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Deborah Kortso Collison

The acceptability and utility of an innovative feeding bowl and sieved spoon to improve maternal and child nutrition practices in Bihar, India

By

Deborah Kortso Collison

Master of Science in Public Health Nutrition

Thesis Committee Chair:

Amy Webb-Girard, PhD

An abstract of a thesis submitted to the Faculty of the Rollins School of Public Health of Emory University in partial fulfillment of the requirements for the degree of

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ABSTRACT

The acceptability and utility of an innovative feeding bowl and sieved spoon to improve maternal and child nutrition practices in Bihar, India

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Introduction: Dietary practices in India often fail to provide adequate nutrition during the first 1000 days of life. We used a life course approach to develop and qualitatively assess a low-cost and easy-to use demarcated feeding bowl and slotted spoon designed to assist mothers to practice appropriate diet practices for themselves during pregnancy and the period of exclusive breastfeeding and for their children 6-24 months of age. **Methodology:** In Samastipur district, Bihar India we conducted 16 focus group discussions and 8 key informant interviews to identify community acceptability and obtain feedback on design and delivery of the bowl and spoon. We conducted user testing with 20 pregnant women and 20 breastfeeding women 0-6 months postpartum and 20 mothers with infants 6-18 months. **Results:** The tools were well accepted by the community, though communities recommended manufacturing them in steel. The proportion of pregnant and breastfeeding women taking an extra portion of food per day increased from 0% to 100%; number of meals increased from 2-3 to 3-4 / day. For children 6-18 months, meal frequency, quantity of food consumed during meals and thickness of the foods increased for all age groups. Children 6-8 months who had not yet initiated complementary feeding all initiated during the testing period. **Conclusion:** Simple feeding tools are culturally acceptable and can be appropriately used by families in Bihar India to improve dietary practices during the first 1000 days of life. Research is needed to assess whether the tools promote dietary and nutrition improvements over and above counseling alone.

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CHAPTER I: INTRODUCTION

In India over 50% of children under three years of age are stunted and 33% are wasted (1).There is a high rate of stunting and wasting even in children under five months old in India. Recent documentation shows 30% wasting and 20% stunting among this age range (2). Low gestational weight gain due to poor and insufficient dietary intake during pregnancy is a major determinant of low birth weight, and it is common in low and middle income countries (3).Low uptake of exclusive breastfeeding, compounded by inadequate complementary feeding practices from 6 months onward further contributes to continued growth faltering in early childhood and other developmental delays (2). Urgency is required to address nutrition during pregnancy and the first two years of a child's life because growth faltering during this period has both short and long-term effects on health outcomes (2). Indeed, evidence has shown that the first 1000 days of a child's life, the period from conception to the second birthday (24 months), is a critical window of opportunity to save a child's life and future as a whole (4). Addressing nutrition through the entire critical window of opportunity enables the promotion of good nutrition, optimal growth and behavioral development of the mother and the child as a holistic unit (4).

Sustained behavior change is foundational to nutrition improvement. A nutrition education counseling (NEC) systematic review concluded that, NEC are most effective in changing behavior to improve gestational weight gain and birth weight in high-income countries or when provided with nutritional support (5). Similarly, a review of the effectiveness of agriculture interventions in improving nutrition outcomes, ranked home gardening projects that also provide nutrition education as moderate to high for achieving positive nutrition outcomes compared with those that did not provide education (6). For prevention of growth faltering, multiple, complex

dietary behaviors must be initiated and sustained during the 1000 days period. This includes the consumption of extra food during pregnancy and breastfeeding to support the mother's changing physiological requirements as well as adequate nutrition to the growing fetus and infant. Daily consumption of iron and folic acid throughout pregnancy to reduce maternal complications and improve birth outcomes; sustained exclusivity of breastfeeding through 6 months postpartum and the introduction of adequate and appropriate complementary foods at 6 months and their continued provision as the child grows and ages are also essential. In many settings, individual, family and community factors including but not limited to low literacy, food insecurity, social norms and supports, work and school requirements and limited access to health care professionals or health education materials challenge the capacity of households to learn, internalize and adopt recommended nutritional practices in a sustained manner (7).

Several socio-psychological theories and frameworks have thus emerged in the health behavior literature to guide the science of behavior change. The health belief model of behavior change is one such model that aims to explain and predict health behaviors by targeting the attitudes and beliefs of the individual. This model suggests that one's health behavioral change is driven by one's perceptions on the given issue's severity, susceptibility, benefits along with the perceived barriers to adopt cues to action, and his/her self-efficacy (8).

A key tenet of the health belief model is the concept of "cues to action". A cue to action is a trigger essential for prompting engagement in health-promoting behaviors. Cues to action can be internal or external and can also take the form of events, people, or things (9). There are several research techniques used in the implementation of cues to action. One of the techniques is the Trials of Improved Practices (TIPs) developed by the Manoff Group for Behavioral Centred Programming. TIPs gives an in-depth understanding of families' preferences and capabilities. It

also shows barriers and hurdles to improving health and investigates the families' motivations in trying new behaviors and practices (10). Cues to action have been implemented in several disciplines in public health. A study shows that a person's knowledge of a fellow church member's prostate cancer is a significant cue to action for African Americans to attend prostate cancer education programs (11). Another study also shows that if one hears television or radio stories about food borne illness as well as reading the safe handling instructions on the package of raw meat and poultry, these serve as cues to action associated with safer food handling behaviors (12). There is some evidence to suggest that development and implementation of cues to action may be an effective strategy for nutrition-related chronic disease. An obesity control study used different sizes of bowls as cue to action for controlling portion sizes of food and this proved to be a simple to use tool to bring about weight loss (13). Also, a study in Beijing developed a two-gram salt restriction spoon as a cue to action to reduce salt intake. Results show that this spoon coupled with education on its usage served as a cue to action to reduce the quantity of salt intake (14). Based on the cues to action strategy, the Manoff Group designed a feeding bowl targeted to improve age appropriate quantity for complementary feeding children from 6 to 24 months in Latin America. It was reported that the bowl was acceptable and was able to cue for the age-appropriate quantity of food for 6-24 month old children. However, there have been no effectiveness studies done to evaluate impact on feeding practices. Furthermore, the tool does not cue frequency or consistency, of meals, two important domains of complementary feeding adequacy. Lastly the Manoff bowl does not include support for maternal nutrition during pregnancy and the period of exclusive breastfeeding (i.e. the first 500days (10).

