



Application of the Capabilities, Opportunities, Motivations, and Behavior (COM-B) Change Model to Formative Research for Child Nutrition in Western Kenya

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ABSTRACT

Background: Interventions aimed at improving dietary intake and feeding practices have alone proven insufficient for combatting stunting resulting from poor nutrition and repeated infections.

Objectives: To support the development of an integrated water, sanitation, and hygiene (WASH) and nutrition, social, and behavior change strategy aimed at reducing stunting, formative research was conducted in 2 program sites in western Kenya.

Methods: Twenty-nine key informant interviews were conducted with community leaders, health workers, and project staff, and 24 focus group discussions with caregivers of children under 2 y on topics related to feeding, sanitation, and hygiene behaviors. Three frameworks informed the study design and analysis of our formative research: the Capabilities, Opportunities, and Motivations model for behavior change, which identifies what needs to change in order for behavior change interventions to be effective; the Grandmother Project's Change Through Culture Approach, which values the important role of influential household and community members in producing household health; and Starr and Fornoff's approach to Theory of Change development.

Results: Caregivers exhibited sufficient psychological capabilities (knowledge and skills) for many of the key maternal and infant nutrition behaviors. However, reflective motivation to perform optimal behaviors was undermined by limitations in physical and social opportunities, including limited time and competing priorities for mothers, limited accessibility and availability of diverse foods, low self-efficacy for exclusive breastfeeding, and fears of negative consequences related to specific foods and recommended practices.

Conclusions: Interventions that aim to improve maternal and child diets should address the underlying social, cultural, and environmental determinants that contribute to motivations and opportunities to perform recommended practices. *Curr Dev Nutr* 2022;6:nzac104.

Keywords: infant and young child feeding, qualitative research, mixed methods, care group model, exclusive breastfeeding, dietary diversity

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Abbreviations used: COM-B, capabilities, opportunities, motivations, and behavior; CRS, Catholic Relief Services; CTC, Grandmother Project's Change Through Culture; EBF, exclusive breastfeeding; FGD, focus group discussion; IYCF, infant and young child feeding; KII, key informant interview; PLW, pregnant lactating woman; SBCC, social and behavior change communication; WASH, water, sanitation, hygiene.

Introduction

In 2015, global leaders pledged to reduce chronic malnutrition in children under 5 y by 40% before 2025 (1). While many regions achieved at least a 50% decline from 1990 to 2015, declines in eastern and southern Africa were much lower at 28% (2, 3). In Kenya, 26% of children under 5 y were stunted (height-for-age z score < -2 SDs) in 2014 (4) and the country's current target is to reduce stunting to 14.7% by 2030

(5). Child stunting results from chronic undernutrition, repeated infection, and chronic inflammation, or a combination of these factors (6, 7). In Kenya, as in many low- and middle-income contexts, multiple factors contribute to suboptimal nutrition and repeated infection in early childhood. These include wider social and structural determinants such as household food insecurity, the status of women, insufficient access to clean water, and limited health, sanitation, and hygiene infrastructure, as well as more immediate determinants related to beliefs about how

and what foods infants and young children should be fed, demands on caregivers' time, and knowledge about preparation of foods for young children (8–10). Further, while trust in the formal health sector is high, families will often turn to trusted neighbors and grandmothers/mothers-in-law for infant feeding advice. Indeed, research in Kenya, Senegal, Sierra Leone, Malawi, and Nepal notes that grandmothers are a significant, and often first source, of infant feeding advice and influence for families (8, 11–16).

Despite the importance of optimal diet practices for adequate nutrition and stunting prevention, interventions like social and behavior change communication (SBCC), aimed at improving dietary intakes and feeding practices alone, have proven insufficient (17). Researchers highlight several factors underlying the limited effectiveness of nutrition programs to change behaviors. First, the theoretical foundations of nutrition behavior change interventions are rarely described; it is often unclear in many instances whether programs are informed by behavior change theories (18–20). Second, the evidence base and pathways explaining how the activities included in the intervention are expected to change behavior and ultimately reduce child stunting (i.e., the program's theory of change) are poorly articulated (18, 20–22). While practitioners increasingly conduct and use formative research to provide insight into context and program audiences, it is often limited to identifying barriers and facilitators to practice without elucidation of the motivations underlying decision making about practices (18, 23). As nutrition interventions move towards greater integration with other sectors like water, sanitation, and hygiene (WASH) and agriculture, formative research methods, including approaches to operationalize multisectoral SBCC strategies, can and should be used to further define the context for appropriate and effective implementation (9, 24–26).

