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The Acceptability of Innovative Feeding Tools to Improve Maternal and Child Nutrition in
Western Kenya

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Abstract

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Dietary practices in Kenya often fail to provide adequate nutrition during the first 1000 days of life. We developed and qualitatively assessed a low-cost, easy-to use demarcated bowl and slotted spoon to assist mothers with appropriate diet practices during pregnancy, breastfeeding, and complementary feeding of children 6-18 months. We conducted 12 focus group discussions with community members and 5 interviews with nutrition experts to assess acceptability and obtain recommendations on design and delivery in Western Kenya. We also conducted 24-28 days of user testing with 14 pregnant, 14 breastfeeding women, and 32 mothers with infants 6-18 months. Tools were positively received by communities. Mothers perceived improvements in theirs and their children's food intakes including increased quantity, frequency, consistency and diversity. Many attributed their own and their child's weight gain or increase in energy to tool use. A minority of women reported using the bowl for other activities, or not using the bowl due to food insecurity. Results indicate these tools have the potential to positively impact maternal and child nutrition, however future work should address food insecurity and counseling on responsive feeding.

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CHAPTER 1: INTRODUCTION

Context of the Project:

Maternal nutrition during pregnancy and infant and young child feeding practices directly affect the nutritional status of children younger than two years of age, and ultimately impact child growth, development, and survival [1]. In resource-poor settings, childhood malnutrition remains a major health problem [2] and is the underlying cause of death for 3.1 million children each year globally [3]. These deaths are the result of repeated infections to weakened bodies that have seldom acquired the necessary amounts of energy, vitamins, proteins, and minerals needed for growth [4]. In Kenya, poor infant and young child feeding practices have resulted in a substantial level of malnutrition and poor child health [5]. In 2008, only about 15% of infants 4-5 months were exclusively breastfed; between 28-42% of children 6-24 months receive less than the minimum number of recommended meals; and only 42-58% received adequately diverse foods [6]. At a national level, 35 % of Kenyan children under five were stunted, while 7% of children were wasted and 16 % were underweight [6].

Maternal malnutrition is also a challenge in Kenya [7]. Twelve percent of women ages 15-45 have a body mass index (BMI) of 18.5 kg/m² which makes these women underweight or severely underweight [6]. Low maternal BMI and short stature can lead to adverse pregnancy outcomes including the increased risk for caesarian delivery due to cephalopelvic disproportion, and intrauterine growth restriction [8]. Other factors that can affect birth outcomes are maternal anemia and low gestational weight gain. Because pregnant women have suppressed immune systems, they are at a higher risk for contracting malaria and developing anemia. In Kenya, the prevalence of anemia among pregnant women is as high as 70% in some areas [9]. Malaria infections can also interfere with the maternal-foetal exchange, leading to low birth weight

infants. According to the DHS 2008-2009, six percent of infants born in Kenya were considered to have low birth weight.

There are a number of interventions geared towards reducing malnutrition during the period of conception to two years of age, collectively known as “the first 1000 days.” These interventions include: nutrition education and counseling, balanced protein and energy supplementation, fortification of staple foods, diet diversity strategies, micronutrient supplementation, and ready to use therapeutic foods to treat severe and acute malnutrition. Although these interventions are efficacious, they may not be available, and may not substantially address the underlying behaviors, and knowledge gaps contributing to suboptimal maternal and young child feeding practices. Several theories including the Health Belief Model (HBM) have been developed to aid in understanding factors that influence individual autonomy when making health decisions.

HBM specifically states that a person is most likely to change a behavior if: 1) they are aware of the adverse health condition, 2) feel that the condition can be avoided, 3) expect positive outcomes as a result of following recommended actions, and 4) accept the cue to action [10]. The concept of the “cue” is an important aspect of the HBM as it triggers individual actions towards the desired health behavior. Behavior change can also be viewed through the lens of the Socio Ecological Model which illustrates behavior change as a result of a multifactorial complex involving the physical, social, and cultural environment [11]. Through the lens of this theory, an individual’s behavior is understood through the web of interactions between the social and environmental entities that influence decision making and actions.

Utilizing cues to action in efforts to promote behavior change in child nutrition, the Manoff group developed a child feeding bowl that cued age appropriate meal quantities in children 6-24 months [12]. Formative research in Latin American suggested that the bowl was an acceptable

way to improve child feeding and promote positive feeding behaviors [12]. Unfortunately, additional research to explore the potential for the bowl to shift child complementary feeding practices has not been reported. Furthermore, no research to date has tested these types of tools as strategies to cue adequate meal frequency or consistency to improve maternal diet during pregnancy and early lactation.

Problem Statement:

Dietary practices in developing countries often fail to provide adequate nutrition during the critical periods of pregnancy, lactation, and early childhood. Improving the quantity and quality of maternal diets during pregnancy and lactation promotes fetal growth and improves breast milk quality. However, feeding during this period is often inadequate as it lacks the necessary protein, energy, vitamins and minerals needed for child growth [4]. Foods given to infants are often times insufficient because of inadequate amounts, poor diet diversity, and watery consistency. Thus, there is a need for appropriate low cost tools to increase food intake by pregnant and lactating women, and infants during the critical growth period from conception until two years of age.

Purpose of the Project:

To address the limitations of maternal and child feeding practices and building on the initial concept of the child bowl developed by the Manoff group, our team developed a low-cost, easy-to-use tool consisting of a bowl with demarcations and symbols corresponding to the nutritional needs during pregnancy, lactation and complementary feeding along with a sieved spoon and counseling card. The demarcations and symbols on the bowl are distinctive and cue mothers on the amounts of extra food required for themselves during pregnancy, 0-6 months postpartum and the frequency and amount of meals needed by children at 6-9 months postpartum, 9-12 months postpartum, and 12-24 months postpartum. The sieved spoon cues the appropriate thickness of

the food. We hypothesize that the bowl and spoon, functioning as simple cues to action, will reduce confusion about the quantity, consistency, and amount of food required throughout the 1000 days of life as well as improve dietary intake.

The purpose of this project was to pilot the bowl, spoon, and counseling card with community stakeholders and pregnant, breastfeeding, and complementary feeding mothers in Western Kenya. Western Kenya was chosen for this project for several reasons. First, according to DHS 2008-09, Western Kenya has one of the highest infant malnutrition statistics in the country with 46% of children under the age of five underweight, stunted, or wasted [6]. Second, approximately 55% of the boys and girls in study areas dropout of primary school before reaching eighth grade and many of these girls marry soon after they reach puberty and become mothers at an early age. As such, they may lack the necessary knowledge about subjects such as maternal and child nutrition. Women who were involved in the study benefited from the nutritional knowledge gained via counseling throughout the study, and kept the bowls and spoons for future use. Lastly, the principal investigator of this study has previous experience leading projects in the area and formed relationships with in-country partners who provided logistical and technical assistance over the study period.

CHAPTER 2: LITERATURE REVIEW

Burden of Maternal and Child Malnutrition:

Malnutrition is the underlying cause of death for 3.1 million children each year [3]. These deaths are the result of repeated infections to weakened bodies that have seldom acquired the necessary amounts of energy, vitamins, proteins, and mineral needed for growth [4]. Ninety nine percent of malnutrition deaths in children under the age of five occur in Africa, Asia, and Latin America [7]. Malnutrition encompasses stunting, wasting, and micronutrient deficiency [7]. Chronic child malnutrition affects 170 million children and occurs on an even greater scale following natural disasters, crop failure, and wars [4]. According to the World Health Organization (WHO) in 2011, 36% of children under the age of five in the African continent were stunted, while 27% of Asian children under the age of five were also stunted [13]. Although these figures are alarming, they show great improvements, a testament to the multiple organizations involved in solving these issues. Stunting has decreased by 35% globally from 1990 to 2011. The number of underweight children has also decreased from the 1990 to 2011 [13]. However, Africa and Asia still bear more than 90% of the global burden of malnutrition, including stunting and underweight [13]. The lack of adequate nutrition for children is a problem as it can have multigenerational effects because stunted children may not fulfill their physical, academic, or economic potentials. It has been noted that stunted mothers are more likely to have underweight children, thereby perpetuating the cycle [4]. To mitigate effects of child malnutrition attention needs to be given to the mother during the first 1000 days of the child's life

Providing adequate nutrition for a young girl can "break the cycle" and allow the girl to become a healthy mother and have healthier babies [14]. Maternal malnutrition is prevalent in many

regions in the world including most countries in sub-Saharan Africa, south-central and southeastern Asia, as well as in Yemen [7]. In Yemen more than 20% of women have a body-mass index (BMI) of less than 18.5 kg/m² which makes these women underweight or severely underweight [7]. In some countries like Bangladesh, India, and Eritria, 40% of women of reproductive age have a BMI lower than the 18.5 kg/m² [7]. Low maternal BMI and short stature can lead to adverse pregnancy outcomes including the increase risk for caesarian delivery due to cephalopelvic disproportion, and intrauterine growth restriction. In developing countries intrauterine growth restriction has a prevalence of 10.8 per 1000 live births [7]. Moreover, maternal micronutrient deficiencies such as low concentrations of vitamin A, iodine, thiamin, and other micronutrients can be depleted by the infant and lead to negative outcomes for the mother and the child. This depletion phenomenon is often seen with vitamin A, where infants depend on maternal secretion via breast milk because infants are born with low storages of vitamin A [7].

Causes of Malnutrition:

Malnutrition is the manifestation of multiple interconnected social and environmental factors that result in poor health outcomes. According to UNICEF, the two immediate factors that operate on the individual level and directly lead to malnutrition are disease and dietary intake. Household food insecurity, inadequate health care for the mother and child, unhealthy environments at the household and community level are the main drivers of these factors. The underlying cause of malnutrition is poverty which is highly regulated by the social, political, and economic structures of societies [7]. The issue of malnutrition particularly in Africa is exacerbated by ongoing conditions such as climate change, crop failure, food distribution obstacles and lack of government involvement in controlling and improving food security [15]. This situation becomes

more complicated by an inefficient and disorganized international response to issues of food security including excessive food aid without insistence on guaranteeing sustainability [15].