To address this gap in the literature of this promising approach, we developed a demarcated bowl similar to the one used by the Manoff group and a slotted spoon as a cue to action for adequate

dietary intakes. In utilizing a life course approach for the first 1000 days, illustrations on the bowl, and written and verbal counseling messages encourage mothers to take their normal diet plus one additional serving of nutritious food from the bowl "for the baby." The mother then continues to use the bowl in the same way during the first 6 months postpartum to support her own nutrition during the period of exclusive breastfeeding. The mother then transitions the bowl to the infants at 6 months to facilitate timely introduction and age-appropriate meal frequency and quantity. As the child ages, the mother gradually increase the amount and frequency of foods as indicated with lines and symbols on the bowl. The slotted spoon allows the mother to test the consistency of the infant meal to ensure it is of adequate thickness.

We conducted formative research in Samastipur District, Bihar, India to explore the dietary knowledge, attitudes and practices during the 1000-day window, and the acceptability and feasibility of the bowl and spoon to influence practices during this period. This research gathered feedback and recommendations on the design of the bowl and spoon, optimal delivery platforms, appropriate messaging and counseling materials, as well as user perceptions, external influencers of uptake, and potential barriers and facilitators to implementation. This research was conducted as part of a larger Integrated Family Health Initiative implemented by CARE India in Bihar.

Objectives

The two main objectives of the formative research conducted in Samastipur District, Bihar, India were as follows:

1) Assess initial community perceptions of the bowl and spoon and community members' knowledge, attitudes and practices in maternal and child nutrition and

2) Obtain feedback on the utility of the bowl and spoon from mothers through a period of user testing using a modified Trials of Improved Practices approach.

Significance

Using the demarcated bowl to guide appropriate feeding during the critical periods of pregnancy and breastfeeding for mothers and then transition to complementary foods for children from 6months will improve quantity and quality as well as frequency of food which will in turn promote growth and development during the period when a child is at greatest risk for growth faltering. The sieved spoon, to be used for infants 6 months and older, is a new innovation that allows mothers to test porridge consistency. Porridge that is sufficiently thick will stay in the spoon; porridge that is too thin will run through the spoon. Mothers can adjust thickness of porridges accordingly. The feeding bowl and spoon can also complement existing strategies including iron and folic acid supplementation, promotion of exclusive breastfeeding, and micronutrient powders for complementary feeding. Bowls and spoons can also be used as teaching tools for frontline health workers who can be trained on appropriate feeding practices and dietary diversity strategies across the life stages.

CHAPTER II: LITERATURE REVIEW

Problem and Consequences of Maternal and Child Malnutrition

According to the new WHO Child Growth standards, in 2005, 20% of children under the age of five in low and middle-income countries were underweight. Of this, South –Central Asia and Eastern Africa had the highest underweight prevalence of 33% and 28% respectively (4). 178 million (32%) children under five years in developing countries were stunted of which 74 million of them were in South- Central Asia. The global estimate for wasting was 10% (55 million children). Among these wasted children, South –Central Asia had the highest prevalence of 16% (29million) (4). In addition, more than 20 million infants are born with low birth weight every year. Out of this, about 3.6 million infants die during the neonatal period and more than one third of these child deaths are attributed to maternal and child malnutrition (15).

In sub-Saharan Africa, South-Central and South-Eastern Asia as well as Yemen, more than 20% of women are undernourished (body mass index of less than 18.5kgm^2). It is even more critical in India, Bangladesh and Eritrea with prevalence of about 40% (4). This poor maternal nutritional status affects pregnancy outcome and the volume or composition of breastmilk (4). Further more, poor infant and young child feeding practices such as inappropriate breastfeeding practices and poor complementary feeding practices also contribute to the high prevalence of child malnutrition in several countries of the world.

India is one of the developing countries with a high rate of stunting and wasting even in children under five months old. According to Young et al. (2013), recent analyses identified 30% wasting and 20% stunting among this age range. This has focused attention on understanding the causes of early wasting and stunting and on developing and implementing effective prevention strategies. Poor nutrition in pregnancy, low uptake of exclusive breastfeeding, compounded by

inadequate complementary feeding practices from 6 months onward further contributes to growth faltering in early childhood and other developmental delays (2).

The consequences of these maternal and child malnutrition problems includes adverse effects on survival, incidence of acute and chronic diseases, healthy development, and the economic productivity of individuals and societies (16). Urgency is therefore required in tackling these maternal and child malnutrition problems. Though a great amount of malnutrition can be reduced by addressing inequities especially in regards to environmental, economic, socio political factors and poverty, malnutrition can also be reduced drastically through simple cost effective health and nutrition intervention programs such as micronutrient supplementation, dietary practices, nutrition education and counseling, age appropriate breastfeeding and complementary feeding practices (4).

Globally different forms of maternal and child interventions are being implemented to help improve maternal and child nutrition. These intervention programs traditionally are fragmented however to address age specific requirements (ie. pregnancy only or infancy only) or nutrition strategy (iron and folic acid in pregnancy; exclusive breastfeeding; postnatal vitamin A supplementation). Currently a single tool that covers the entire 1000 days is lacking.