This research was embedded within THRIVE II, a community-based nutrition and child development program in western Kenya led by Catholic Relief Services (CRS). In 2017, CRS undertook efforts to integrate WASH and maternal and child nutrition social and behavior change strategies into THRIVE II. To support the work of CRS on WASH and maternal and child nutrition, our team conducted formative research in 2 of their program areas in western Kenya. We sought to understand what determinants influence caregivers' practices related to WASH and maternal and child nutrition. Our guiding theoretical framework was the capabilities, opportunities, motivations, and behavior (COM-B) framework, which identifies 3 behavioral domains necessary to practice a specific behavior (27, 28). In addition to the COM-B framework, we drew from the Grandmother Project's Change Through Culture (CTC) approach (13, 29, 30). This approach values and seeks to understand how immediate and extended family members and other community members, especially elder women, positively influence maternal and child health and ways to engage them in creating change. We also drew on Starr and Fornoff's approach to the Theory of Change development to enable a systematic approach to our process (31). These 3 frameworks were used to inform the study design and analysis of our formative research.

Here we present the approach and findings of formative research as they relate to the nutrition and dietary behaviors of mothers and children. We refer readers to previous papers by our group discussing the findings related to WASH behaviors (32, 33), the full description of how the formative research was applied to the intervention design (26), and the results from the intervention evaluation (34).

Methods

Overview

We used a cross-sectional, rapid ethnographic design to understand community perspectives and the capability, opportunity, and motivation of maternal and child nutrition behaviors. To meet our aims, we used multiple methods of data collection, including focus group discussions (FGDs) with mothers, husbands, and elder women; key informant interviews (KIIs) with community stakeholders; market surveys; and household observations.

Study site

We purposively selected 3 communities in each of 2 counties (Homa Bay and Migori) where CRS had active programming to maximize variability in agro-ecological zones, distance to the nearest health facility, and distance to the nearest urban center. Communities were characterized by poverty, severe food insecurity, and a high prevalence of HIV/AIDS. With support from the implementing partners (4), we recruited participants based on their involvement in THRIVE II within selected communities for specific research activities.

Data collection

Following a 2-wk training, data were collected by 8 trained data collectors from October to December 2016. Guides were piloted and refined based on data collectors' experiences and feedback from piloting. **Table 1** describes the methods used, the target populations engaged, the number of participants, and the specific objectives of each activity. The CTC approach influenced our decision to include those outside of the mother/child dyad (e.g., grandmothers, fathers, influential community members) in our study and informed interview and discussion topics related to the influence of household and community members in maternal and child health, including roles, responsibilities, and decision making, as well as age and gender hierarchies related to these. Across study sites, we conducted 24 FGDs with mothers ($n = 12$), fathers ($n = 6$), and grandmothers ($n = 6$) of children under 2 y. Mothers, fathers, and grandmothers who participated in the FGDs were not always from shared households. We conducted 29 KIIs with community health extension workers, community health volunteers, CRS program staff, community leaders, and religious leaders. Although not elaborated on in this paper, we conducted household observations focused on WASH, food hygiene, children's play spaces, and infant feeding practices, as well as market surveys to assess local food prices and triangulate food availability/accessibility information with participant reports. The background and demographic characteristics of participants are presented in **Supplemental Table 1**.

Data management and analysis

All FGDs and KIIs were transcribed verbatim in Luo, translated into English, anonymized, and uploaded to MAXQDA (version 12, VERBI GmbH) for coding. The Emory University research team was responsible for the security of the data. All transcripts and data files were password protected.

Debrief sessions using a barrier analysis strategy adapted from the Designing for Behavior Change approach (35) followed each day of data collection. During debriefs, researchers identified emergent, common, and unique barriers, facilitators, and motivators related to WASH

TABLE 1 Activities completed and participants included during WASH and IYCF research in Migori and Homa Bay Counties, October–December 2016¹

Method and population	No. of activities	Participants, <i>n</i>	Activity objectives
Focus group discussions			
Pregnant and mother of CU2-WASH	6	34	To capture details about a typical day in the life of mothers; handwashing practices for mothers and CU2; latrine use; child feces disposal practices and norms; child play environments
Pregnant and mother of CU2-feeding	6	34	To capture perceptions about food availability, affordability, and the acceptability of food for pregnant and lactating women and for children under 2
Elder women	6	36	To understand the roles and responsibilities of grandmothers to their families, daughters, daughter-in-law, and grandchildren; to understand the beliefs about IYCF and household sanitation practices
Fathers	6	36	To understand the roles and responsibilities of fathers to their families, wives, children, and parents; to understand the beliefs about IYCF and household sanitation practices
Key informant interviews			
Community health extension workers	5	5	To understand the determinants to community IYCF and WASH behaviors, the roles and responsibilities that interviewees had in relation to encouraging optimal behaviors, and to elicit recommendations for programming based on their experiences working in the community
CRS/partner staff	7	7	
Religious leaders	6	6	
Community leaders	5	5	
Community health volunteers	6	6	
Household observations			
Caregiver of CU2	24	12	To observe behaviors related to meal preparation, feeding, hygiene, sanitation, water collection, and handwashing; research assistants also conducted spot checks of sanitation hardware and environmental sanitation in the compound
Market surveys			
Sellers	4	4	To develop food lists to be used in FGDs and to triangulate perceptions of food availability and affordability reported during FGDs; to identify which foods were common across study sites and which were unique to specific sites during the season that data were collected; created based on the most commonly available foods observed in the markets
Total	81	288	—

¹CRS, Catholic Relief Services; CU2, child under 2; FGD, focus group discussion; IYCF, infant and young child feeding; WASH, water, sanitation, and hygiene.

and nutrition behaviors. Detailed field notes incorporating information from debriefs were drafted in English by research assistants. From these detailed notes, we created a preliminary codebook that included the common determinants to behaviors, including those aligned with the behavioral determinants identified in the COM-B framework.

