechanisms used?

Seasonality: Presence or absence of a food item changes by season

Food storage: Mode of storage and/or amount of time stored

Prices: Monetary value of food products (When a specific price number is mentioned)

Vendor & Product Properties: Vendor properties (typology, opening hours, services) and product properties (food quality, composition, safety, level of processing, shelf-life, packaging)

Food safety concerns: Concerns about soil, chemicals, or food preparation.

WASH practices or beliefs: Water, sanitation, and hygiene practices or beliefs about food and water safety and household hygiene (such as washing dirty vegetables, handwashing, cleanliness of household).

Marketing & Regulation: Promotional information, branding, advertising, sponsorship, labelling, policies

Table A.3 Demographic characteristics of mothers and fathers who participated in the focus group discussions that included pile sorting exercises

Characteristics		Mother (31 participants; 4 focus groups; 33 young children)	Father (30 participants; 4 focus groups; 30 young children)
Number of participants per focus group (average number of people)		7.75	7.50
Participant Characteristics			
Participant's age in years (median, IQR)		30 (24, 35)	32 (29, 41)
Education (%)	Did not attend	3%	0%
	Some primary	6%	0%
	Completed primary	71%	90%
	Some secondary to completed secondary	19%	10%
Occupation (%)	Farmer	97%	93%
	Mechanic	0%	3%
	Mason	0%	3%
	Small business	3%	0%
Household Characteristics			
Monthly income in Tanzanian shillings (median, IQR)		25,000 (10,000 , 32,500)	20,000 (10,000, 41,250)
Distance to market in minutes (median, IQR)		60 (25, 120)	30 (15, 75)
Land size in acres (median, IQR)		2.3 (1.0, 3.1)	2.8 (1.5, 4.3)
Child Characteristics			
Child's gender (% female)		55%	63%
Child's age in months (median, IQR)		17 (9, 30)	18 (11, 24)

Table A.4 Mothers' and fathers' perceptions of food items they considered appropriate or inappropriate to feed children of varying ages

Food Groups	Perceptions	6-8 months		9-23 months	
		Mother	Father	Mother	Father
1. Flesh foods	**Positive**	Fish (2)	Fish (3)	Fish (4)	Fish (3) Meat (3) Chicken (2)
	Negative	Meat (3)	Meat (2)		
2. Dairy	**Positive**	Milk (2)	Milk (3)		
	Negative	Milk (2)			
3. Eggs	**Positive**		Eggs (2)		
	Negative				
4. Legumes & nuts	**Positive**	Groundnuts (3) Beans (2)	Groundnuts (2) Beans (2)	Groundnuts (3) Beans (3)	Groundnuts (2) Beans (2)
	Negative	Groundnuts (2)			
5. Grains, roots, & tubers	**Positive**	Rice (3) Millet (3) Irish potatoes (2) and Potatoes (2) Sorghum (2)	Rice (3) Millet (2) Irish potatoes (2)	Rice (4) Maize (3) Cassava (3) Sorghum (2) Millet (2) Irish potatoes (2) and Potatoes (2)	Rice (2) Maize (3) Cassava (2) Sorghum (3) Millet (2) Irish potatoes (2)
	Negative	Maize (3) Cassava (2) Sorghum (2)	Millet (2)	Maize (2)	
6. Vitamin A-rich fruits and vegetables	**Positive**	Amaranths (2) Mangoes (2) Pawpaw/papaya (2)	Amaranths (3) Mangoes (2) Pawpaw/papaya (2)	Amaranths (3) Mangoes (2) Pawpaw/papaya (2)	Amaranths (2) Mangoes (2) Pawpaw/papaya (2) Sweet potatoes (2)
	Negative	Cassava leaves (2)			
7. Other fruits and vegetables	**Positive**	Banana (3) Fruits (2) Oranges (2) Watermelon (2)	Banana (2) Fruits (2)	Banana (4) Pineapple (2) Passion fruit (2)	Banana (2) Pineapple (2)
	Negative	Guava (3) Tamarind (2)			
Juice & sugar-sweetened beverages	**Positive**			Sugar (2)	Sugar (2) Juice (2)
	Negative		Soda (4) Juice (2)		
Mixed dishes	**Positive**	Soft porridge (3) Stiff porridge (2)	Soft porridge (3)	Stiff porridge (4) Soft porridge (3) Soup (2)	Stiff porridge (3) Soft porridge (2)
	Negative	Stiff porridge (3) Soft porridge (2)			

Note. Positive (in blue) food perceptions indicate foods parents consider appropriate to feed infants and young children, while negative (in orange) food perceptions indicate foods parents consider inappropriate to infants and young children. Only foods mentioned in two or more focus groups with mothers or in two or more focus groups with fathers are presented in this table. Numbers in parentheses indicate the number of focus groups in which a food item was identified appropriate or inappropriate for children of a certain age group.