Assessment of Current Maternal and Child Nutrition Interventions

The aim of the myriad different nutrition intervention strategies is to improve the nutritional status of mothers and their children. The following are areas currently being explored. These interventions are implemented at facility or community or home-based levels and often target a particular life stage

Maternal Nutrient Regulation and Child Outcomes

Macronutrients and single micronutrients have been seen to have an effect on maternal and child outcomes. A review by Wu G. et al, (2012) outlines how the development of the human conceptus absolutely depends on adequate and balanced supplies of both macronutrients and micronutrients. During implantation, the embryo receives nutrients from maternal uterine secretions, which include water, protein, amino acids, lipids, glucose, minerals and vitamins. After placentation, the fetus takes up nutrients and oxygen from the mother via the umbilical vein. Maternal undernutrition or overnutrition during pregnancy can result in intrauterine growth restriction, which in turn, is a major factor contributing to reduced neonatal survival as well as the impairment of postnatal growth, neurological function, learning abilities and health. Folate deficiency greatly increases the risk of neural tube defects and orofacial clefts in newborns. In addition, severe iodine deficiency results in cretinism, which is characterized by impaired neurological development and permanent growth stunting in offspring. Also, reduced concentration of calcium in the plasma of pregnant women contributes to pathogenesis of preeclampsia and pre term labor. Deficiency of zinc also increases the risk for maternal oxidative stress and pre mature labor. Furthermore, dietary deficiencies of protein or iron can result in maternal anemia and may subsequently increase the risk of maternal hemorrhage. Fortunately strategies to increase intake of these deficient nutrients, including dietary supplementation with multiple micronutrients (15), iodine (17) iron and folic acid (18) and balanced energy and protein (18) as well as more indirect strategies such as food fortification (18), dietary diversification (5, 18), and nutrition education (5, 18), are efficacious to alleviate the burden of, and even completely prevent, certain poor pregnancy and birth outcomes.

Maternal Knowledge, Nutrition Counseling and Education

Of the strategies to improve nutrition outlined above, nutrition education and counseling strategies to affect change in dietary intakes or improve uptake of supplements are perhaps the most widely implemented. While maternal nutrient regulations are essential for optimal maternal and child health outcomes, without appropriate maternal knowledge and behavior change, including via nutritional counseling and education, the effectiveness of these strategies will likely be limited.

Maternal knowledge of nutrition tends to affect the nutritional status of the mother as well as the developmental outcomes of children under two years. It also has an effect on the infant and young child feeding practices. A study conducted in Bangladesh, a country where approximately 60% of rural girls become mothers before the age of 18, found that education about improved infant and young child feeding practices was often targeted to older mothers. Furthermore, they found adolescent and young mothers in two rural regions in northwest Bangladesh were no more knowledgeable about feeding practices than their nulliparous peers. This then clearly shows that for an effective infant and young child feeding practices, there is a need to target the promotion and education of appropriate infant and young child feeding practices to all mothers (19).

In promoting age appropriate maternal and infant and young child feeding practices, the kind of messages need to be culturally acceptable in the implementing countries. A formative research was conducted in rural Zimbabwe to develop feeding messages to improve complementary feeding with or without Lipid based Nutrient Supplements (LiNS) using Trials of Improved Practices Methodology. This was done with mothers of infants aged 6-12 months to assess the feasibility of improving infant diets using (1) only locally available resources and (2) locally available resources plus 20 g of LiNS as Nutributter®/day. Results showed that poor dietary

diversity and low energy density were the common feeding problems. Further more, consumption of beans, fruits, green leafy vegetables, and peanut/seed butters increased after counseling ($P < 0.05$) whilst the intakes of energy, protein, vitamin A, folate, calcium, iron and zinc from complementary foods increased significantly after counseling either with or without the provision of Nutributter ($P < 0.05$). The study concluded that even though, Lipid based nutrient supplement is very essential to ensure adequate intakes of iron and zinc, educational messages could pose great barrier and as such must be culturally sensitive and directly delivered to mothers to improve their diets as well as that of their children (20).

Additionally, a systematic review showed that anemia risk, increment of gestational weight gain and birth weight improvement can be observed in persons who are given nutrition education and counseling (NEC) during pregnancy. These improvements in antecedent behaviors noted in this review were namely improved dietary intakes in pregnancy and uptake of micronutrient supplementation (5). They further stated that NEC was most effective in improving gestational weight gain and birth weight in high-income countries (HIC) or when provided with nutritional support. Conversely, NEC significantly reduced anemia in low and medium income countries (LMIC) but not in HIC. This may be an artifact of the relatively lower prevalence of anemia among pregnant women in HIC. NEC provided either alone or with nutritional support reduced maternal anemia although the magnitude of the effect was stronger and significant when NEC was provided with nutritional support, usually in the form of micronutrient supplements such as iron and folic acid (5). Similarly, a review of the effectiveness of agriculture interventions in improving nutrition outcomes, ranked home gardening projects that also provide nutrition education as moderate to high for achieving positive nutrition outcomes compared with those that did not provide education (6).

Intensive nutrition education and counseling is essential to improve the nutritional knowledge and practices of mothers since it has great impact on the their health as well as the infant and young child feeding practices due to their primary role as care takers of the infant.

Infant and Young Child Feeding Practices

Age appropriate Infant and Young Child Feeding Practices are very important for the growth and development of children. Nutritional practices such as early initiation of breastfeeding, exclusive breastfeeding, continuous breastfeeding and complementary feeding play vital roles in the nutritional status of the child. Further more, culture, social, religion and geographical location play a very essential role in infant and young child feeding practices. Breastfeeding is one of the optimal practices of infant feeding that has shown to provide many benefits to the mother and infant. It is also one of the important foods for the proper growth and development of the child as well as preventing morbidity and mortality. A systematic review conducted by Black et al., (2008) showed that breastfeeding reduces mortality in infants and young children (4). Another systematic literature looked at all studies that have evaluated the impact of breastfeeding promotional strategies on any breastfeeding and exclusive breastfeeding (EBF) rates at 4-6 weeks postpartum and at 6 months. After meta-analysis was done and the evidence graded according to the rules of Child Health Epidemiology Reference Group, there was an overall increase of 137%. Exclusive breastfeeding had significantly increased in developing countries by 6 folds as compared to developed countries, which, has increased, by 1.3 folds. It also showed that prenatal counseling had significant impact on the outcomes of breastfeeding 4-6 weeks. Prenatal counseling was seen also to be important for exclusive breastfeeding at 6 months. Based on the results it was concluded that any form of breastfeeding increased due to breastfeeding promotion interventions **(21)**.