The COM-B framework identifies 3 essential domains needed for any behavior to occur: capability, opportunity, and motivation. The COM-B framework defines capability as having the necessary physical ability, stamina, skills (physical capability), or knowledge (psychological capability) to engage in the activities involved in performing a behavior (28). The opportunity domain in the COM-B framework includes those factors that lie outside the individual and that influences one's ability to perform a behavior. This can mean the physical opportunity related

to resources, environment, and time, as well as social opportunity related to social structures, norms, interpersonal influences, and social cues. Since Michie et al.'s approach to the social opportunity domain is grounded in research and norms for societies where individual autonomy is prioritized, we drew on the CTC approach to understand social opportunity, including the values, role, responsibilities, and interactions of women and other household and community members, particularly elder women, in creating household health. This framework recognizes and values collectivist social norms while seeking to understand gender- and age-related social norm hierarchies (13, 29, 30). The COM-B framework defines motivation as the "brain processes that energize and direct behavior." Reflective motivation involves planning, reflection, and beliefs about one's ability to do something (i.e., self-efficacy), whereas au-

tomatic motivation is sparked by emotions and impulses that arise from dissociative learning or innate dispositions—for example, fear, disgust, or pleasure.

Concurrent with coding, the study team developed preliminary problem trees (36) for the target behaviors that were then collaboratively refined with stakeholders during a workshop held in Kenya following the completion of the formative research. The problem trees served as visual representations of the direct, underlying, and root causes of behaviors identified in the formative research, and were based on the data collected from the FGDs and KIIs (31). During the workshop, participants provided feedback on the preliminary problem trees, developed compatible solution trees, and identified the most feasible and impactful points for intervention. An example problem tree corresponding with 1 prioritized behavior (maternal diet diversity) is depicted in **Supplemental Figure 1**. Following the creation of problem trees, we applied the COM-B model (capabilities, opportunities, motivation) to further characterize determinants of behavior (27, 28). Informed by the findings from the formative work we then applied a systematic, theory informed, and evidence-based approach to intervention design (26).

Ethics

The research protocol was reviewed and approved by Emory University's Institutional Review Board (Atlanta, GA; no. IRB00090057) and Great Lakes University of Kisumu Research Ethics Committee (Kisumu, Kenya; no. CREC/1954/2017), and from the Government of Kenya National Commission for Science, Technology, and Innovation (Nairobi, Kenya; NACOSTI/P/16/72200/13631) in July 2016. Participants provided written informed consent prior to participating in formative research activities.

Results

Ultimately, 6 critical nutrition-related behaviors were identified from formative research and selected for intervention design (**Figure 1**) based on CRS priorities, feasibility within the CRS delivery platform (e.g., care group models) (37), and evidence base for stunting reduction or dietary improvement in western Kenya and elsewhere.

We present findings on determinants of these key maternal and infant diet behaviors organized by the COM-B domains of capability, opportunity, and motivation. We provide illustrative quotes for these dietary behaviors by domain in **Table 2**. For an alternative view, domains are reorganized by target behavior in **Supplemental Table 2**.

Capability

Psychological capabilities included skills and knowledge for maintaining a diverse diet, infant and young child feeding (IYCF), and exclusive breastfeeding (EBF). Physical capability was not identified as a primary determinant for caregiver behaviors. Although community and religious leaders often depicted caregivers and family members as “ignorant” of optimal practices and in need of knowledge or awareness, the research activities with families and frontline workers indicated otherwise, suggesting sufficient psychological capability. Indeed, 1 community health volunteer confirmed that “lack of knowledge is not an issue.” For example, caregivers, husbands, and grandmothers were aware that

pregnant and lactating women (PLW) and children under 2 y should consume a “balanced diet” and most correctly characterized certain foods based on their qualities [e.g., meat builds the body; *ugali* (stiff maize porridge) gives energy]. Knowledge of how often to feed young children (i.e., meal frequency) and increasing frequency with age was also high, suggesting that caregivers and family members were aware of recommended optimal practices.