Fluctuation of food prices on the world market also play a large role in the prevalence of malnutrition as some countries depend on one crop such as coffee or coco, and the decrease of prices of these foods on the global market causes disturbance to family income [15].

Other factors that contribute to malnutrition include maternal educational. Maternal education is closely linked to children's' nutritional statuses as mothers who are more educated possess knowledge of nutrition and disease prevention strategies that can reduce morbidity and mortality in the households [15]. Educated mothers also tend to have smaller family sizes, thereby placing less of a burden on the family when resources including food are limited.

Climate change is another challenge that directly and indirectly affects malnutrition. Changes in rain patterns disturb the supply of water used in agriculture, which directly impacts the availability of foods. This is mainly because increases in temperature deplete moisture in lands resulting in high salinity of agricultural lands which leads to the destruction of crops. Moreover, lack of safe water can compromise hygiene and increase the risk of diarrheal diseases, which predicted to be even more of an issue because of global climate change [15]. Lastly, governments in many of the countries with high burdens of malnutrition lack capacity to measure burdens of malnutrition and therefore have a skewed understanding of its impact on the population which results in the failure to address the issue via policy change [15].

Strategies to Alleviate Malnutrition during the 1000 Days:

Understanding the causes of malnutrition has allowed programmers to use various strategies to target factors such as disease and dietary intake that result in malnutrition. These strategies often

target nutritional practices during the 1000 days beginning with conception and pregnancy, into the exclusive breastfeeding and complementary feeding periods. These interventions include targeting iron and folic acid intake, micronutrient deficiencies, as well as balance protein and energy supplementation during pregnancy. Maternal education during the postpartum period and a series of approaches to improve breastfeeding and the complimentary feeding period are also implemented. Below is a discussion of the efficacy and effectiveness of various interventions during each stage of the 1000 day period.

Interventions during Pregnancy and 0-6 Months Postpartum:

Iron and Folic Acid Supplementation: Iron demands dramatically increase during pregnancy and are difficult to be met through women's typical food intake. Because of this, 50% of the anemia cases that occur during pregnancy are due to nutritional iron deficiency [16]. Iron and folic acid (IFA) supplementation is the most common strategy to prevent and treat anemia during pregnancy, and prevent birth defects such as neural tube defects and spinal bifida in children. Folic acid supplementation is highly recommended prior to conception and into the first trimester of pregnancy while iron supplements are recommended from conception throughout the pregnancy. However, because IFA is normally administered as one, women are recommended to take IFA if they are trying to become pregnant or begin as soon they learn they are pregnant [17, 18].

Oral IFA supplements are effective at reducing the prevalence of anemia and improving the iron status of compliant individuals. A review conducted by Yakoob et.al, found that daily IFA supplementation reduced iron deficiency anemia by 67% and general anemia by 73% at 37 weeks of pregnancy [19]. Iron supplementation not only reduced the prevalence of iron deficiency, but it also reduced the risk of contracting infections during or after childbirth [17].

Moreover, women who received iron as part of their supplements were less at risk for severe anemia in the weeks after their delivery [17]. Some evidence suggests that women who receive IFA are also less likely to have premature births; however, this finding is not statistically significant in a meta-analysis [17].

The efficacy of IFA supplements is determined by multiple factors this includes: The individual's diet, presence of pathogens, the composition of the supplement, the severity of iron deficiency at baseline, and the duration of iron consumption [16]. In many developed countries there is no requirement for iron supplementation; however it is recommended that pregnant women take a 30 mg pill of ferrous iron daily [19]. In developing countries on the other hand, the recommendation is a daily dose of 60 mg of iron for non-anemic pregnant women and 120 mg for anemic women or women in areas with high prevalence of anemia [19].

There are many benefits to the consumption of iron and folic acid to prevent anemia and birth defects. Although side effects are often stated as a barrier, the primary barriers to IFA supplementation are challenges related to supply chain distribution and inadequate support and counseling for women [20]. Delivery to the target population is affected by multiple factors including lack of a steady supply of supplements, inability to reach the target audience, and lack of compliance by women [20]. These issues are most prominent in low and middle income countries where there is a lack of clear guidelines and protocols about supplement distribution. There is a need for training health personnel and community health workers about various communication strategies to motivate consumption of IFA supplements. According to Sanghvi et. al, anemia prevention programs could be successful in scaling up if a comprehensive approach is used. These programs would need to include IFA supplementation for pregnant women, universal fortification of staple foods, behavior change communication, training for

health services delivery staff, and community engagement in counseling targeted towards mothers [20].

Multiple Micronutrient Supplementations and Balance Protein and Energy Supplementation:

Multiple micronutrients supplementation (MMS) and balance protein energy supplementation (BPES) have proven to be effective during pregnancy to prevent low birth weight babies (LBW) [21]. A review conducted by Bhutta et. al showed 11–13% decrease in LBW and small for gestational age (SGA) because of MMS. Moreover, in 31 trials that compared multiple micronutrient supplementations with iron-folate supplementation during pregnancy in Bangladesh [22] showed a significant reduction in preterm births and anemia [1]. Combined data from five studies showed a 32% reduction in the risk of LBW and a 34% SGA signifying BPES's effectiveness [23]. In these studies, greater effects were seen in mothers who were undernourished compared to mothers we were adequately nourished [23].

Similar to IFA, adherence to MMS and BPES is a challenge because often women, especially those in rural settings, lack the knowledge and access to the supplements, or if they have access to supplements, they may not consume supplements as recommended [24]. Shankar et. al conducted a trial that examined the health impacts of MMS using community facilitators to promote behavior change and improve compliance in Indonesia [24]. They found with the use of MMS as instructed by a community facilitator, infant mortality decreased by 50% [24].

There is clear evidence that BPES is beneficial for mothers and infants who need it. However, there is no effective way to identify women who need the intervention versus those who do not. Women who have adequate amounts of BPES may have impaired fetal growth if given supplements containing >20% of energy as protein [25]. Therefore, there is a need for studies

that focus on the effects of MMS and BPES on morbidity and mortality, as well as the effects of over dosing with these supplements [21].

Nutritional Counseling: Nutrition counseling is another strategy often used alongside multiple interventions such as micronutrient and IFA supplementation. The goal of nutritional counseling is to improve maternal diet quality by increasing the amounts and types of foods consumed. In addition, nutritional counseling during pregnancy also promotes necessary weight gain through consumption of adequate amounts of balanced proteins and energy [26]. In a review conducted by Girard and Olude, there was significant gain in infant birth weight in low and middle income countries when nutritional counseling was provided along with nutritional support [26].

However, this effect was not when counseling was provided alone or in conjunction with other health messages [26]. Generally, nutritional education and counseling improved dietary habits as well as the consumption of both micro and macronutrients. Studies that delivered effective counseling in Egypt [27] and Senegal [28] have shown a significant increase in the consumption of animal-source foods.

Nutritional counseling not only has effects on dietary habits, but also improves consumption of micronutrient supplements [26]. In a randomized trial conducted in Nepal, women were assigned to four groups where the first group received IFA supplementation only; the second group received IFA and did pill counting to measure compliance; the third group received IFA and nutritional counseling; and the fourth group received IFA, pill counting as well as nutritional counseling [26]. Results indicate that women who received nutritional counseling and those who were assessed through pill counting had a significantly greater increase in hemoglobin than women who received IFA alone or IFA and pill counting without the counseling [26]. Over all, nutritional counseling was found to be effective, and even more so when presented with

micronutrient or food supplements. This was a prevalent finding in low and middle-income countries [29].

Generally there are not many interventions targeting maternal nutrition during the postpartum period. Maternal vitamin A supplementation in the first few weeks postpartum was recommended prior to 2011 however, it is not recognized by the WHO as an intervention that contributes to the reduction of maternal and infant mortality and morbidity [19]. The current recommendations encourage women to consume a “balanced healthy diet [19].”

Interventions for Infant and Young Child Feeding (IYCF):

Infant and young child feeding practices in developing countries often not only fail to provide adequate nutrition during complementary feeding, but also attitudes and beliefs about infant feeding do not support exclusive breastfeeding. The WHO recommends that infants be exclusively breastfed from birth to 6 months of age. This recommendation is mainly because of breast milk’s protective abilities against infections such as diarrhea and respiratory tract infections. However, in Africa, Asia, Latin America, and the Caribbean, only 47–57% of infants younger than two months are exclusively breastfed [7]. These numbers decrease as the child ages, as only 25-31% of children between ages two to five months are exclusively breastfed [7]. Thus, several interventions have been designed to encourage exclusive breastfeeding and improve complementary feeding practices in developing countries.

Other interventions targeting breastfeeding include trials that have been conducted surrounding peer support and counseling groups for lactating women. Results from these trials indicate that a combination of individual and group counseling is more effective than group or individual counseling sessions alone. Such results were reported in a review by Imdad et. al where group

counseling improved the rates of exclusive breastfeeding by 67% for four to six week old children compared to 38% which was achieved through individual counseling [1]. Although these results are promising, they do not provide a platform for addressing perceived barriers associated with exclusive breastfeeding such as returning to work, lack of support, and the perception of insufficient milk [1].

Once children reach 6 months of age, breastmilk is no longer sufficient to meet their nutritional needs. As such the WHO recommends that children be given complementary foods in addition to breast milk. The complementary feeding period is crucial because damage due to inadequate nutrition and introduction of pathogens can be irreversible. Children, especially those in developing countries are often at a greater risk for becoming malnourished due to unsafe food preparation and inadequate quantity and quality of complementary foods. To prevent negative growth outcomes, complementary feeding interventions such as nutritional counseling, food supplementation, fortification of complementary foods, and food processing techniques to enhance nutrient quality have been developed [29].