Exclusive breastfeeding has been shown to reduce risk of death amongst infants born from both HIV positive and HIV negative mothers (22). The duration of breastfeeding has also shown to improve the motor development of a child (23). Age appropriate complementary feeding practices are also important for the growth and development of the child. Poor dietary diversity (24, 25) and inappropriate meal frequency (24) for infant and young child feeding has shown to be a challenge and the likelihood of a mother feeding her child adequately may be dependent on the mother's exposure to media (24). Delay in the introduction of lumpy solid (chewy) foods during complementary feeding is another barrier in appropriate complementary feeding practices. This therefore causes long term feeding problems and reduced consumption of important food groups such as fruit and vegetables (26). Key indicators in infant and young child feeding practices enable comparison of children in different countries to help see the gaps and the best approach to improve infant and young child feeding practices. A study compared the key indicators of complementary feeding among children aged 6-23 months in five South Asian countries - Bangladesh, India, Nepal, Pakistan and Sri Lanka to the latest Demographic and Health Survey and National Family Health Survey data in India. The introduction of solid, semi-solid or soft foods, minimum dietary diversity, minimum meal frequency and minimum acceptable diet, and their significant determinants were compared across the countries. Results show that the minimum dietary diversity among these children ranges from 15% in India to 71% in Sri Lanka, with Nepal (34%) and Bangladesh (42%). For the minimum acceptable diet among breastfed children, it was 9% in India, 32% in Nepal, 40% in Bangladesh and 68% in Sri Lanka. Across the countries in the study, the most consistent determinants of inappropriate complementary feeding practices were the lack of maternal education and lower household wealth. Also, the results showed that there was limited exposure to media, inadequate antenatal

care and lack of post-natal contacts by health workers were among predictors of inappropriate feeding. The study also stated that there is a necessity of more intensive interventions targeting the 6-23 months children groups with sub-optimal practices **(27)**.

Culture also has a great influence in infant and young child feeding practices. A study was conducted in Melbourne, Australia to show how acculturation and cultural identity influenced breastfeeding practices among Indian immigrants. Results showed that social support and cultural connectivity impacted positively on duration of breastfeeding but acculturation negatively affected the duration of breastfeeding. In addition, exclusive breastfeeding was negatively affected due to the inconsistent advice given by the health care professionals. One may notice that the lack of social and control networks for recent immigrants hinders its involvement in cultural systems that traditionally supports breastfeeding (28). Further more, a qualitative study conducted by Nielsen et al., (2013), explored the concerns and dilemmas associated with diet, health and child feeding in families with ethnic minority backgrounds in Denmark affirmed that "ethnic distinctions do matter in the concerns and dilemmas mothers experience when feeding their children, but they also challenge the health authorities' reliance on dichotomies in promoting health among immigrant families." Hence there is a need to adapt appropriate feeding practices in the context of the community (29). Due to the gaps in implementing appropriate infant and young child feeding practices, it is essential to train or teach effective age appropriate infant and young child feeding practices. A cluster randomized trial tested the hypothesis that teaching caregivers appropriate complementary feeding and strategies on how to feed and play responsively through home visits would increase children's dietary intake, growth and development compared to home-visit complementary feeding education alone or routine care in sixty villages in Andhra Pradesh in India. In these sixty villages there was

randomization into three groups of 20 villages with 200 mother-infant dyads in each group. The control group (CG) received routine Integrated Child Development Services (ICDS); the complementary feeding group (CFG) received the ICDS plus the World Health Organization recommendations on breastfeeding and complementary foods; and the responsive complementary feeding and playgroup (RCF&PG) received the same intervention as the CFG plus skills for responsive feeding and psychosocial stimulation. Both intervention groups received bi-weekly visits by trained village women. During the analysis of data, potential confounding factors were controlled, the 12-month intervention to the CFG and RCF&PG significantly ($P < 0.05$) increased median intakes of energy, protein, Vitamin A, calcium (CFG), iron and zinc, reduced stunting [0.19, confidence interval (CI): 0.0-0.4] in the CFG (but not RCF&PG) and increased ($P < 0.01$) Bayley Mental Development scores (mean = 3.1, CI: 0.8-5.3) in the RCF&PG (but not CFG) compared with CG. Community-based educational interventions can improve dietary intake, length (CFG) and mental development (RCF&PG) for children less than 2 years in food-secure rural Indian families. This therefore, shows that teaching appropriate complementary feeding and strategies on how to feed and play responsively through home visit may contribute to the reduction of malnutrition in India **(30)**.

Potential Opportunities in Improving Current Maternal and Child Malnutrition Intervention

Based on the problems and its consequences as well as current maternal and child nutrition interventions being implemented, there are two main cross cutting potential areas that needs to be integrated in the nutrition programs aimed at solving the problem of maternal and child undernutrition. These are the behavioral patterns of people and its effects on health and the importance of the implementing interventions within the life course approach.

For the life course approach, research has shown that the first thousand days, which is the period from conception to a child's second birthday, is the critical window of opportunity to save the life and future of a child. The first 24 months is a very unique period when breast milk is recommended; as an exclusive source of nutrition from 0-6months or as a component of nutrition from 6months to 24 months. From 6months to 24months, major energy and nutrients come from complementary foods since there is an intrinsic gap left by the mother's breast milk supply both in terms of quantity and micronutrient content that an infant or toddler needs for normal physical and cognitive growth and development during this phase (31). Focusing on the critical window of opportunity will tend to produce very high profits on investments that will help improve development as well as achieving most of the Millennium Development Goals (MDGs).

The behavioral approach focuses on cues to action, which are part of the health belief model/theory and the socio-ecological model in solving the problem of maternal and child malnutrition. The health belief model of behavioral change is one of the psychological models that tries to explain and predict health behaviors by targeting the attitudes and beliefs of the individual (8). A key tenet of the health belief model is the concept of cues to action.