Psychological capability, in the form of knowledge among mothers, was similarly high for EBF. PLW across sites nearly universally acknowledged that 6 mo was the recommended time to introduce other foods and liquids; however, they acknowledged that this recommendation may not be practical for a number of reasons, including perceived insufficient milk, the need to leave home for work/school, lack of time, and crying/fussy children. Grandmothers and mothers across sites appeared to simultaneously hold conflicting beliefs about the consequences of feeding infants foods or liquids in addition to breast milk, or mixed feeding, from an early age. While caregivers noted that EBF promoted infant health and mixed feeding increased diarrhea and malnutrition, they also reported foods perceived to be beneficial when fed before 6 mo, usually in the event of maternal illness or perceived insufficient milk. These included light/thin porridge, bananas, mangoes, and cow milk.

Among grandmothers, the majority could correctly cite the recommended duration of EBF, although there were some examples of grandmothers stating 2–5 mo as the appropriate age for the introduction of foods. Grandmothers and mothers stated that the recommendation to EBF stemmed from hospitals and health workers. One grandmother described the need to give the infant boiled water with herbs or salt during the first weeks after birth to stimulate the baby to “defecate the *oyare* [meconium] and prevent stomachache.”

The psychological capability of mothers and grandmothers may also influence the practice of cup-feeding thin porridge for children aged 6–24 mo. As 1 mother noted, she trained her child “to use a cup” because she did not know “how to feed a child porridge with a spoon.” Other caregivers preferred to cup-feed thin porridge because they had little confidence in others’ ability to feed with a spoon or feed thicker porridge, and mothers’ competing priorities often meant leaving their child under the care of other family members. Interestingly, cup-feeding was also perceived as a safe alternative to bottle feeding, with which mothers and grandmothers rightly noted an increased risk of illness.

We should not give the baby cold porridge, we should feed it warm porridge and use only the cup not the spoon. When we start training the child, we use the cup alone so that it gets used to it and not the baby bottle. —Grandmothers’ FGD, community 3

Another mother relayed how grandmothers are critical advisors for child feeding as a result of their experience and their availability.

The reason why you would go to the grandmother is because the grandmother knows. She has passed through these stages, so you can ask her what you can feed the child to make the child healthy. —Mothers’ FGD, community 2

While psychological capability does appear to influence the practice of cup-feeding thin porridge, the underlying determinants of this practice appeared to stem more from physical and social opportunity con-

TABLE 2 Illustrative quotes describing maternal nutrition and IYCF target behaviors presented by COM-B domains¹

Target behavior domain	Capability	Opportunity	Motivation
Maternal and child diet diversity Target behaviors: Women consume foods from 5 or more groups each day during pregnancy and lactation; families provide 4 or more food groups to children 6–24 mo of age each day	[We] will give [a pregnant woman] the classes of food, of which she will have to taste each and everyone just a little, she will have to eat carbohydrates, she has to eat body building, and also she has to eat proteins, and that is how they say it. (Fathers' FGD, community 4) Fruits my sister has already mentioned, she has mentioned vegetables, [mother] should also eat meat that is what will build her body and the baby's. (Grandmothers' FGD, community 3) Beans are good for a pregnant woman to eat because they are part of the body-building foods. (Mothers' FGD, community 3) [if] I give my child thick porridge at six months, it will force me that anywhere that I go to, I go with this child because when I leave [them] with the care taker, she will not be able to give the child porridge using a spoon, she will force the child to drink the porridge with a cup which sometimes she can even hurt the child's gums with the cup and even bleed, so it will force me that anywhere I go, I go with the child. (Mothers' FGD, community 3)	Sometimes I am expected to give but I don't have money that I can use to go and buy meat. (Grandmothers' FGD, community 2) She is my son's wife, so I will tell [my son] to give her good food [and] feed the baby [in utero] in a good way [so] that the baby does not become someone who is hungry. (Grandmothers' FGD, community 2)	I think that the child should start eating [eggs] after it has started talking because it will make the child have delayed speech. (Mothers' FGD, community 2)
Feeding thick porridge Target behavior: families provide thick porridge to children beginning at 6 mo	... a child who breastfeeds for six months never being given anything else, is not attacked by many diseases, is never sickling... a child who is introduced to food early, is often sick be it distended stomach, kwashiorkor, some things are in her body but a child who is breastfeed up to six months, is a bright child, is intelligent and is healthy. (Mothers' FGD, community 3);	—	When the porridge is thick then it becomes difficult to give it to the child... It is a problem because it is going to give the child stomach upset... The child will have stomach problems. (Mothers' FGD, community 2) Some children have problems with eating because now this porridge is thick and you want to force [them] with it that [they] have to swallow it; yes, so [they] try to swallow it forcefully which can sometimes choke [them]. (Mothers' FGD, community 1) "You can give birth to a very greedy child, like in most cases they refer to boys [...] that will not get enough of the breast milk, it will force you because the baby can cry until you don't sleep, there is no house chore that you can even do when the child is one month or two months" (Mothers' FGD, community 3)
Exclusive breastfeeding Target behavior: women practice exclusive breastfeeding for up to 6 mo	—	I can say this; they [grandmothers] start giving [the baby] food at this time because the mother is busy... she wants to go and fetch firewood, water, and these and that... And the baby is crying, and that [is] why [children] are being given food at an early age. (Mothers' FGD, community 6); the challenges that you can see is that sometimes you do not have enough	(Continued)