Table A.5 Associations between parental predictors and dietary diversity among children 6-23 months of age

Independent Variables		Reported by	Dietary diversity out of 7 food groups among children 6-23 months of age (n = 764)							
			1-Day Univariable Adjusted		1-Day Multivariable		7-Day Univariable Adjusted		7-Day Multivariable	
			Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*
Nutrition knowledge of 7 food groups	Knowledge of ways to make porridge more nutritious	Mothers	0.10 (0.003, 0.19)	**0.04**	0.08 (-0.02, 0.18)	0.14	0.05 (-0.06, 0.16)	0.37	0.001 (-0.12, 0.12)	0.99
		Fathers	-0.002 (-0.10, 0.09)	0.97	0.06 (-0.05, 0.17)	0.27	0.03 (-0.08, 0.14)	0.58	0.06 (-0.07, 0.18)	0.40
	Knowledge of foods that a child should eat for good growth and development	Mothers	0.03 (-0.03, 0.10)	0.33	0.005 (-0.07, 0.08)	0.89	0.14 (0.07, 0.21)	**<0.001**	0.11 (0.03, 0.19)	**0.01**
		Fathers	-0.02 (-0.09, 0.04)	0.46	-0.07 (-0.14, 0.01)	0.07	0.02 (-0.06, 0.09)	0.67	-0.02 (-0.11, 0.06)	0.58
Self-efficacy about nutrition	Confidence in own ability to provide child with a diverse diet (% agree or strongly agree)	Mothers	0.23 (0.04, 0.41)	**0.02**	0.13 (-0.06, 0.32)	0.17	0.19 (-0.02, 0.41)	0.08	0.15 (-0.07, 0.37)	0.18
		Fathers	-0.05 (-0.24, 0.13)	0.59	-0.06 (-0.24, 0.13)	0.54	-0.02 (-0.23, 0.20)	0.86	-0.04 (-0.25, 0.18)	0.75
	... with a nutritious diet (% agree or strongly agree)	Mothers	0.16 (-0.03, 0.35)	0.10	-	-	0.08 (-0.15, 0.31)	0.49	-	-
		Fathers	0.03 (-0.15, 0.22)	0.71	-	-	0.01 (-0.20, 0.23)	0.92	-	-
Time use	Time spent on work away from home (typical number of hours / day)	Mothers	0.01 (-0.01, 0.03)	0.21	0.02 (-0.002, 0.04)	0.08	0.02 (-0.001, 0.05)	0.07	0.03 (0.004, 0.05)	**0.03**
		Fathers	0.01 (-0.01, 0.03)	0.48	0.01 (-0.02, 0.03)	0.66	0.004 (-0.02, 0.03)	0.77	-0.002 (-0.03, 0.03)	0.90
Social support	High overall social support (% with average score of 4-5 on a scale of 1-5)	Mothers	0.35 (0.17, 0.52)	**<0.001**	0.26 (0.08, 0.44)	**0.004**	0.39 (0.19, 0.60)	**<0.001**	0.28 (0.07, 0.49)	**0.01**
		Fathers	0.05 (-0.14, 0.24)	0.62	0.06 (-0.13, 0.25)	0.51	-0.17 (-0.40, 0.05)	0.14	-0.13 (-0.36, 0.09)	0.24
Household savings	Household currently has savings (%)	Mothers	0.23 (0.05, 0.42)	**0.01**	0.11 (-0.07, 0.30)	0.24	0.33 (0.11, 0.54)	**0.003**	0.21 (-0.01, 0.43)	0.06
		Fathers	0.12 (-0.07, 0.32)	0.23	0.06 (-0.13, 0.26)	0.51	0.10 (-0.12, 0.33)	0.37	0.07 (-0.16, 0.29)	0.57
		Couples	0.21 (-0.03, 0.46)	0.09	-	-	0.36 (0.08, 0.65)	**0.01**	-	-

Table A.5 Associations between parental predictors and dietary diversity among children 6-23 months of age (continued)