A cue to action is a trigger essential for prompting engagement in health-promoting behaviors. It can be internal or external or could take the form of events, people, or things (9). Research carried out by Meillier et al. (1997) evaluated cues to action in health behavior and investigated which of the cues produced some form of change and how. The study used the grounded theory approach and it conducted in-depth qualitative interviews with twenty-one 40-year-old men. The themes that were mainly used were changes in previous health behavior, motivation for intentions to change in health behavior, and the role of health education in the process of change. From the results, knowledge, attitude, confidence, social influence, experiences and possibilities

for change were the health behavior determinants. This is because a wide variety of determinants are exhibited that create difficulty in implementing behavioral change through health education. The study further states that social influence, experiences, or underlying shifts in the possibilities of change creates the cues to action (32). However, changes in confidence, attitude and motivation to change are initiated by experiences and social influence due to the health behavior in question. The study concluded that to create more cues to action through personal experiences based on a specific health behavior or around people when they are going through new life circumstances, one needs to initiate changes in health behavior strategies (32). Cues to action have been used in various disciplines in public health in health promotion and prevention such as food safety and disease prevention. A study shows that if a person knows that his fellow church member who has prostate cancer is a significant cue to action for African Americans to attend prostate cancer education programs (11). Another study also shows that if one hears television or radio stories about food born illness as well as reading the safe handling instructions on the package of raw meat and poultry, they tend to serve are cues to action associated with safer food handling behaviors (12). There is also some evidence to suggest that development and implementation of cues to action may be an effective strategy for nutrition-related chronic disease. An obesity control study used different sizes of bowls as cue to action for controlling portion sizes of food and this proved to be a simple to use tool to bring about weight loss (13). However, the usage of cues to action in nutrition is relatively limited. To my knowledge, the only study that has used cue to action in nutrition is the Manoff Group. Manoff Group designed a feeding bowl targeted to improve complementary feeding practices of children greater than 6 months in Latin America. It was reported that the bowl was acceptable and was able to cue for age appropriate quantity of food for 6-24 months old children. However, though its proven to be

acceptable, there have been no effectiveness studies done to evaluate its use (10). Additionally, a cross-sectional study conducted in Beijing, China to explore the determinants of salt –restriction spoon behaviors involving 269 rural residents and 244 urban residents. This study used the HBM approach. It developed a two gram salt restriction spoon and observed that the two gram salt restriction spoon coupled with education on how to use the spoon served as a cue to action to reduce the quantity of salt intake (14).

In health promotion and prevention interventions, cues to action can be used in socio ecological health promotion and prevention programs. Social ecological model is a systems-oriented framework that defines research problems in terms of structures and processes (33). It acknowledges that individuals are embedded within larger social systems and describe the interactive characteristics of individuals and environments that cause health outcomes (34). In developing nations, due to the communal living external factors are a great influence in maternal and child nutrition practices. Hence the socio ecological model approach influences the maternal and child nutrition practices. Optimal nutrition related practices within the context of a household are very important and significant in improving the nutritional status of infants and young children in medium and low-income countries as well as developing nations. However, societies that have wider household and community environments whereby other actors, hierarchical patterns of authority and informal communication networks operate and influence such practices are normally neglected in most policies, research and programs on child nutrition and rather focus narrowly on the mother-child dyad. The influence of grandmothers or senior women in this dyad is very great but yet their roles have received little attention. A study research on child nutrition from different socio cultural areas in Africa, Asia and Latin America showed three common patterns linked to social dynamics and decision- making within the

households and communities. When it comes to nutrition and health issues, grandmothers play a key or central role as advisors to young women and also as caregivers to both women and children. Also maternal and child related practices especially with pregnancy, feeding and care of infants, young and sick children are collectively influenced by the grandmother's social networks in the community. Further more, the role of men in the day-to-day child nutrition within the family systems is relatively low or limited. Based on this, there is therefore a need to re-conceptualize the parameters measured in nutritional policies and programs. This could be done by the expansion of the mother-child dyad to include grandmothers due to the fact that culturally their role in the community and households are considered as advisors and caregivers (35).

Based on the above literature review, though there have been interventions implemented to improve maternal and child nutrition practices, there are still problems of low gestational weight gain due to poor and insufficient dietary intake during pregnancy, and low uptake of exclusive breastfeeding, compounded by inadequate complementary feeding practices from 6 months onward. These still contribute to continued growth faltering in early childhood and other developmental delays. Additionally, though addressing nutrition through the entire critical window of opportunity enables the promotion of good nutrition, optimal growth, and behavioral development of the mother and the child as a holistic unit, interventions implemented are targeted at age-specific groups. Furthermore, cues to action serve as a key to change in behavior and has proven to be acceptable in many studies in health prevention and promotion but only one nutrition study has used this method to improve complementary feeding and it has proven to be effective. Despite these many interventions implemented in India, the country still faces these maternal and child nutrition problems. In India over 50% of children under three years of age are

stunted and 33% are wasted (1). There is a high rate of stunting and wasting even in children under five months old in India. Recent documentation shows 30% wasting and 20% stunting among this age range (2). Urgency is therefore required to address nutrition during pregnancy and the first two years of a child's life because growth faltering during this period has both short- and long-term effects on health outcomes. In utilizing a life course approach for the first 1000 days, we developed a demarcated "baby" bowl similar to the one used by the Manoff group and a slotted spoon. These tools serve as a cue to action for adequate dietary intakes for the mother during pregnancy and the first 6 months postpartum as well as adequate meal frequency, amount, and consistency for the child from 6-24 months of age. Briefly, the use of the bowl begins in pregnancy. The illustrations on the bowl, as well as written and verbal counseling messages encourage mothers to take their normal diet plus one additional serving of nutritious food from the bowl "for the baby." The mother then continues to use the bowl in the same way during the first 6 months postpartum to support her during the period of exclusive breastfeeding. The mother then transitions the bowl to the infant at 6 months to facilitate timely introduction and age-appropriate meal frequency and quantity. As the child ages the mother gradually increases the amount and frequency of foods as indicated with lines and symbols on the bowl. The slotted spoon allows the mother to test the consistency of the infant meal to ensure it is of adequate thickness. Our research explored the dietary knowledge, attitudes, and practices during the 1000-day window, and the acceptability and feasibility of the bowl and spoon to influence practices during this period. This was conducted to gather feedback and recommendations on the design of the bowl and spoon, optimal delivery platforms, appropriate messaging and counseling materials, as well as user perceptions, external influencers of uptake, and potential barriers and facilitators to implementation.