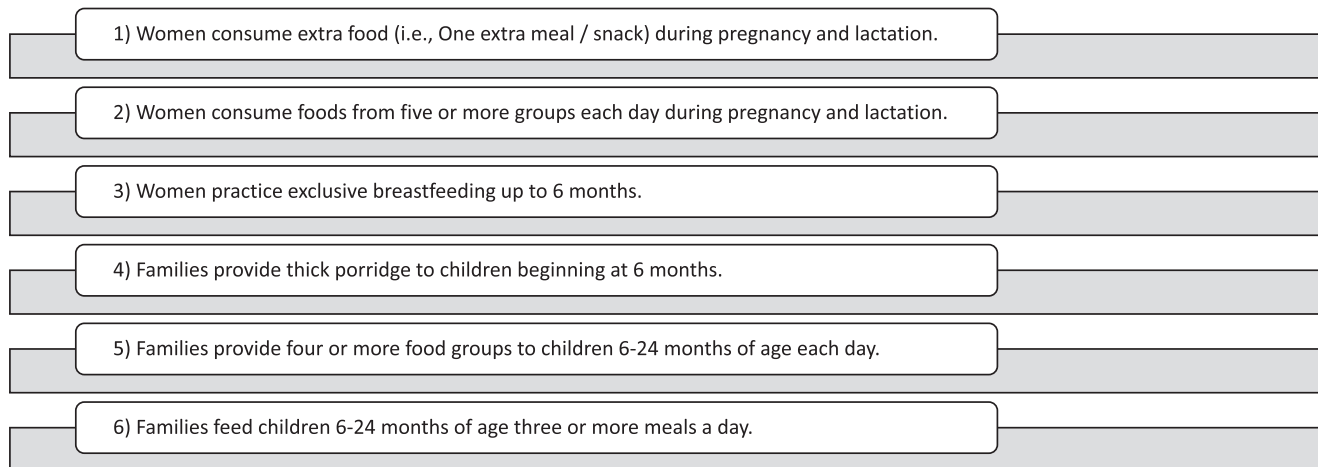


FIGURE 1 Nutrition-related behaviors prioritized for formative research.

straints related to competing demands on women's time and availability and are elaborated in more detail in later sections.

Opportunity

Deficits in physical opportunities, most notably limited access to micronutrient-rich foods and competing demands on caregivers' time and physical availability, undermined multiple recommended practices, and contributed to less optimal behaviors being perceived as more convenient, safe, or feasible. Behaviors impacted by physical opportunities included eating a diverse diet, feeding thick porridge with a spoon, and EBF.

Several root causes of limited food access were noted. These included environmental changes that impacted critical livelihoods that provide both food and income for the household—namely, agricultural and fishing. Changes cited by participants ranged from increased water scarcity for crop growing to decreased fish population resulting from invasive hyacinth in Lake Victoria. These changes, along with seasonality, resulted in inconsistent food availability and fluctuating food prices in markets. Distance to markets also affected food accessibility for caregivers, especially in Homa Bay County.

Food scarcity also affected women's perceived self-efficacy as it related to consuming a diverse diet of sufficient amount to support EBF for 6 mo. While caregivers cited the importance of eating sufficient and diverse foods to ensure breast-milk production, many did not feel that they were able to achieve this due to physical opportunity constraints. These constraints contributed to caregivers' reflective motivations for exclusive breastfeeding.

Mothers also noted that competing demands on time were a barrier to performing multiple target nutrition behaviors. These included the following: mothers' ability to feed children frequently enough, responsively, and to satiety; to breastfeed exclusively on demand for 6 mo; and to feed children adequately thick foods. Mothers and grandmothers cited that the high burden of household and community responsibilities rendered them physically unavailable or allowed insufficient time to practice optimal behaviors. As a result, caregivers were forced to prioritize competing tasks and identify various strategies to ensure that children under 2 y were fed. These strategies often meant that tradeoffs

occurred between quality, safety, quantity, or frequency of infant feeds. For example, cup-feeding thin porridge saved mothers and grandmothers valuable time as it allowed infants to more easily feed themselves at an earlier age and enabled older children and other caregivers to manage infant feeding, freeing mothers and grandmothers to focus attention on other competing tasks (Table 2, Figure 2).

Social opportunity related to gendered work allocation, household food prioritization, and financial decision making, intersected with physical opportunities to influence women's caregiving strategies, including lack of time to practice optimal behaviors. Mothers attributed their lack of time to having a higher workload than other family members and a perceived lack of support to manage that workload alongside childcare. This meant they were unavailable to practice optimal feeding and depended on others to provide for the child.

Fathers and grandmothers expressed commitments to supporting PLW with adequate nutrition, although mothers highlighted the entrenched social norm of prioritizing women last for food, particularly during periods of food scarcity.