Improving IYCF through Education: The effects of education as an independent intervention for improving infant feeding practices are not clearly documented. However, there is a larger body of evidence suggesting significant gains in weight and length of infants as a result of education as an intervention than one suggesting otherwise. In a review by Dewey and Adu-Afarwah, the authors conclude that there is a minimal increase in the length and weight of children when education is the main intervention. However, studies conducted in China [30], Peru [31], Malawi [32] and Bangladesh [33] reported significant increase on weight and length of infants as well as an increase in iron and zinc intake from complementary foods. These positive results were attributed to the specificity of counseling messages which promoted complementary feeding

mixtures with animal source proteins such as meat, eggs and fish [29]. Another review conducted by Lassi et. al stated that education significantly improved height for weight Z score and reduced the rates of stunting, but no significant impacts were observed for height and weight gain [34]. However, according to a subgroup analysis comparing food secure populations to food insecure populations, education on complementary feeding significantly impacted height for age Z scores and weight gain; stunting was not significantly reduced. In food insecure populations, education improved height for age and weight for Z scores, and significantly reduced stunting [34]. It has been reported that provision of complementary foods with nutritional counseling or nutritional counseling alone significantly increased weight and length [35].

Although these results are promising, the amounts of iron and zinc uptake from complementary foods is still not at the recommended levels, especially in Brazil [36] where a large scale supplementation program failed to improve zinc, iron and vitamin A intake [29]. There is inconsistency regarding the effects of education on iron intake, because studies conducted in China [30] and India [37] indicate an increase in hemoglobin levels, while studies done in Nicaragua [38] and Brazil [36], appear to show no significant effects [29]. Dewey and Adu-Afarwua did further analysis to assess the effectiveness of combined interventions of food provision and education on the length and weight of the infant and concluded that a combined intervention of food provision and education is more effective than education alone [29]. Further evidence examining the effect of education on quality of complementary foods are needed to conclude the true effects of educational on length and weight of infants.

Iron Fortification of Complementary Foods: Iron fortification of foods was studied in multiple efficacy and effectiveness trials where program groups were given fortified complementary foods and comparison groups received no foods or unfortified foods. Results from these studies

indicate a significant increase in hemoglobin levels and reduction in anemia in the intervention group compared to the control group. Other fortification trials include five efficacy trials and two program evaluations that have assessed the effects of home fortification on iron and anemia by using powders, crushable tablets and fat-based products. These programs showed an increase in average hemoglobin levels as well as a 21% reduction in anemia [29]. Studies have also been done to determine the effects of Sprinkles™ on hemoglobin levels and anemia prevalence. One trial conducted in Haiti provided the intervention group with Sprinkles™ and a fortified wheat/soy blend, while the control group received only the fortified wheat/soy blend [39]. After two months, the Sprinkles™ group had a higher mean hemoglobin level and a lower prevalence of anemia in comparison to the control group (28% vs. 45%) [39]. It should be noted that it is difficult for children to acquire the amounts of iron needed without fortification because of the high costs of iron rich foods like meat and liver [29].

Zinc and Vitamin A Fortification of Complementary Foods: Of all micronutrients, zinc level as measured by zinc plasma concentration, is one of the most difficult to increase. It was found that fortification of complementary foods had no effect on mean zinc plasma concentration for children ages 6-12 months [40, 41]. According to the studies that have assessed the effects of zinc fortification through home fortification and crushable zinc tablets, food fortification did not affect zinc plasma concentration [40]. However, the zinc tablets had significant results in the intervention groups when compared to the control group [40]. The authors speculated that the observed low zinc concentration in plasma may be due to the low bioavailability of zinc when consumed with cereal or legume based foods [29]. This differs from the fortification of vitamin A as vitamin A fortification of complementary foods has been proven effective in reducing the prevalence of vitamin A deficiencies in children 6-12 months [36, 40, 42].

Large Scale Programs to Improve IYCF: Large-scale complementary feeding programs are sparse. There are two programs one of which is LINKAGES a long term USAID program implemented in Bolivia, Ethiopia, Ghana, Jordan, Madagascar, and Zambia [43]. LINKAGES was used to increase timely initiation of breastfeeding, increase exclusive breastfeeding, expand locational amenorrhea and increase timely initiation of complementary feeding [44]. Details regarding program implementation in each country differed; however, each study site completed formative research then designed an implementation strategy involving policy makers and at a national, district and local level. Behavior change communication strategies were used to develop and promote targeted behavioral messages through prints, electronics, traditional mass media, interpersonal communication (women's groups, counseling), and community events. Moreover, the program conducted trainings for health workers and utilized monitoring and evaluation techniques to measure impact [43]. LINKAGES results regarding breastfeeding practices were promising because the exclusive breastfeeding rate in all five intervention countries increased significantly [44]. These results were not observed with complementary feeding practices because in many intervention countries complementary feeding was initiated early. Thus, no significant differences were observed between the rates of complementary feeding initiation at baseline and post intervention [44]. In addition, changes in complementary feeding practices related to continued breastfeeding, age appropriate frequency of feeding, and dietary diversity did not prove to be significant in program areas except in Madagascar where there was a 44% improvement between the baseline and endline evaluation [44]. As demonstrated by LINKAGES the success of complementary feeding interventions depends on many factors such as the prevalence of malnutrition at baseline, household food insecurity, the

amount of energy in traditional complementary foods, and the availability of micronutrient rich foods [29].

Another large scale complementary feeding program is Alive & Thrive which promotes exclusive breastfeeding as well as adequate complementary feeding practices in Bangladesh, Ethiopia, and Vietnam [45]. Alive & Thrive utilizes successful strategies to promote large-scale behavior change namely via counseling and mass media campaigns [45]. As reported by Sanghvi et. al., program implementer have an elaborate scheme of operation involving multiple partners aimed towards delivering infant and young child feeding (IYCF) messages to the appropriate audience in compelling and culturally appropriate ways. In Bangladesh for example, health messages are directed towards mothers, and are strategically aired with commercials between dramatic films and television series. However, in Ethiopia, the media campaign is directed towards men as they have the greatest access to televisions and radio; while women, on the other hand, are reached through non media based strategies such as through women's groups [45]. Alive & Thrive used many of the strategies employed by LINKAGES in addition to nontraditional methods to promote healthy behavior change. One of these is environmental alterations where small changes are made to encourage a behavior. This includes actions such as placing water and soap near food preparation areas to encourage hands washing [45]. Alive & Thrive has no published results up to data, thus we cannot determine the effect of their intervention on maternal and IYCF practices.

Models for Improving Maternal and IYCF:

Many of the behaviors targeted for interventions by maternal and infant nutrition programs are complex behaviors that are affected by many factors. Girard et al, that health may not be the

most important determinant of individual's food choices [26]. Other factors such as palatability, social norms, attitudes and beliefs, availability, and accessibility also play large roles in making decisions about foods and supplement consumption [26]. This statement is in alignment with the Socio Ecological Model (SEM) which illustrates behavior change as a result of a multifactorial complex involving the physical, social, and cultural environment. Another model that is often used to explain health behaviors is the Health Belief Model (HBM). HBM specifically states that a person is most likely to change a behavior if: 1) they are aware of the adverse health condition, 2) feel that the condition can be avoided, 3) expect positive outcomes as a result of following recommended actions, and 4) accept the cue to action [10].

Several studies have used HBM to promote behavioral change to improve health outcomes in various settings. Maternal and IYCF interventions that have been implemented with HBM and SEM as underlying theories include a study conducted by Paul et. al in rural Zimbabwe [46]. In this trial, the authors first attempted to understand the local diet of rural Zimbabwean children, then used local foods in addition to introducing the lipid-based nutrient supplement Nutributter® (LiNS) to improve quality of complementary foods [46]. In the first phase of the study, the authors used qualitative methods to identify the general concern with complementary feeding practices in rural Zimbabwe. They then utilized this information to inform key messages to offset some of the issues identified. Problems identified included the lack of diet diversity, low feeding frequency, and poor hygiene practices such as drinking untreated water [46]. Participants were divided into two groups, round one and round two interventions. The authors used a “goal setting” approach utilizing the Trial of Improve Practices (TIPs) methods which included a baseline interview to identify current dietary practices, a counseling session discussing feeding problems, recommendations for improvements, and an agreement by mothers to try two or three

improved practices over 10 days [46]. In round one, only TIPs method was used to improve complimentary feeding practices. Round two participants received LiNS supplement in addition to TIPs counseling.

Paul et. al's results indicated mothers were able to increase nutrient intake via complementary feeding using only locally available foods [46]. However, LiNS was needed to reach recommended amounts of iron and zinc due to the scarcity of animal source foods in the complementary feeding diet. TIPs counseling brought meaningful behavioral change as participants made significant improvements in feeding complementary foods containing energy, protein, vitamin A, folate, calcium, iron and zinc, irrespective of receiving LiNS [46]. Paul et. al also found that after counseling, mothers were significantly more likely to feed beans, fruits, green leafy vegetables, peanut/seed butters and meat. Participants in both TIPs and TIPs with LiNS reported that after counseling they began feeding thicker porridges containing enrichment such as bean powder, cream, custard fruit, juice, milk, peanut butter, or pounded termites [46]. The authors attribute the success of their interventions to their ability to use tailored and context specific messages. For example, they counseled mothers using phrases such as "mash mango," "grind termites," and "prepare bean powder" and found those messages more helpful than general WHO messages such as, "peas, beans, lentils, and nuts and seeds are good for children" [46].