CHAPTER III: MANUSCRIPT

Title Page

The acceptability and utility of an innovative feeding bowl and sieved spoon to improve maternal and child nutrition practices in Bihar, India

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I was involved in this project from the beginning. I conducted the formative, qualitative research in Bihar, India over the summer of 2013, and subsequently performed the quantitative data analysis using the results obtained from the data. My role in the formative research was to write the guides for focus group discussion, as well as in-depth interview guides (IDI), supervise and manage the facilitation of data collection, analyze the data from the formative research, and write up the findings. I was also responsible for writing and preparing the manuscript for publication, including the creation of all figures and tables.

Abstract

Introduction: Dietary practices in India often fail to provide adequate nutrition during the first 1000 days of life. Behaviour change theory suggests that effective cues to action can influence positive uptake of optimal recommendations. We explored the utility and benefit of low-cost and easy-to use demarcated feeding bowl and slotted spoon designed as a cue to action for the dietary practices in the first 1000 days. **Methodology:** In Samastipur district, Bihar India we conducted 16 focus group discussions and 8 key informant interviews to identify community acceptability and obtain feedback on design and delivery of the bowl and spoon. We conducted user testing with 20 pregnant women and 20 breastfeeding women 0-6 months postpartum and 20 mothers with infants 6-18 months. **Results:** The tools were well accepted by the community, though communities recommended manufacturing them in steel. The proportion of pregnant and breastfeeding women taking an extra portion of food per day increased from 0% to 100%; number of meals increased from 2-3 to 3-4 / day. For children 6-18 months, meal frequency, quantity of food consumed during meals and thickness of the foods increased for all age groups. Children 6-8 months who had not yet initiated complementary feeding all initiated during the testing period. **Conclusion:** Simple feeding tools are culturally acceptable and can be appropriately used by families in Bihar India to improve dietary practices during the first 1000 days of life. Research is needed to assess whether the tools promote dietary and nutrition improvements over and above counseling alone.

Keywords:

Feeding bowl, slotted spoon, cues to action, acceptability nutrition, dietary practices

Research Highlights [requirement of Social Science & Medicine]

- Defines culturally specific domains of dietary practices in the critical periods from pregnancy, lactation and complementary feeding (1000days of the child's life) in Bihar, India
- Determines the use of cues to action using innovative approaches to improve dietary practices
- Confirms mechanism by which the key stakeholders in house hold and community influences infant and young child feeding
- Indicates the key role of stakeholders which could help improve the dietary practices within the continuum of care.

Keywords:

Feeding bowl, slotted spoon, cues to action, acceptability nutrition, dietary practices

Introduction

In India over 50% of children under three years of age are stunted and 33% are wasted (1).There is a high rate of stunting and wasting even in children under five months old in India. Recent documentation shows 30% wasting and 20% stunting among this age range (2). Low gestational weight gain due to poor and insufficient dietary intake during pregnancy is a major determinant of low birth weight, and it is common in low and middle income countries (3). Low uptake of exclusive breastfeeding, compounded by inadequate complementary feeding practices from 6 months onward further contributes to continued growth faltering in early childhood and other developmental delays (2). Evidence has shown that the first 1000 days of a child's life, (24 months), is a critical window of opportunity to save a child's life and future as a whole (4). Addressing nutrition through the entire critical window of opportunity enables the promotion of good nutrition, optimal growth and behavioral development of the mother and the child as a holistic unit (4).

Sustained behavior change is foundational to nutrition improvement. A nutrition education counseling (NEC) systematic review concluded that NEC are most effective in changing behavior to improve gestational weight gain and birth weight in high-income countries or when provided with nutritional support (5). Similarly, a review of the effectiveness of agriculture interventions in improving nutrition outcomes ranked home gardening projects that also provide nutrition education as beneficial for achieving positive nutrition outcomes compared with those that did not provide education (6). For prevention of growth faltering, a package of evidence-based dietary behaviors must be initiated and sustained during the 1000 days period. These include increased dietary intake and daily consumption of IFA during pregnancy; exlusive breastfeeding for the infant up to six months followed by age-appropriate quantity and quality of

complementary foods with continued breastfeeding for children up to two years. In many settings, individual, family and community factors including low literacy, food insecurity, social norms and supports, work and school requirements and limited access to health care professionals or health education materials challenge the capacity of households to adopt the recommended nutritional practices in a sustained manner (7).

Several socio-psychological theories and frameworks have thus emerged in the health behavior literature to guide the science of behavior change. The health belief model of behavior change is one such model that aims to explain and predict health behaviors by targeting the attitudes and beliefs of the individual (8). A key tenet of the health belief model is the concept of "cues to action" - a trigger essential for prompting engagement in health-promoting behaviors. Cues to action can take the form of events, people, or things (9). One of the techniques used to implement a cue to action is the Trials of Improved Practices (TIPs) developed by the Manoff Group for Behavioral Centred Programming. TIPs give an in-depth understanding of families' preferences and capabilities. It also shows barriers and hurdles to improving health and investigates motivations in trying new behaviors and practices (10). Cues to action have been implemented in several disciplines in public health including prostate cancer awareness programs (11) and food-borne illness prevention by promoting (12) . There is some evidence to suggest that development and implementation of cues to action may be an effective strategy for nutrition-related chronic disease. An obesity control study used different sizes of bowls as cue to action for controlling portion sizes of food and this proved to be a simple to use tool to bring about weight loss (13). Also, a study in Beijing developed a two-gram salt restriction spoon as a cue to action to reduce salt intake. Results show that this spoon coupled with education on its usage served as a cue to action to reduce the quantity of salt intake (14). Based on the cues to

action strategy, the Manoff Group designed a feeding bowl targeted to improve age appropriate quantity for complementary feeding children from 6 to 24 months in Latin America. It was reported that the bowl was acceptable and was able to cue for the age-appropriate quantity of food for 6-24 month old children. However, though these feeding bowls were found to be acceptable in the study communities, there have been no effectiveness studies done to evaluate its impact (10). Furthermore, this study did not cue for frequency of meals and also their tool only addressed only the last 500days and not the entire 1000days so this may do more for prevention and growth faltering (10).