Despite these shifting attitudes towards food allocation during pregnancy, similar shifts were not reported for lactating women, even though participants recognized the importance of good nutrition for breastfeeding success. Although participants highlighted multiple social constraints, they also acknowledged opportunities to shift social norms to be more supportive. Mothers noted that fathers can be a source of support through encouragement when available to do so.

What can make it easier after giving birth, the mother and the father should be present and close by to their child [...] the husband becomes closer to the woman so there is no difficulty [...] she knows that her work is to breastfeed the child, she eats and breastfeeds the child, he brings her food and she breastfeeds the child. —Mothers' FGD, community 1

Fathers and grandmothers both expressed a sense of responsibility in caring for women and children, particularly during pregnancy and early infancy. For example, fathers expressed that they felt responsible for providing appetizing food to their pregnant wives. As one father noted,

When a woman is pregnant... Then you must know the kind of food that she likes and the ones she doesn't like... Sometimes you left to go

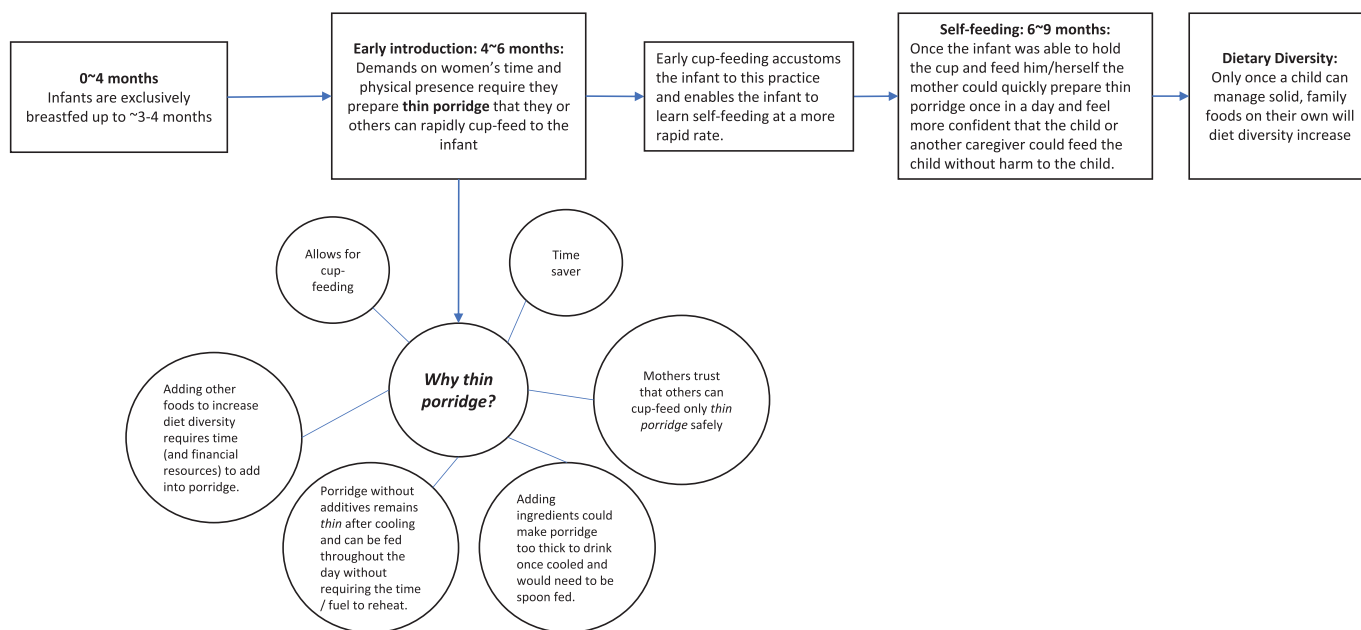


FIGURE 2 Framework showing women's decision to cup-feed children under 2 y.

and fend...Then she tells you to bring something for her but then you did not find that thing...So even you who stay with her in this house, then you will say that 'Okay I did not get this thing, what else does she always like?'... So you buy the one that you normally see that she so when you go back home you tell her that I did not get the one you wanted, but I got this....Then she will be closer to you 'So... my husband knows that if whatever I wanted is not there, then he knows that I like this other alternative....So he brings it for me.'—Fathers FGD, community 3

Grandmothers were also often cited as important sources of support, knowledge, and advocacy. For example, they served as critical mediators for maternal nutrition—namely, by putting pressure on their sons to prioritize food for pregnant women in the household.