Another study conducted by Holtz and Gibson examined the acceptability and potential of educational programs impact on nutrient intakes via complementary feeding in rural Malawi [32]. The authors were aware of the complexities associated with improving feeding practices in a low-income setting and were addressing this through their intervention activities. As a part of this study, mothers were given four "simple doable actions" aimed at improving complementary

feeding practices [32]. The first lesson was increasing energy density of porridges commonly fed to children; mothers were to do this by adding more porridge mixture. The second lesson was to increase the intake of bioavailable iron and zinc by soaking maize prior to preparation. The third lesson was to enrich porridge mixture by adding energy dense foods such as groundnuts, fish powder, and eggs among other ingredients. The fourth and last lesson was to encourage child feeding, especially when the child was ill. The authors found that over all, participants were willing to adopt these new methods of complementary feeding, although they had difficulty following all the steps offered in some of the lessons [32]. On average, intervention mothers had attended three of the four lessons. When comparing intervention mothers to the control mothers, the amount, intake of energy, macronutrients, iron and animal protein from complementary foods was much greater in the intervention group than the control group [32]. Of the four lessons presented to mothers, the most accepted intervention was the enrichment of porridge while the most difficult intervention was increasing the bioavailable iron and zinc from maize. The authors thought these difficulties may be attributed to complexity of the maize preparation process [32].

Understanding strategies that lead to the implementation of successful behavioral change programs in a culturally appropriate context is crucial to IYCF programming. Unfortunately, there is limited information regarding using behavior change strategies to address not only IYCF, but also the 1000 day period. In an attempt to narrow this gap, our team-developed tools consisting of a bowl, spoon, and counseling card that address the first 1000 days of life starting from conception to when the child is two years old. These tools are designed to aid mothers with intake in relation to the amount, frequency, consistency, and diversity of foods while pregnant and during the postpartum period for themselves as well as during the complementary feeding of infants 6-24 months. Thus, the purpose of this research is to: First conduct formative research

with key informants and community members, regarding the design of the bowl, spoon, and counseling messages as well as discuss potential delivery platforms; Second, to conduct user-testing with pregnant women and mothers with children 0-18 months using a modified Trial of Improved Practices methodology.

CHAPTER 3: MANUSCRIPT

**The Acceptability of Innovative Feeding Tools to Improve Maternal and Child Nutrition in
Western Kenya**

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Abstract:

Dietary practices in Kenya often fail to provide adequate nutrition during the first 1000 days of life. We developed and qualitatively assessed a low-cost, easy-to use demarcated bowl and slotted spoon to assist mothers with appropriate diet practices during pregnancy, breastfeeding, and complementary feeding of children 6-18 months. We conducted 12 focus group discussions with community members and five interviews with nutrition experts to assess acceptability and obtain recommendations on design and delivery in Western Kenya. We also conducted 24-28 days of user testing with 14 pregnant, 14 breastfeeding women, and 32 mothers with infants 6-18 months. Tools were positively received by communities. Mothers perceived improvements in theirs and their children's food intakes including increased quantity, frequency, consistency and diversity. Many attributed own and child's weight gain or increase in energy to tool use. A minority of women reported using the bowl for other activities, or not using the bowl due to food insecurity. Results indicate these tools have the potential to positively impact maternal and child nutrition, however future work should address food insecurity and counseling on responsive feeding.

Introduction:

Maternal nutrition during pregnancy and infant and young child feeding practices directly affect the nutritional status of children younger than two years of age, and ultimately impact child growth, development, and survival [1]. In resource-poor settings, childhood malnutrition remains a major health problem[2] and is the underlying cause of death for 3.1 million children each year globally [3]. These deaths are the result of repeated infections to weakened bodies that have seldom acquired the necessary amounts of energy, vitamins, proteins, and minerals needed for growth [4]. In Kenya, poor infant and young child feeding practices have resulted in a substantial level of malnutrition and poor child health [5]. In 2008, only about 15% of infants 4-5 months were exclusively breastfed; between 28-42% of children 6-24 months receive less than the minimum number of recommended meals; and only 42-58% received adequately diverse foods [6]. At a national level, 35 % of Kenyan children under five were stunted, while 7% of children were wasted and 16 % were underweight [6].

Maternal malnutrition is also a challenge in Kenya [7]. Twelve percent of women ages 15-45 have a body mass index (BMI) of 18.5 kg/m² which makes these women underweight or severely underweight [6]. Low maternal BMI and short stature can lead to adverse pregnancy outcomes including the increased risk for caesarian delivery due to cephalopelvic disproportion, and intrauterine growth restriction [8]. Other factors that can affect birth outcomes are maternal anemia and low gestational weight gain. Because pregnant women have suppressed immune systems, they are at a higher risk for contracting malaria and developing anemia. In Kenya, the prevalence of anemia among pregnant women is as high as 70% in some areas [9]. Malaria infections can also interfere with the maternal-foetal exchange, leading to low birth weight

infants. According to the DHS 2008-2009, six percent of infants born in Kenya were considered to have low birth weight.

There are a number of interventions geared towards reducing malnutrition during the period of conception to two years of age, collectively known as “the first 1000 days.” These interventions include: nutrition education and counseling, balanced protein and energy supplementation, fortification of staple foods, diet diversity strategies, micronutrient supplementation, and ready to use therapeutic foods to treat severe and acute malnutrition. Although these interventions are efficacious, they may not be available, and may not substantially address the underlying behaviors, and knowledge gaps contributing to suboptimal maternal and young child feeding practices. Several theories including the Health Belief Model (HBM) have been developed to aid in understanding factors that influence individual autonomy when making health decisions.

HBM specifically states that a person is most likely to change a behavior if: 1) they are aware of the adverse health condition, 2) feel that the condition can be avoided, 3) expect positive outcomes as a result of following recommended actions, and 4) accept the cue to action [10]. The concept of the “cue” is an important aspect of the HBM as it triggers individual actions towards the desired health behavior. Behavior change can also be viewed through the lens of the Socio Ecological Model which illustrates behavior change as a result of a multifactorial complex involving the physical, social, and cultural environment [11]. Through the lens of this theory, an individual’s behavior is understood through the web of interactions between the social and environmental entities that influence decision making and actions.

Utilizing cues to action in efforts to promote behavior change in child nutrition, the Manoff group developed a child feeding bowl that cued age appropriate meal quantities in children 6-24 months [12]. Formative research in Latin American suggested that the bowl was an acceptable

way to improve child feeding and promote positive feeding behaviors [12]. Unfortunately, additional research to explore the potential for the bowl to shift child complementary feeding practices has not been reported. Furthermore, no research to date has tested these types of tools as strategies to cue adequate meal frequency or consistency to improve maternal diet during pregnancy and early lactation.

To address the limitations of maternal and child feeding practices and building on the initial concept of the child bowl developed by the Manoff group, our team developed a low-cost, easy-to-use tool consisting of a bowl with demarcations and symbols corresponding to the nutritional needs during pregnancy, lactation and complementary feeding along with a sieved spoon and counseling card. The demarcations and symbols on the bowl are distinctive and cue mothers on the amounts of extra food required for themselves during pregnancy, 0-6 months postpartum and the frequency and amount of meals needed by children at 6-9 months postpartum, 9-12 months postpartum, and 12-24 months postpartum. The sieved spoon cues the appropriate thickness of the food. We hypothesize that the bowl and spoon, functioning as simple cues to action, will reduce confusion about the quantity, consistency, and amount of food required throughout the 1000 days of life as well as improve dietary intake.

Methods:

Our study piloted the feasibility and acceptability of the feeding bowl and spoon to promote optimal food intake of mothers during pregnancy and the first 6 months postpartum, as well as of children from 6-24 months postpartum in one urban and one rural community in Western Kenya.

The aims of the study were to:

1. Conduct formative research with key informants, community members, and key community stakeholders on the design of the bowls and spoons, delivery platforms, and counseling messages.
2. Conduct user-testing with pregnant women and mothers with children 0-18 months using a modified Trial of Improved Practices methodology.

Development of the Bowl, Spoon, and Counseling Card: The parameters in table 1 were used to develop bowl prototypes of appropriate volume [47]. Various prototypes of the bowl were rendered using SolidWorks software and printed on a Stratasys Dimension 3D printer. Multiple sizes for spoon slots were tested using locally relevant complementary foods of varying consistency including rice porridge, maize porridge, and millet porridges. The slot sized deemed most appropriate for ensuring adequate thickness was 0.4 cm. Refinements to the shape and design of the bowl and spoon as well as accompanying counseling card were made based on inputs from East African mothers with young children and maternal and child health experts residing in Atlanta Georgia. The final prototypes used in field testing in Western Kenya were produced via injection molding by ProtoMold Inc.

Sampling: Focus group and user testing participants were purposively sampled with the assistance of a key informant who worked with the community for many years. Community health workers also identified participants that met our criteria and were willing to participate.

Data Collection: We drafted semi-structured interview guides and focus group discussion guides and pilot tested them in Atlanta with East African mothers, as well as nutrition experts with international experience working in maternal and child nutrition. We further refined interview and focus group guides during the in-country training and piloting.

Objective 1: To assess community acceptability and obtain feedback on the bowl, spoon, and counseling card we conducted a total of 12 FGD with 6-10 participants and five in-depth interviews with maternal and child nutrition experts in one urban and one rural community in Western, Kenya. FGDs were conducted with the following groups: pregnant women; mother in laws/grandmothers; community leaders; husbands; and health care workers. We recorded all interviews and FGDs with participant permission and took extensive notes from which we prepared detailed summaries for the FGDs and verbatim transcripts for interviews. FGDs and interviews with key informants took approximately 1-1.5 hours. All summaries and transcripts which were directly translated to English were de-identified prior to analysis.

Objective 2: To test acceptability and understand families' perceptions of the bowls and spoons, we conducted user testing using a modified trial of improved practices methodology whereby pregnant women and mothers with children 0-18 months tried the bowls and spoons for a 28 day period with researcher-administered interviews and counseling as needed at baseline, midline, and end-line. A final focus group discussion was conducted after the endline interview with participants in user testing. Through this process we gained feedback on use, barriers to uptake and recommendations for improvements. We conducted user testing with 14 pregnant women (7 urban, 7 rural), 14 women 0-6 months postpartum, and 32 women with children 6-18 months (16 urban, 16 rural).