To address this gap in the literature of this promising approach, we developed a bowl similar to the one used by the Manoff group and a spoon as a cue to action for adequate dietary intakes. In utilizing a life course approach for the first 1000 days, we included demarcations and symbols that align with nutrition recommendations for pregnant and breastfeeding (ie. 1 extra meal per day) and for children from 6-24 months of age. These symbols and demarcations guide the user on the appropriate meal frequency and quantity.(see Figure 1 and 2). In brief the marks on the bowl and counseling messages cue pregnant women oo take their normal diet plus one additional serving of nutritious food from the bowl "for the baby." The mother then continues to use the bowl in the same way during the first 6 months postpartum to support her during the period of exclusive breastfeeding . The mother then transitions the bowl to the infants at 6 months to facilitate timely introduction and age-appropriate meal frequency and quantity. As the child ages, the mother gradually increase the amount and frequency of foods as indicated by the lines and symbols on the bowl. The slotted spoon allows the mother to test the consistency of the infant meal to ensure it is of adequate thickness. If porridge flows through the slots the mother knows to add more flour to thicken the porridge.

From May-August 2013 our teamexplored the dietary knowledge, attitudes and practices during the 1000-day window, and the acceptability and feasibility of the bowl and spoon to influence practices during this period, Samastipur District, Bihar, India. This research gathered feedback and recommendations on the design of the bowl and spoon, optimal delivery platforms, appropriate messaging and counseling materials, as well as user perceptions, external influencers of uptake, and potential barriers and facilitators to implementation. This research was conducted as part of a larger Integrated Family Health Initiative (IFHI) implemented by CARE India in Bihar.

Methods

Development of Bowl and Spoon:

The parameters in Table 1 were used to develop bowl prototypes of with appropriately marked volumes. Prototypes 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 appropriate thickness was 0.4 cm. Refinements to the shape and design of the bowl, spoon, and counseling materials were made based on inputs from mothers with young children and maternal and child health experts residing in Atlanta Georgia. The final prototypes used in field-testing in Bihar were produced via injection molding by ProtoMold Inc.

Design, Study Setting and Participant Recruitment

We conducted qualitative formative research in one urban and one rural community in Samastipur District Bihar, India in a two-phased approach for the following objectives:

1) Assess initial community perceptions of the bowl and spoon and community members' knowledge, attitudes and practices in maternal and child nutrition and

2) Obtain feedback on the utility of the bowl and spoon from mothers through a period of user testing using a modified TIPs approach.

Communities were selected based on accessibility to an urban or market center as well as the rural area. The CARE field staff working on the IFHI served as gatekeepers and recruited frontline health workers and community members to participate in focus group discussions, in depth interviews and user testing. Participants were recruited from their homes, Anganwadi centers, health sub-centers and community spaces to provide diversity in social characteristics and experiences.

Tool Development

Focus group discussion guides and in depth interview guides were developed in partnership with collaborators at CARE India. All tools were pretested with local communities for cultural relevance and understanding and modified accordingly. All research assistants on the study were trained on research ethics, study design and rationale, qualitative research methods, effective interviewing and facilitation, how to use the feeding bowls and spoons, and responsive counseling methods.

Data Collection:

Data was collected from May to August 2013. We conducted 16 focus group discussions (8 urban, 8 rural) with an average of 10 participants in each of the following stakeholder groups: pregnant women and women with children less than or equal to 2 years of age; mothers in law; husbands; community leaders; and frontline health workers (ASHAs and Anganwadis). Focus groups discussions with mothers / pregnant women and mother in laws were stratified into 2 groups according to caste with General and Other Backward Caste constituting one group and Schedule Caste and Schedule Tribe constituting the other group. Additionally 8 in-depth

interviews were conducted with local experts in maternal and child nutrition, including 1 CARE District manager, 2 Child Development Project Officers, 1 District Project Officer, 1 Auxiliary Nurse Midwife, 1 Physician, and 2 Lady Supervisors.

The focus group discussion and the in-depth interviews explored community beliefs about maternal and child nutrition and examined the initial reactions to the feeding bowl and spoon, acceptability, potential delivery platforms and promotion strategies as well as potential barriers to use. To facilitate this discussion, participants were provided the tools to examine. Facilitators demonstrated how to use the feeding bowl and spoon and described the purpose, proper usage and potential benefits of the bowl and spoon.

To achieve objective 2, we conducted user testing with 10 pregnant women, 10 breastfeeding women < 6 months postpartum; and 10 women with children 6-24 months of age per residential community. In total, we had 60 participants for this user testing: 30 in the urban area and 30 in the rural area. A modified Trial of Improved Practices (TIPS) approach was employed. This is a technique developed by the Manoff Group and it is a behavioral centered programming that allows one to pretest the actual practices that a program will promote. The usage of TIPS gives an in-depth understanding of a population preference and capabilities as well as the obstacles they face in improving their health and their motivations in trying new behaviors and practices (10). Families were provided the bowl, spoon, and counseling card for a 14-day trial period. Data collection and counseling occurred at three time points in the home as outlined below.

1. Enrollment/ Baseline: In-depth Interviews (IDIs) were held with mother/caregivers to understand current dietary practices, explore expectations and potential problems with the bowls and spoons and capture basic household demographics. Research assistants then provided mothers /caregivers with dietary counseling appropriate for their or their children's needs,

including detailed counseling on how to use the feeding bowl and spoon for the relevant life stage (ie. pregnancy, lactation, complementary feeding).

2. Midline (Day 7): Research assistants "checked in" with participants and observed use of the feeding bowl and spoon. Mothers were interviewed about their experiences using the bowls and any problems experienced. Mothers were provided one or two additional or reinforcing counseling messages based on needs emerging during the interview.