Motivation

A number of reflective and automatic motivators influenced caregiver feeding practices. Grandmothers and mothers cited an inability to soothe a crying infant as a common automatic motivation to introduce other foods and liquids, particularly for male children. Mothers indicated an overwhelming belief that crying was the dominant cue for infant hunger, indicating potentially limited awareness of other earlier hunger signs or other, nonhunger, related reasons for crying. Caregivers stated that when the child continued crying or exhibited fussiness after being offered the breast, then the mother did not have enough milk and that the child needed supplementation. One grandmother shared the following:

...the baby will now cry so much and so even if you give it breast milk, it will just hold [the breast] but there is no milk—it just holds but there is no milk, and so when you even try it with this porridge, it will take [the porridge] and just sleep, that's why you will have to give it this porridge and you also continue to give it what-your breast milk.—Grandmother FGD, community 2

This motivational cue, experienced in the context of food insecurity and superimposed on the common belief that women who do not consume sufficient food cannot produce enough milk, created a downward self-efficacy spiral for EBF and ultimately contributed to the early introduction of other foods and liquids.

The emotional motivator of fear underpinned several behaviors that affected both IYCF and nutrition for PLW. Speaking to caregivers' beliefs about consequences, thick porridge was believed to be “too heavy” for young children; they believed that feeding thick porridge would cause their child to experience upset stomach or constipation. Caregivers also expressed concern that thick porridge could choke infants, especially if force-fed, although mothers noted forced feeding was practiced less now than in the past.

Fear also motivated food aversions and reduced food intake during pregnancy. A commonly expressed fear related to the belief that if pregnant women increased the amount of specific foods they ate, the infant would become “big,” which would lead to complications in childbirth, possibly leading to a cesarean section—a procedure that many feared as dangerous. Foods cited as contributing to “big babies” included cow milk, avocado, ripe banana, groundnuts, and oranges. Mothers cited other negative consequences believed to be associated with eating certain foods while pregnant. For example, some caregivers described that groundnuts would result in making the infant “dirty” and chewing sugarcane would cause an infant's skin to “peel off.” Groundnuts were also described as “for men” as people associated them with virility and libido; several participants described increased libido during pregnancy as inappropriate. These same fears did not emerge when discussing the diets of lactating women; rather, women were encouraged to eat foods that “brought milk.” Nearly all foods, except for some candies and tea, were perceived as “good” for lactating women.

TABLE 2 (Continued)

Target behavior domain	Capability	Opportunity	Motivation
	When the child is born and it is still small, water is boiled and then you put the orange peels and this prevents stomach ache. (Mothers' FGD, community 2); The reason why they are given [solid] foods, is so that they have an appetite. They make their mouth sweet (adding appetite) such that when they reach six months then they can eat anything different from what they are eating at three months. (Mothers' FGD, community 2)	food that you can eat so that the child can get milk. So that is one of the challenges that you can see that will make you start giving the child other foods before it reaches the time to start eating those foods. (Mothers' FGD, community 2)	
Adequate meal frequency Target behaviors: women consume extra food (i.e., 1 extra meal/snack) during pregnancy and lactation; families feed children 6–24 mo of age 3 or more meals a day	Children are fed every 2 hours or 4 times per day. (Mothers' FGD, community 4) You take your time to give [porridge] to her until she is satisfied. (Mothers' FGD, community 6)	Children get hungry so fast that you have to keep on "giving without rest." (Mothers' FGD, community 4)	—

¹COM-B, capabilities, opportunities, motivations, and behavior; IYCF, infant and young child feeding.

Discussion

We applied multiple methods to investigate the determinants of optimal maternal and child dietary intake and feeding behaviors. We anchored our analysis and conceptualized our findings using the COM-B theoretical model and the theoretical domains framework. We found that caregivers exhibited sufficient psychological capabilities (knowledge and skills) for many of the key mealtime behaviors we aimed to address; however, reflective motivation to perform optimal behaviors was undermined by limitations in physical and social opportunities. These findings were consistent with our formative research focused on WASH practices (32, 33). Given the importance of physical and social opportunities as well as reflective and automatic motivation, traditional knowledge-based approaches to nutrition behavior change will likely prove insufficient or unsustainable. Indeed, a key takeaway from our formative research was the pervasive influence of physical and social opportunity determinants on multiple behaviors. Nutrition behavior change programs have traditionally been siloed, lacking multisectoral approaches (38). However, multi- and intersectoral strategies that target social and environmental opportunity-related determinants—women's status, healthy food access, and time constraints—can create an enabling environment for optimal care practices with potentially more far-reaching effects on multiple behaviors. Such approaches may create synergistic impacts on maternal health and child growth and development (38, 39).

From a social opportunity perspective, in our formative research women were generally a lower priority for food than other household members, especially when resources were scarce. Lactating women were a lower priority than pregnant women, further limiting food access and likely support in the home with time-consuming activities. Such prioritization reflects the influence of women's lower status relative to other household members. Research across South Asia (40, 41) and sub-Saharan Africa (42, 43) has elaborated on the influence of women's status and women's empowerment on women's and children's nutrition. Indeed, several studies have supported expanding the focus of nutritional programming beyond the mother-child dyad to include other influential household members. Grandmothers in non-Western societies, including Kenya, play a significant role in both advising young mothers and caring for women and children in the household, particularly related to nutrition and health (10, 13, 15, 44). One study in Vietnam showed potential for improving rates of EBF by directly targeting fathers with mass media communication, group counseling, individual counseling, and social public events (45).