Independent Variables		Reports from	Dietary diversity out of 7 food groups among children 6-23 months of age (n = 764)							
			1-Day Univariable Adjusted		1-Day Multivariable		7-Day Univariable Adjusted		7-Day Multivariable	
			Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*
Couples' communication frequency	Number of topics out of 8 often communicated about with their partner	Mothers	0.07 (0.04, 0.11)	**<0.001**	0.06 (0.03, 0.10)	**<0.001**	0.07 (0.03, 0.11)	**0.001**	0.06 (0.02, 0.10)	**0.01**
		Fathers	-0.03 (-0.07, 0.01)	0.12	-0.02 (-0.06, 0.02)	0.31	-0.03 (-0.07, 0.02)	0.26	-0.02 (-0.06, 0.03)	0.47
Couples' communication quality	Number of topics out of 8 in which mothers felt their opinions were often taken seriously when discussing the topic	Mothers	0.05 (0.02, 0.09)	**<0.001**	-	-	0.07 (0.03, 0.10)	**<0.001**	-	-
Women's involvement in decision-making	Number of topics out of 8 in which the mother makes final decisions independently or jointly with her partner	Mothers	0.02 (-0.02, 0.06)	0.38	0.02 (-0.03, 0.06)	0.46	0.09 (0.04, 0.14)	**<0.001**	0.08 (0.02, 0.13)	**0.004**
		Fathers	-0.04 (-0.07, -0.004)	**0.03**	-0.02 (-0.05, 0.01)	0.16	-0.01 (-0.05, 0.03)	0.57	0.004 (-0.03, 0.04)	0.84

Note. Coefficients indicate the number of food groups. Results are from mixed-effects linear regressions. Univariable adjusted analyses included study design characteristics, demographic covariates, and each independent variable of interest in a separate model. Multivariable adjusted analyses included study design characteristics, demographic covariates, and multiple independent variables of interest in one model. All models accounted for the study design characteristics of clustering at the village level as a random effect and of district as a fixed effect. Demographic covariates included age of child in months (rounded to one decimal), sex of child, education of both parents, age of both parents, marital relationship (monogamous / polygamous), survey group (delayed / on time data collection), household wealth index, household size (number of people residing within household), a missing indicator for household size, breastfeeding in the previous day (yes / no), and distance to market (less than 30 minutes / more than 30 minutes to get to the market).

Table A.6 Associations between parental predictors and exclusive breastfeeding and dietary diversity in multivariable models including household food security

Independent Variables		Report of	Exclusive breastfeeding among children < 6 months (n=189)		Dietary diversity out of 7 food groups among children 9-23 months (n= 597)				Dietary diversity among children 6-23 months (n= 764)			
					1-Day		7-Day		1-Day		7-Day	
			Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*
Nutrition knowledge of breastfeeding	Knowledge of exclusive breastfeeding (score of 0-3)	Mothers	1.09 (0.43, 2.76)	0.85	-	-	-	-	-	-	-	-
		Fathers	0.58 (0.33, 1.01)	0.055	-	-	-	-	-	-	-	-
	Knowledge of how to maintain breastmilk (score of 0-4)	Mothers	1.24 (0.69, 2.22)	0.47	-	-	-	-	-	-	-	-
		Fathers	1.8 (0.85, 3.8)	0.12	-	-	-	-	-	-	-	-
Nutrition knowledge of 7 food groups	Knowledge of ways to make porridge more nutritious	Mothers	-	-	0.13 (0.02, 0.24)	**0.02**	0.06 (-0.06, 0.18)	0.32	0.08 (-0.03, 0.18)	0.14	0.001 (-0.12, 0.12)	0.98
		Fathers	-	-	0.08 (-0.03, 0.20)	0.17	0.10 (-0.02, 0.22)	0.11	0.06 (-0.05, 0.17)	0.30	0.06 (-0.07, 0.18)	0.38
	Knowledge of foods that a child should eat for good growth and development	Mothers	-	-	-0.03 (-0.10, 0.04)	0.41	0.10 (0.02, 0.18)	**0.02**	0.01 (-0.06, 0.08)	0.79	0.11 (0.03, 0.19)	**0.01**
		Fathers	-	-	-0.05 (-0.13, 0.02)	0.17	-0.02 (-0.10, 0.06)	0.64	-0.07 (-0.14, 0.01)	0.07	-0.02 (-0.11, 0.06)	0.59
Self-efficacy about nutrition	Confidence in ability to offer child a diverse diet (% agree or strongly agree)	Mothers	-	-	0.14 (-0.05, 0.34)	0.15	0.14 (-0.07, 0.36)	0.18	0.12 (-0.07, 0.31)	0.22	0.13 (-0.09, 0.36)	0.24
		Fathers	-	-	0.0002 (-0.19, 0.19)	1.00	0.03 (-0.18, 0.24)	0.77	-0.05 (-0.24, 0.13)	0.59	-0.04 (-0.25, 0.18)	0.74
Time use	Time spent on work away from home (typical number of hours/day)	Mothers	0.87 (0.77, 0.99)	**0.04**	0.01 (-0.01, 0.03)	0.30	0.02 (-0.01, 0.04)	0.15	0.02 (-0.003, 0.04)	0.09	0.03 (0.004, 0.06)	**0.02**
		Fathers	1.02 (0.9, 1.15)	0.80	0.01 (-0.02, 0.03)	0.50	-0.01 (-0.03, 0.02)	0.59	0.01 (-0.02, 0.03)	0.63	-0.002 (-0.03, 0.03)	0.89