Baseline Interviews: Baseline interviews provided us with an understanding of the families' dietary practices and expectations for the feeding tools, as well as addressed initial perceptions about the bowl, spoon and counseling card. Mothers were asked detailed questions about their current dietary practices using the bowl for estimating amounts of foods consumed, followed by

a dietary counseling session based on current practices. The tools were introduced and mothers received counseling on use to achieve dietary recommendations.

Midline: After 12-14 days, a midline interview was conducted. Mothers were interviewed about their experiences with the bowl and spoon, current dietary practices and how they address emerging issues concerning the tools thus far. Mothers were provided with additional counseling as needed.

Endline: 12-14 days post midline; mothers were visited for the final interview in which they were asked to discuss their holistic experience with the tools. This included acceptability, problems encountered and how they were resolved during the trial period. Participants were also asked to discuss potential delivery platforms, recommendations on tool improvement, and perceived impacts on maternal and young child feeding practices.

Follow up FGDs: After completion of the user testing, we conducted two FGDs one with 10 rural participants and one with 6 urban participants. The purpose of these FGDs was to discuss collective experiences and provide opinions about acceptability, feasibility, and potential delivery strategies for the bowl, spoon and counseling card.

Ethics: Research protocols were reviewed and approved by Emory and Kenyan ethical review boards. All participants provided informed consent form and granted us permission to record interviews and FGDs.

Analysis: Detailed summaries of focus group discussions and transcripts of in-depth interviews were analyzed using MAXQDA 11 to identify common dietary beliefs and practices as well as the best delivery platforms for the bowl and spoon. Detailed summaries and transcripts were entered into MAXQDA where memos were created followed by the creation of 25 codes. A

thematic analysis was done mainly by activating the desired document codes and retrieving segments. Thematic analysis of participants' opinions on the various topics related to the bowl spoon and counseling card was conducted via Microsoft Excel for the baseline, midline and endline interviews with mothers. This was the most appropriate methods for data analysis considering the large number of interviews (~180). We created five excel sheet one for pregnant women, one for breastfeeding women 0-6 months postpartum and three (6-8, 9-11, 12-18) for complementary feeding children. The stratification for complementary feeding was due to the difference in feeding practices associated with different age groups. Columns were created for each question in the interview guide and all answers were numerically coded and entered for each participant based on their answer. Data on attitudes and belief were memoed, grouped based on themes, interpreted, then reviewed for accurate representation.

We did not conduct direct quantitative measurements of the amounts of foods consumed by mothers or their children. Rather quantities were qualitatively assessed using the demarcations on the bowl based on quantitative calculations. We determined the consistency of foods based on the utensils used for consumption and background knowledge about the foods consumed. Numbers of solid meals per a day were determined by the amount of solid foods consumed and the frequency of consumption. To determine changes in food consumption during pregnancy/breastfeeding and non-pregnancy/non-breastfeeding, we compared corresponding food item columns (solid meals, snacks, porridge etc.) and did a simple comparison of the number of times the foods were consumed during pregnancy/breastfeeding and non-pregnancy/non-breastfeeding. A similar method was followed to determine the difference in food consumption at baseline, midline, and endline.

Results:

Acceptance of the Bowl, Spoon and Counseling Card: The bowl, spoon and accompanying counseling card were well received by community members who participated in the focus group discussions. Participants were fond of the material and the durability of the bowl, and most liked the concept of the sieve spoon in measuring the constancy of meals especial children porridge. All participants also said that because the bowl is white, “dirt can be easily detected” thereby promoting cleanliness. Mothers who participated in user testing stated that the bowl was well accepted in their homes. One mother said “At my place they just took it well. They saw it as the baby’s feeding bowl.” Another said, “My people were so happy; they said that the bowl is beautiful and if you were distributing them for free, they would also come for theirs.” However, a few groups such as the rural husbands group said, the spoon would be too big for babies’ mouths.

Community Norms Regarding Maternal and Child Feeding Practices:

Dietary Practices of Pregnant Women: We collected data from community FGDs and baseline interviews with mothers who participated in user testing to identify norms and practices related to maternal and young child feeding. Dietary practices did not vary during pregnancy and non-pregnancy for participants in urban and rural area. Generally interview and FDG participants reported women consumed tea, two meals a day irrespective of pregnancy status, and one to two snacks per a day. Beans, ugali (dense boiled corn porridge) vegetables, and fruits were the most commonly consumed foods. However, consumption varies by seasonal availability, and cultural beliefs about the effects of different fruits and vegetables on milk production and size of the baby at delivery. Participants in the FGDs and interviews also stated that pregnant women mainly ate what they craved but they also ate more traditional vegetables like jute plant and cow pea leaves, which are thought to be “good for pregnant women.” Participants also reported that the

consumption of animal source protein did not vary by pregnancy status, over all; chicken was rarely eaten, while meat and egg consumption depended on financial resources. Fish consumption varied by type of fish and stage of pregnancy as some fish were believed to be better than others for fetal development.

Dietary Practices of Breastfeeding Women: Participants from FDGs and interviews said the majority of breastfeeding women's eating habits remained the same pre-and post-delivery; however, during user testing 40% of breastfeeding women reported consuming an extra meal at baseline because culturally they are expected to do so. Breastfeeding women consumed all foods with the exception of cow pea leaves prepared with bicarbonate and other spices thought to prohibit milk production. A rural breastfeeding mother said "If you are breastfeeding you should not cook 'kunde' using 'msherekha' (traditional spice) because it will dry out your breast milk." Other beliefs include the prohibition of spider plant 1-14 days post-delivery. In addition, user testing participants reported that women who delivered via caesarian section do not eat ugali for two months, because it believed to puts stress on the stomach and the caesarian wound. By default, these women also do not eat the accompanying vegetables and meats normally consumed with ugali. A rural woman who experienced a caesarian section said, "I do not eat ugali so I do not eat a lot of things and therefore milk is little. Ugali promotes milk."

Breastfeeding women reported regularly attending postnatal clinics. However, mothers reported rarely receiving advice on how they should eat to support breastfeeding. Of the few women who received advice, they were told to consume a "balanced diet" which ultimately translated to consuming foods "available to the women." Half of the breastfeeding women participating in user testing received advice regarding infant feeding and indicated they were told to exclusively breastfeed for the first 6 months, then feed cow's milk and light porridge as first foods.

Infant and Young Child Feeding Practices: Initiation of complementary feeding varied by family circumstances and babies perceived level of dissatisfaction with breast milk alone. Among mothers participating in user testing, for example 17/36 women began complementary feeding at 6 months, while the majority of the remaining initiated complementary feeding earlier. Almost all mothers initiated complementary feeding with a two to three week period of diluted cow's milk (1/2 milk and 1/2 water) followed by the introduction of a light 'beginner' porridge (uji). Beginners' uji is mainly a homemade mixture of maize, cassava, millet flour, milk and sugar. Children ages 6-8 months are fed beginners uji two to three times a day, and are fed thicker uji past 8 months of age as ingredients like groundnuts, soybeans, ground fish, and sometimes eggs, are added. This thicker uji is typically prepared to be thin enough to serve in a cup and drank by the child.

Fruits, which are generally mashed and sieved, are introduced as snacks prior to the introduction of vegetables. The most commonly fed fruits are avocado, ripped bananas, papaya, and oranges. Other foods commonly fed beside uji include fruits are mashed Irish potatoes and cooked bananas (plantains). Potatoes and bananas usually accompanied by boiled and mashed traditional vegetables such as black night shed, amaranth jute plant, cow pea leaves, and kale. Although these vegetable mixes are typically semisolids, they are considered snacks by families. Figure 1 show specific ages for the introduction of other foods such as ugali, githeari (mixture of beans, corn, and vegetables), rice and beans which are also reserved for older children (figure1).

Many protein rich foods are introduced to children between the age of 12-24 months due to various reasons, the biggest being fear of choking. A minority of mothers with children 6-8 months fed protein rich foods at baseline. Generally children ages 6-11 months receive their

proteins from uji mixes containing ground beans, fish, and groundnuts. Eggs, although highly nutritious, were not fed to children prior to speech development because of the common belief that consumption of eggs slows the child's speech. Another norm that surfaced was forced feeding, which was reported to be widely practice in Western Kenya. At baseline 38% of mothers indicated they used force-feeding to get children to eat more foods. Force feeding was most common when a child's feeding habits changed and especially during illness.

Effects of Feeding Tools on Dietary Practices:

Effects among Pregnant Women: At baseline, only 4/14 pregnant women were consuming three to four meals per a day. By midline all the pregnant women in the study increased the number of meals consumed by at least one extra meal a day while 40% of women increased the number of meals by two or more meals. These numbers remained constant through endline (table 2).

Perceived Benefits: Pregnant women, who used the bowl as recommended, reported positive physical changes, such as increase in energy, lack of headaches, and weight gain. An urban pregnant woman said "I take a bowl full of githeri or bananas and then I take porridge afterwards. I now have strength in the body to be able to work. I used to eat before, but I would still feel weak afterwards. But I now have strength because of the extra porridge that I take after eating." Another urban woman said "They [the tools] are very helpful. They can better someone's health especially those who are pregnant...one becomes more active. Spells of dizziness disappear too. One is instructed to eat four times; there is a big difference between someone who eats four times a day as compared to one who eats three times a day. "

Women who participated in user testing stated high desirability for the bowl and spoon in their communities during follow up FGDs. A rural mother states "I think if people in my area are

given, most of them will use it because they keep asking me questions and ask me why I am the only one who got it. They say that I should have informed them when they [bowls] were being distributed so that they [neighbors] go and get one too. I tell them that it is by the Grace of God that I was chosen to be given one. They said that I should inform them if I hear that the bowls are being distributed, and I told them that I definitely will.” Several pregnant women also stated teaching family members and friends about the bowl and its’ benefits including allowing them to demark feeding cups and bowls based on age appropriate measurements from the feeding bowl. One rural pregnant woman said “I have educated my pregnant friend and my husband about the bowl, spoon and card and they are so impressed.”