For women with children less than 6 mo old especially, the intersections of social (i.e., the social norm of low priority in household food allocation) and physical opportunities (i.e., low food access and time) undermined women's diets, EBF, and timely introduction of energy-dense complementary foods. For example, women's perceived hunger and inadequate diets contributed to reduced self-efficacy (reflective motivation) for EBF. This lack of confidence was reinforced in the presence of cues such as child crying. Previous research in Kenya noted that food insecurity influenced women's belief in their ability to produce sufficient milk for their infants and the duration of EBF (46). And several studies support that breast-milk quality and quantity can vary in relation to mothers' nutritional status (47–50). Programs that influence women's status, social support, and household food alloca-

tion may have the potential to impact maternal diet and child feeding practices.

Strategies that shift gendered and age-related roles and identities and create an enabling environment for task-sharing and task-shifting could reduce women's time constraints. Competing demands on women's time contributed to both the practice of cup-feeding thin, nutrient-poor porridge to infants and doing so before 6 mo. Other studies have similarly found that when mothers are overburdened with household responsibilities they are forced to prioritize competing tasks, sometimes abandoning optimal practices when inconvenient or perceived of as of lower or less immediate benefit (51–53). For example, if other family members contribute time to reduce mothers' workload, then mothers could be freed to allocate the time necessary to prepare/reheat adequately thick porridge and responsively feed it to their infants. Studies suggest that strong social support for mothers is predictive of improvements in feeding practices and multiple studies found positive impacts on early breastfeeding through engaging fathers or grandmothers (15, 54). Alternate caregivers could receive training in feeding thick porridge, thereby increasing mothers' confidence that any caregivers can perform these practices safely. As caregivers gain the resources and time to perform the behavior and associate positive consequences with feeding thicker porridge, fears about feeding thick porridge may subside, contributing to sustained change.

Beyond the body of work on women's time allocation in agriculture (29, 55–59), little is known about how interventions to reduce women's time constraints can influence maternal or child nutrition. In this study, time constraints impacted caregivers' decision to feed children thin porridge that falls far below the recommended energy density for young children. Our formative research suggests that interventions aimed at promoting the timely introduction of appropriately energy-dense thick porridge must address women's workloads or those least capable of taking up a recommended practice will continue to be left behind. Nordang et al. (56) highlight that few studies explore the impacts that early-childhood interventions have on caregivers, providing an incomplete characterization of program impact. However, the evidence from the few studies that do measure the impacts of these interventions on caregivers suggests that many programs that are good for children also result in women's financial well-being, mental health, and empowerment (56).

In addition, utilizing context-specific knowledge about typical household foods and perceived affordability and availability of local foods and working with households to identify small, manageable changes may be a practical approach to reaching motivation in an area with such volatile opportunity. For example, Peltó et al. (60) recommend identifying whether a society distinguishes foods for infants and young children as separate from foods for everyone else. Whether or not foods for infants are different from foods for the rest of the family will have implications on how to approach an intervention aimed at increasing dietary diversity.

Our formative research identified that psychological capability, notably knowledge about a practice and how to do a practice, was generally adequate. Limited social and physical opportunity, which decreased behavioral motivation, however, were identified as significant underlying determinants. Because targeting physical opportunities such as infrastructure and access to resources was beyond the scope of THRIVE II, we hypothesized that a focus on motivation and social opportunity

could enable families to overcome limited environmental opportunities and support existing psychological capability (26). Ultimately, we observed that the final package of interventions, grounded in theoretically informed formative research and a systematic intervention design approach, significantly improved key practices related to maternal and child dietary diversity and providing infants with thick porridge (34).

Strengths and weaknesses

Strengths of this study included the ability to triangulate data, thus grounding findings on participants' experiences. The data collection involved processes that contributed to minimizing social desirability, ensuring anonymity, and using well-worded and proxy questions. Additionally, interviewers were women who had a shared culture with the participants. Observers' influence on participants' behaviors was reduced through 2 d of observation by the same observer. However, since women had other competing priorities, this limited observation of some feeding practices by the caregivers.

Conclusions

In this region of western Kenya, caregivers exhibited low self-efficacy to achieve adequate dietary diversity in their households, and while some foods were identified as locally available and affordable, participants did not feel that they could maintain a balanced diet. Households should not be expected to make a jump from knowledge to practice in the absence of behavior change strategies that are appropriate for the household context. Increasing motivation could be achieved through action planning and goal setting that is context specific to shift caregiver beliefs about capabilities. But these approaches will only go so far given the physical and social opportunity barriers related to food access and availability. Thus, nutrition-sensitive programming to address women's status, household food insecurity, and time allocation is needed to foster an enabling environment that supports and sustains improved maternal and child diets.

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Data Availability

Data described in the manuscript, code book, and analytic code will be made available upon request pending Institutional Review Board (IRB) approval and relevant data-sharing agreement.

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