Table A.6 Associations between parental predictors and exclusive breastfeeding and dietary diversity in multivariable models including household food security (continued)

Independent Variables		Report of	Exclusive breastfeeding among children < 6 months (n=189)		Dietary diversity out of 7 food groups among children 9-23 months (n= 597)				Dietary diversity among children 6-23 months (n= 764)			
					1-Day		7-Day		1-Day		7-Day	
			Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*
Social support	High overall social support (% with average score of 4-5 on a scale of 1-5)	Mothers	1.27 (0.53, 3.00)	0.59	0.18 (-0.01, 0.37)	0.06	0.18 (-0.02, 0.39)	0.07	0.27 (0.09, 0.45)	**0.003**	0.27 (0.06, 0.48)	**0.01**
		Fathers	0.95 (0.40, 2.3)	0.92	0.01 (-0.19, 0.21)	0.91	-0.16 (-0.37, 0.06)	0.15	0.07 (-0.12, 0.26)	0.50	-0.13 (-0.35, 0.09)	0.25
Household savings	Household currently has savings (%)	Mothers	1.15 (0.46, 2.91)	0.76	0.11 (-0.08, 0.31)	0.26	0.17 (-0.04, 0.38)	0.12	0.11 (-0.08, 0.29)	0.27	0.2 (-0.02, 0.42)	0.07
		Fathers	0.48 (0.19, 1.20)	0.12	0.11 (-0.09, 0.30)	0.29	0.06 (-0.16, 0.27)	0.61	0.06 (-0.13, 0.25)	0.53	0.06 (-0.16, 0.28)	0.59
Couples' communication frequency	Number of topics out of 8 often communicated about with partner	Mothers	1.22 (1.02, 1.47)	**0.03**	0.06 (0.02, 0.09)	**0.002**	0.04 (0.01, 0.08)	**0.02**	0.06 (0.02, 0.09)	**0.001**	0.06 (0.01, 0.10)	**0.007**
		Fathers	0.82 (0.67, 1.00)	**0.05**	-0.04 (-0.08, 0.002)	**0.06**	-0.03 (-0.08, 0.01)	0.13	-0.02 (-0.06, 0.02)	0.32	-0.02 (-0.06, 0.03)	0.47
Women's involvement in decision-making	Number of topics out of 8 in which the mother makes final decisions independently or jointly with her partner	Mothers	1.18 (0.98, 1.42)	0.09	-0.002 (-0.05, 0.04)	0.94	0.04 (-0.01, 0.09)	0.10	0.02 (-0.03, 0.06)	0.46	0.07 (0.02, 0.12)	**0.005**
		Fathers	0.78 (0.66, 0.92)	**0.003**	-0.01 (-0.05, 0.02)	0.46	0.01 (-0.03, 0.04)	0.76	-0.02 (-0.05, 0.01)	0.17	0.003 (-0.03, 0.04)	0.86

Note. Coefficients: number of food groups. These multivariable adjusted mixed-effects linear regressions included study design characteristics, demographic covariates, and multiple independent variables of interest in one model. All models accounted for clustering at the village level as a random effect, district as a fixed effect, age of child in months (rounded to one decimal), sex of child, education of both parents, age of both parents, marital relationship (monogamous / polygamous), survey group (delayed / on time data collection), household wealth index, household size (number of people residing within household), a missing indicator for household size, and household food security status. Covariates for dietary diversity also included breastfeeding in the previous day (yes / no) and distance to market (less than 30 minutes / more than 30 minutes to get to the market).