Perceived Challenges: Pregnant women faced two main challenges when using the bowl; namely cultural beliefs related to eating down during pregnancy and secondly financial constraints that limit access to food. Thirty five percent of women at baseline stated fear of having large babies and the inability to have natural deliveries due to consumption of too much foods or fatty foods. Women were given advice by their mother and mother in laws such as “If you eat then just in very small portions because the baby will grow very big and it will be hard to deliver” (rural pregnant woman). Another reported challenge was the need to ensure children’s needs are met prior to consuming extra foods for themselves. When asked, an urban pregnant woman said “I don’t eat more because we are buying food and there are other needs. My other children are in school and they require school fees. I cannot concentrate on eating food and forget about their education.”

Effects among Breastfeeding Women 0-6 Months Postpartum: Breastfeeding women 0-6 months post partum’s’ feeding habits shifted dramatically over the course of the study. At baseline 6/15 women were consuming three to four meals a day, and by midline 93% of the women were

consuming three to four meals a day. 12/15 women continued consuming an extra meal until the end of the study while, three women stated having food insecurities and used the bowl when extra foods were available. In addition to the extra meal, 71% of breastfeeding women consumed at least one to two snacks (fruits, ground nuts, maiz) per a day at endline.

Perceived Benefits: Most women 0-6 months postpartum reported positive physical changes that they attributed to tool use. Eleven of fifteen women reported a combination of the following perceived benefits: increased milk production, weight gain, increased energy, and perceived infant weight gain. Perceived health benefits did not differ between urban and rural women however, these benefits influenced women's infant feeding decisions. For example, three mothers who were intending to initiate complimentary feeding early due to perceived "lacks of milk" decided to exclusively breastfeed until 6 months after using the bowl. An urban women states "The teachings you gave me have helped me have enough milk for the baby. The baby was hungry all the time, but now he is ok. The baby is now stronger and she breastfeeds well." Other women noted the general health benefits regarding the bowl and spoon use, they made comments such as "The baby is healthy, I eat and the baby gets the nutrients from me...the baby's body just shows this, it [skin] is softer" rural woman.

Perceived Challenges: The biggest challenge for lactating women during the user testing period was food insecurity. At endline three women had cut their food consumption to one meal a day to ensure food for their children. Another challenge, though minor, was that ½ of the women misunderstood the message and did not add an extra meal, or used the bowl to measure all foods consumed including tea instead of using the bowl once a day for an extra meal. By endline, all but one woman understood the message and used the bowl as recommended when foods were available.

Effects of Tools on Feeding Practices of Children 6-18 Months: As presented in table 3, complementary feeding practices improved greatly over the course of the study. At baseline, approximately half of all children and most of those 6-8 months whose main diet consisted of thin uji and diluted cow's milk were underfed. By endline, however 100% of children 6-8 months were the recommended number of semisolid meals. Most families introduced new foods to their children by end line. These included eggs, leafy vegetables, and fish. A rural mother who began feeding vegetables during user testing said "I bet I just used to deny my child foods thinking she couldn't chew them, but she actually enjoys eating them."

Perceived Benefits: Complementary feeding mothers were extremely appreciative of the bowl and said it provided certainty, because they often were unsure about under or over feeding their children. A rural mother said "What I liked in the bowl is the demarcations for the amounts of food, since now I know how much the baby should feed." This was reiterated during follow up FGDs. One mother said "For me it was the demarcations on the bowl that pleased me as they enabled me to feed my baby food that was adequate for his stomach since before then I didn't feed enough food, but when you gave me the bowl I now see that the baby has good health."

By endline, 81% of complementary feeding mothers perceived their children had gained weight, increased in energy, and/or had reduced illness which they attributed to changes in feeding practices. One urban mother said "She has gained weight.... I think I was giving her less food before." Three women who indicated their children were malnourished at baseline reported improvements in children's weight at the end of the study. One child in the urban area was on Plumpy Nut and the mother reported the child gained ½ a kilogram during user testing, despite being on Plumpy Nut for four months with limited weight change prior to using the tools.

Another woman, a rural mother of a seven months old child, said "If it were not for changing the

way I used to feed him, I guess I could have buried him a long time ago. He really had poor health. He was so wasted till people could just pity him. He cannot even laugh.”

Perceived Challenges: Complementary feeding mothers were uncomfortable with preparing “thick uji.” Many mothers decided to use the spoon for preparing “medium thickness” uji which “moved slowly through the spoon slots.” Furthermore, incorporating protein rich foods, especially animal source proteins was a challenge for mothers because of fear of choking and the belief that eggs inhibit speech development. Mothers who agreed to introduce eggs (n=20) were relieved about absence of speech impediments. Overall, consumption of protein rich foods for all children increased significantly from baseline to endline (figure 2, 3, 4).

Discussion:

This pilot study assessed the feasibility and acceptability of a feeding bowl, spoon, and counseling card as cues to action to promote optimal food intake of mothers during pregnancy during the first 6 months postpartum, as well as of children aged 6-24 months in Western Kenya. Tools were positively received by communities. Mothers perceived improvements in theirs and their children’s food intakes including increased quantity, frequency, consistency and diversity. Research on the implementation of cues to action during user testing as a means of encouraging optimal nutrition intake for mothers and infants is limited. However, Paul et al utilized a user testing method similar to ours for improving complimentary feeding practices of children in Zimbabwe [46]. Their results indicated that TIPs counseling brought meaningful behavioral change where mothers were able to increase nutrient intake via complementary feeding using only locally available foods [46]. Based on Paul et al results and investigations completed by Manoff [12], we can confidently state that observed improvements in maternal and child nutrition are a result of the bowl, spoon, and counseling card use.

Use of the bowl, spoon, and counseling card positively affected perceptions of improved health among pregnant women and milk production among breastfeeding mothers. Several authors have written about maternal perceptions of food consumption and its association with milk production [48-50]. Webb et al. who conducted a mixed methods study in Nakuru, Kenya regarding women's attitudes towards exclusive breastfeeding as a result of food insecurities reported a strong positive conceptual link between maternal well-being and the perceived ability to produce sufficient breast milk [51]. It is hypothesized that increased perceived ability to produce sufficient milk may increase breastfeeding self-efficacy, a critical behavioral component for successful breastfeeding [52]. In our study, breastfeeding women perceived and attributed increases in milk production to tool use and cited greater confidence in their ability to exclusively breastfeed, with some claiming they had switched from mixed feeding back to exclusive breastfeeding. These perceptions suggest that the bowl, spoon, and counseling card may serve as avenues for supporting exclusive breastfeeding given the perceived links that women make between food consumption and milk production.

As previously reported by Manoff, the concept of a child bowl is effective in improving complementary feeding practices in developing countries [12]. Specifically, our findings suggest that children were fed greater amounts of thicker and more diverse foods more frequently. This shift is largely a result of counseling and the demarcations on the bowl. User testing mothers were empowered by the demarcations because it bridged the knowledge gap between their desire to feed their children optimal amounts and the possibility of doing so thereby allowing them to act i.e feeding their infants the recommended frequencies and amounts of foods. Lack of knowledge about amounts, and frequency of complementary feeding was reported as a challenge in Zimbabwe by Paul et. al and in Bangladesh during the Alive & Thrive program

implementation [45, 46]. To remedy this, Alive & Thrive provided a 250-mL bowl to cue mothers about age-specific feeding quantities [45]. This is one example that shows the need for these tools in promoting optimal foods intake for infants, especially in developing countries. In this trial, the bowl, spoon, and counseling card were successful as cues because women believed in their ability to follow the recommendations and expected positive outcomes as a result.

Factors that Undermined Uptake: According to the socio ecological model, individual's behaviors are affected by cultural and environmental factors that can undermine or support the uptake of new ideas. In the case of the bowl, spoon, and counseling card, there were several factors that supported uptake, however, food insecurity, repurposing, fear of choking, and cultural beliefs challenged the recommended use of these tools. Food insecurity was reported as a barrier to increase maternal but not child food consumption. This was because of the cultural expectations of mothers eating last during times of food scarcity. Acknowledging that people make decisions based on their cultural beliefs and environmental pressures, we counseled food insecure mothers to consume the extra meal whenever possible. Another factor that undermined tool uptake was repurposing as indicated by a few mothers in the study. This was a common practice in Western Kenya as it is perceived that if an object can be used for multiple functions, then it is a worthy investment. To limit this practice, mothers were encouraged to mark other household items with desired measurements in order to use the bowl for its intended purpose. Moreover, several mothers expressed the wide spread concerns regarding children choking on vegetables. These mothers were encouraged to feed "soft" vegetables such as amaranth, and jute plant as opposed to kale. Lastly, tool use was hindered by cultural beliefs such as eating down for pregnant women and the prohibition of eggs from children's diets. Similar findings regarding eating down have been reported by Christian et. al who found that Nepalese women not only ate

less frequently, but also limited the diversity of foods consumed [53]. Women ate less for various reasons including personal preference, seasonal availability, and the desire for smaller babies to ease delivery [53]. Understanding mothers' desires for uncomplicated deliveries as well as their desires for healthy babies, we counseled women on the importance of different types of foods for infant development. Furthermore, to address the speech impediment concerns, participants were presented with alternative food preparation methods which was a technique also used by Paul et. al during user testing with Zimbabwean women to address cultural barriers related to complementary feeding [46].

Factors that Supported Uptake: Although there were social and environmental barriers to the uptake of the bowl, spoon, and counseling card, there were also factors that promoted uptake and allowed for the use of the tools as cues. One of these factors was food availability especially for breastfeeding women because in times of food abundance, these mothers are socially encouraged to consume more food. This expectation eased breastfeeding women's ability to consume the extra meal as it was in congruency with cultural norms. The actual act of consuming the foods was made possible because in this case the perceived barrier (lack of food) was removed and women's self-efficacy was restored leading to an increase in food consumption. This is not illustrated in the quantitative data reported in table 2 because several lactating mother who were experiencing food insecurity remained in the study, while pregnant women who may have experienced food insecurity were loss to follow up. Similarly to the expectation of increased food consumption for breastfeeding women, the concept of "baby dishes" was already in place as children 6-24 months were trained to recognize individualized set of feeding utensils and associate them with feeding times. This allowed for our tool to become the "baby bowl" with little opposition. Over all, we found that the strongest predictor of recommended tool use for

breastfeeding women is food availability while for pregnant women it is their belief in the ability to have natural deliveries. The strongest predictor of recommended tool use for children, however, was caretakers perceptions regarding choking when consuming thick foods.

Recommendations and Delivery Platforms: Participants from the community FGDs and user testing were fond of the bowl, spoon and counseling card; however, they made suggestions for improvement. These include making double handles for the bowl as well as making the spoon smaller and smoothing the edges. Minor suggestions were made to improve counseling card, such as adding messages about varying food preparation methods, or dual purposing counseling card such as creating a nutritional counseling calendar. Participants suggested that the tools be delivered through health facilities, with support and counseling from community health workers to prevent corruption and preferential distribution.

Limitations and Future Research: Despite the positive aspects of this study there are some limitations. These include a small sample size, lack of a comparison group, short study duration, and intensive counseling which does not reflect field conditions. Our small sample size prohibits the generalizations of these results outside of the communities included in the study. Also the short duration of the study did not allow for the observation of barriers and long term benefits associated with tool use. In addition, we also did not utilize comparison groups which do not allow us to attribute perceived benefits to tool use alone. Also, the intensive counseling received by participants during user testing is not reflective of field conditions. Moreover, because of simultaneous implementation of intense counseling and the provision of the bowl, spoon, and counseling card, it is difficult to distinguish whether the tools or the intense counseling resulted in the observed outcomes. Lastly, we had several pregnant women lost to follow up which can

explains the discrepancies in the quantitative results between pregnant and lactating women presented in table 2, and the qualitative data presented in the results section.

Future research regarding these tools should focus on quantitative measurements of food intake and physical improvements as a result. Further investigations can also be done to assess the effects of individual counseling or group counseling on adherence to tool use as recommended. Moreover, there is a need to conduct this study with counseling that is aligned with field conditions. In addition, further research is needed to identify effective and efficient delivery platforms for these tools. In summary, the bowl, spoon, and counseling card are a promising mechanism for improving the amount, frequency, consistency, and diversity of foods consumed by Western Kenyan mothers and their infants. These tools also have the added benefit of improving adherence to other health messages such as consumption of IFA and the improvement of hygiene practices

Tables and Figures:

Table 1: Parameters used to estimate the size of the bowl					
Life Stage	Kcal/perday ¹	g/day ²	Meals/day ³	g/meal	mL/meal ³
<i>6-9 months</i>	356	593	3	200	~210
<i>9-12 months</i>	476	793	3-4	264 ⁴	~277
<i>12-23 months</i>	772	1287	3-4	322 ⁵	~338
<i>Pregnancy & Lactation</i>	~400-500	500-625	N/A		~460-575

¹Additional kcal needed assuming average breast milk intake of infant (Dewey et al, 2003) or healthy pregnant / breastfeeding woman (NRC, 2006)

²based on low energy density foods, 0.6 kcal/g

³based on calculations using low density food (ie. maize meal porridge = 219g/230 mL)

⁴based on 3 meals a day

⁵based on 4 meals a day

Table 2: Changes in nutritional practices among pregnant and breastfeeding women at baseline, midline, and endline in Western Kenya (n=28)

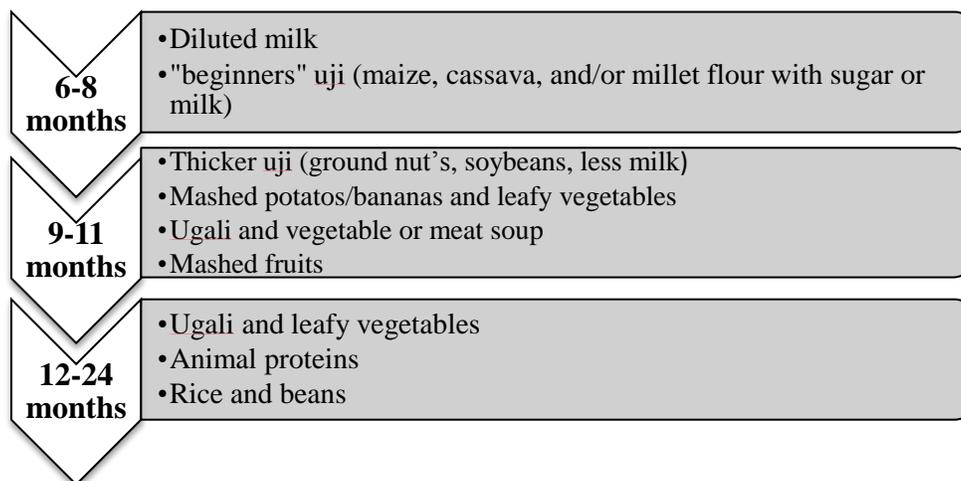
	Consuming IFA			Consume 3-4 meals per day			Consume extra meal per day		
<i>Women's Status</i>	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>
<i>Pregnant Women (n=14)</i>	3/14 (21%)	7/12 (58%)	6/10 (60%)	4/14 (28%)	12/12 (100%)	10/10 (100%)	0 (0%)	10/12 (83%)	9/10 (90%)
<i>Breastfeeding Women 0-6 months postpartum (n=15)</i>	N/A	N/A	N/A	6/15 (40%)	14/15 (93%)	12/14 (86%)	6/15 (40%)	13/15 (87%)	12/14 (86%)

Table 3: Complementary feeding practices of children ages 6-18 months at baseline, midline, and endline in Western Kenya (n=32)

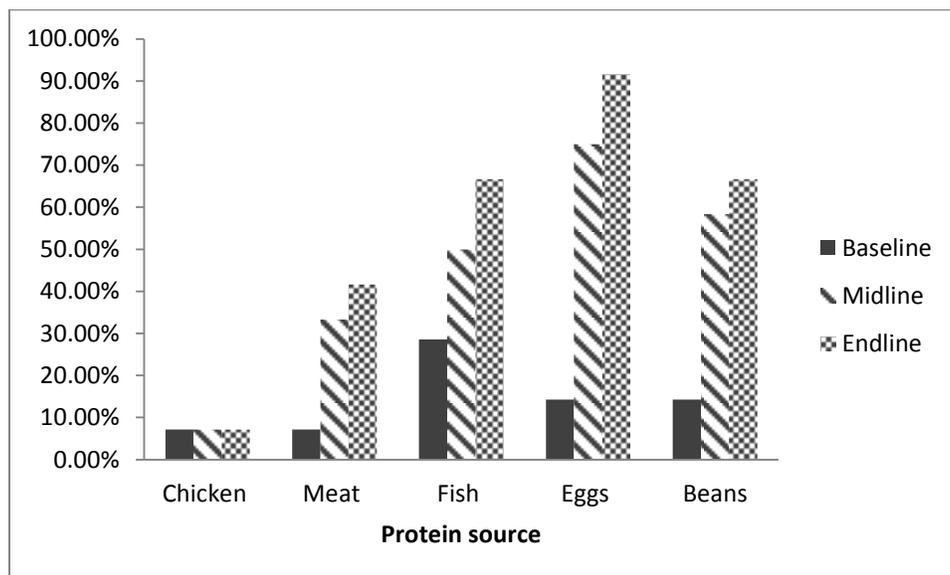
*Depicst lower uptake-mothers of 12-18 used the bowl for ugali only and did not measure accompaniments (vegetables, meat/eggs) even though they were consumed

<i>Child's age</i>	Consumed recommended <i>number</i> of semisolid meals per a day			Consumed recommended <i>amount</i> of semisolid food during meals			Consumed recommended <i>thickness</i> of uji		
	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>	<i>Baseline</i>	<i>Midline</i>	<i>Endline</i>
6-8 (n=14)	28%	71%	100%	42%	92%	92%	21%	83%	83%
9-11 (n=10)	70%	78%	86%	10%	89%	100%	70%	78%	86%
12-18 (n=11)	45%	44%	72%	0%	50%*	50% *	45%	44%	70%

Figure 1: Complementary feeding timeline for children 6-24 months in Western Kenya (n=32)



**Figure 2: Change in consumption of protein rich foods for children ages 6-8 months
(baseline n=14, midline & endline n=12)**



**Figure 3: Change in consumption of protein rich foods for children ages 9-11 months
(baseline n=10, midline n=9, endline n=7)**

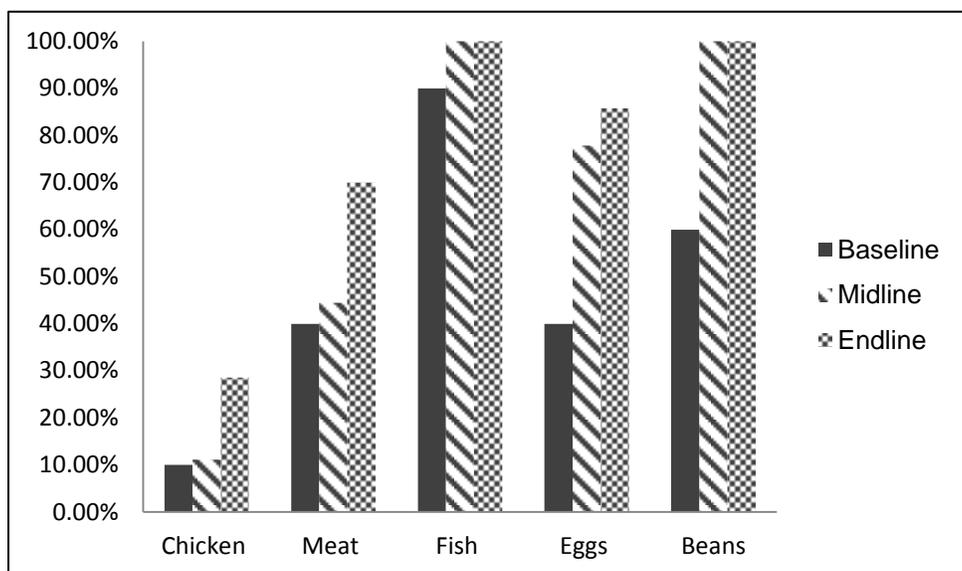
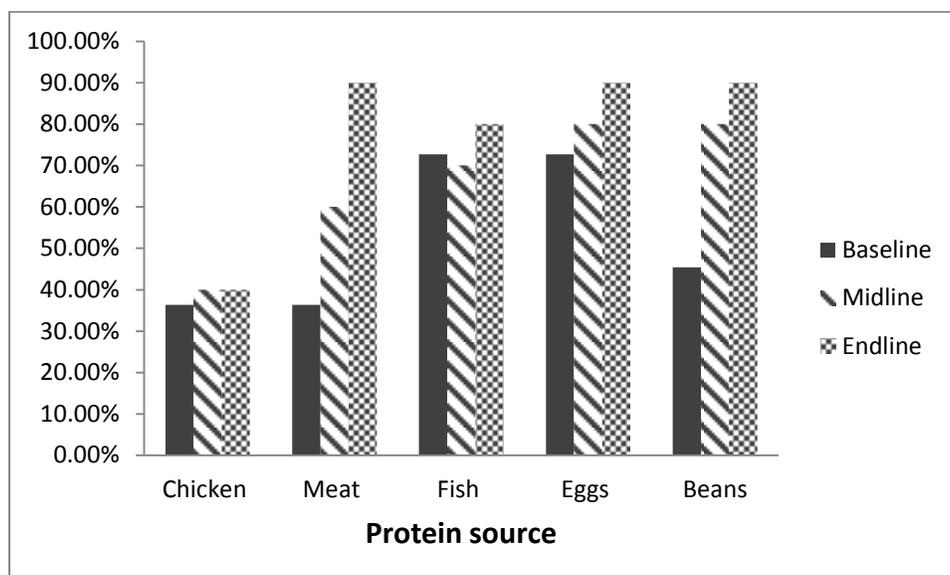


Figure 4: Change in consumption of protein rich foods for children ages 12-24 months (baseline n=11, midline n=10, endline n=10)



CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

Public Health Implications:

Malnutrition including fetal growth restriction, suboptimum breastfeeding, stunting, wasting, and deficiencies of vitamin A and zinc, cause 45% of child deaths, causing in 3.1 million deaths annually [3]. Over two-thirds of these deaths are associated with poor nutrition in pregnancy inappropriate feeding practices during the first year of life. Although the WHO recommends exclusive breastfeeding for the first 6 months, only about 35% of infants worldwide are exclusively breastfed for the first four months of life [54, 55]. Many children begin complementary feeding too early or too late and are often given nutritionally inadequate or unsafe foods. Thus, there is need for a sustainable and cost effective intervention that addresses this issue during the first 1000 days, from conception to two years of age. Our team developed tools to promote optimal feeding for pregnant and breastfeeding woman 0-6 months postpartum as well as children 6-24 months of age. We conducted formative research with community stakeholders and received feedback regarding the design of the bowls, spoons, and counseling cards as well as possible delivery platforms. We also conducted user testing with pregnant, breastfeeding, and mothers with children 6-18 months. We found that these tools shifted maternal and child feeding practices in participant households. The majority of pregnant, breastfeeding, and complementary feeding women in the study increased the amounts, frequency and diversity of foods consumed by themselves as well as by their children. Looking at the health belief model, we attribute the reported results to the mothers' self-efficacy and their ability to view the bowl, spoon, and counseling card as cues for behavior change. Several sociocultural and environmental conditions contributed to the uptake of these tools including the

expectation for breastfeeding mothers to consume more foods; while others factors such as food insecurity and fear of choking undermined tool uptake.

Based on our findings we make the following recommendations for maternal and IYCF programmers in Western Kenya as well as in the context of the bowl, spoon, and counseling card.

Pregnant and Breastfeeding Women 0-6 Months Postpartum:

1. Create demand and ensure available stocks of iron and folic acid (IFA) in health facilities. Many women in this study were not aware of the importance of IFA and those who were aware were hindered by lack of supplements at their local health facilities. Therefore, ensuring a steady supply of IFA is crucial in determining consumption. Our results indicate that once women possessed knowledge about the benefits of IFA, they are more inclined to attend antenatal clinics and receive the supplements. This indicates that promotion of benefits associated with IFA consumption can be used as mechanism to create demand.
2. Conduct refresher trainings for health care workers regarding nutrition recommendations for pregnant and breastfeeding women. The majority of women in this study who attended antenatal/postnatal clinics were not given recommendations regarding own diet and nutrition. Those who were advised were often misinformed. Health care providers are an excellent vehicle for delivering messages because they are highly respected and trusted members of the community and thus have the potential to shift attitudes.
3. Involve husbands and mother in-laws in maternal and child health issues. Household decisions are often not made by women in Western Kenya therefore the involvements of the husbands as the head of households and the grandmothers as culturally designated

care givers and advisors is crucial for program uptake [56]. This strategy has also been effective in Malawi, Senegal and Bangladesh and can easily be adopted in Kenya [56-58].

4. Emphasize simple doable actions based on cultural values. Creating personalized health messages reflective of the cultural context has been used in other African countries and has proven to be effective [46]. These messages can be simple phrases such as “Eat cooked greens with your ugali to increase your blood (iron levels).”
5. Continue emphasizing the importance of exclusive breastfeeding and assisting mothers to manage barriers. Although children are universally breastfed in Kenya, the prevalence of exclusive breastfeeding is extremely low as reported by user testing women in this study and supported by other findings [6]. Maternal perceptions of inadequate quantities and quality of milk, beliefs about particular foods and their ability to promote child growth, and baby cries interpreted as signs of hunger are some of the barriers associated with early initiation of complementary feeding in Kenya [59]. Educational campaigns or counseling targeting these perceptions may be the most effective for promoting exclusive breastfeeding in Western Kenya. Specifically, emphasize the benefits of exclusive breastfeeding, including the nutritional, protective, emotional, and cognitive development value in a culturally relevant manner may be most effective. Campaigns can also address misconceptions regarding baby cries and offer explanations other than hunger as a trigger. Furthermore, women can be taught about expressing milk and appropriate storage options.
6. Promote bowl, spoon, and counseling card use to improve breastfeeding self-efficacy. As demonstrated in this study, feeding tools greatly improve breastfeeding practices because

they shift women's perceptions regarding their ability to produce milk and breastfeed for the recommended duration of 6 months.

Complementary Feeding:

1. Teach home enrichment techniques of foods using specific and context relevant messages. Adherence to the preparation of nutritious foods can be accomplished when the ingredients are perceived to be palatable and available. In Kenya, many foods are available based on seasonality; however some foods like fish in Western Kenya are abundant throughout the year and vary in price range which makes it easier for both rich and poorer families to obtain fish. By using such ingredients and providing specific counseling messages IYCF programs can dramatically shift complementary feeding practices in Kenya. Such messages can include: "Add grounded omena and ground nut powder to thicken uji."
2. Counsel on various methods of food preparation. This strategy is most important for feeding foods like eggs which when boiled are believed to cause infant speech impediments. However, other methods of preparing eggs are permissible for infants. Offering different methods of food preparation can dispel beliefs regarding infants' inability to consume particular foods. This tactic was effective in this study for increasing the consumption of eggs by children 6-24 months of age.
3. Promote responsive feeding. Forced feeding was reported as a common practice due to various reasons including child illness. To discourage this practice, caregivers should be taught about the hazards of force feeding including choking, injuries and possibly death.
4. Use tools to counsel and support adequate meal quantity, frequency, consistency and diversity. Results from this trial illustrate the need for tools to aid mothers with the

preparation of optimal complementary foods and demonstrate community acceptability of such aids. Mothers were confident in their ability to feed their children adequate complementary foods as a result of using the bowl, spoon, and counseling card.

Future Research:

Future research regarding these tools should be focused on quantitative assessments using controls groups and different interventions groups to understand the effects of the bowl, spoon, and the counseling card as individual entities. Quantitative assessments should also focus on measuring the physical changes attributed to each intervention. Moreover, if these tools are being implemented on a larger scale in Western Kenya, counseling messages should include various methods of food preparation, and responsive feeding to address the issue of force feeding. Also, since a combination of group and individual counseling has been documented as the most effective method of improving feeding practices in many contexts, it would be worthy to test this dynamic using these tools. In addition, future research can be done in a different season to better understand the effect of seasonality on diet diversity, amounts, and number of meals consumed by pregnant, breastfeeding women, and children 6-24 months old. Also, there is a need for research regarding effective and efficient delivery platforms for these tools. As indicated in this study, multiple avenues including facility and market based delivery platforms can be adopted. Lastly, acknowledging the reported changes on severely malnourished children, further investigations can be done to better understand the effects of the bowl, spoon, and counseling material as an intervention to improve the nutritional status of severely malnourished children in this region.

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