3. End-line (Day 14): In-depth Interviews (IDIs) were conducted to assess dietary / feeding practices, use of the bowl and spoon, acceptability, problems and recommended modifications. Where feasible, study staff observed the use of the feeding bowl and spoon for complementary feeding. Additional counseling was provided to reinforce mothers' knowledge and on how to use the bowls and spoons for the other life stages. The bowl, spoon and counseling card were left with the family.

Individual user testing was followed by a focus group discussion with participating mothers in a central location. FGDs were held with the women who participated in user testing to discuss experiences with the feeding bowls and spoons, acceptability, problems encountered, potential delivery platforms and perceived impacts on maternal nutrition and Infant and Young Child Feeding (IYCF) practices. Two focus group discussions (FGDs) per community with 5-8 participants per focus group discussion (FGDs) were conducted.

Data Preparation and Management

Detailed notes were taken during all focus group discussions and in-depth interviews. When the environment was feasible, focus group discussions and interviews, including those conducted during user testing were recorded with participants' consent. Notes and recordings were used to generate detailed summaries and verbatim transcripts that were translated from Hindi to English

and de-identified. These data were supplemented with interviewer's field notes, which provided information on the participants, the context of the interview and the interviewer's own reflections about the interview. A bilingual team member, not involved in their development, verified all summaries, transcripts and translations against the recordings. Recordings were stored in a secure location. Once transcripts, detailed summaries and their translations were verified the recordings were destroyed. The de-identified detailed summaries, transcripts and other data were stored in password-protected computers.

Data analysis

Qualitative data were entered into MAXQDA version 11 software, coded and analyzed using a thematic analysis approach. The first step in data analysis was to identify specific a priori codes for each of the topics that were presented by the facilitator/ interviewer. Additional inductive codes were identified as they emerged from the discussions. The codes were used to develop themes, which were used to create a set of matrices. Matrices analyzed with the aid of Excel such that the topics were entered along one axis and themes from the group discussions and in-depth interviews along the other axis. Evaluation of salience was based on the frequency with which a specific theme was reported in each transcript and by examining the nature of discussion about that topic in each interview and group discussion. The identification of themes and the assessments of salience were developed by a member of the research team. Throughout the analytic process, we also made note of representative quotes.

Research Ethics:

The study protocol was approved by the Emory Institutional Review Board and an independent ethical review board in India (Futures Group). All participants provided oral consent to participate in focus group discussions and in-depth interviews and a written form that describes

the study and the components of the consent process (translated into Hindi) was given to participants before consent.

3.0 Results

The results can be broadly organized into three categories. The first is a description of community norms and current maternal and child nutrition practices developed from focus groups and interviews with community members and mothers engaged in user testing. The second category is related to the potential for the bowl and spoon to shift maternal and child feeding practices and was developed from interviews with mothers during user testing. The final set of results is related to feedback on the feeding bowls and spoons, including recommendations for delivery platforms and modification to the tools, compiled from all discussions and interviews with community members and user testing participants.

1.0 Community Norms and Current Maternal and Child Nutrition Practices

Findings obtained through focus group discussions with community stakeholders and baseline interviews with mothers participating in user testing indicated numerous challenges in maternal and child nutrition practices. These challenges deviated little across urban and rural areas, caste and religion.

The barriers to inadequate maternal diets varied by residence type (rural or urban) but not by caste and religion. The main reason provided for inadequate quantity and frequency of meals were similar for pregnant and lactating women but varied by residence type. For rural women, lack of affordability for additional food and a perception that current practices were sufficient emerged as the main barriers to recommended maternal diet. While for urban women, concern over “becoming fat” was cited as the main reason for inadequate diet.

Certain cultural practices were also explained by participants when discussing influencers of practices. The pregnant women in both urban and rural also received counseling from their mother in law who tells them to eat less animal protein foods and no extra food because they will become too heavy. A quote from a mother in law in the urban area states, "*She should eat a balanced meal 2-3 times a day in addition to fruits and milk. If her stomach also permits her to eat less than that then she can do that but there should be no extra feeding*."

Also there is a perceived knowledge that "mansoor ka dal" a kind of legume help in the production of breast milk so once they eat that then there is no need to eat more. This belief was iterated across residence types (urban and rural) and religion (Muslim and Hindu).

In regards to child nutrition, initiation of complementary feeding in both urban and rural areas was based on the religious calendar and revolved around the date selected by the priest to give the first sweet to the child. As such, timing of initiation is guided by the calendar rather than the child's age and may fall earlier or later than 6 months. Once this ritual is performed then other foods can be introduced.

While introduction of semi-solid foods begins on average around 9 months, children younger than 9 months are often given "*dal ka paani"* (watery pulses), cow's, and goat's milk in addition to breastmilk. It was a widely held belief that children should not be given animal based proteins (ie eggs, meat, fish) until children are at least 1½ years because at that age they will have a good digestive system to handle animal proteins. Mothers generally feed their child on average 2-3 times a day, regardless of age. Quantities fed to children during this period tend to slowly increase as the child grows. This increase is based on the mothers' discretion. Many community members, including mothers and mothers in law, cited a lack of certainty on the frequency of

meals for young children and the quantity of food to give. Few reported receiving counseling on how much to feed their child and those that had received counseling described it as inadequate.

Mother in laws were considered by many in the community to be the most knowledgeable and experienced in regards to diet and nutrition and as such have the greatest influence on maternal and child nutrition practices. As one rural pregnant woman stated, "*My mother in law has all information and she is well experienced. She took care of my husband and so she is the one who advises me on what to eat and she will also tell me what to feed my child when I give birth. She is always right so I follow her advice".*

Results from our focus group discussion with the frontline workers showed they have inadequate knowledge on maternal and child nutrition practices. Frontline workers also lamented on the heavy workload that tends to affect their counseling approaches during home visits. An ASHA said, *"The mothers I visit are many in my village. I have to visit them all to give them a lot of messages. This makes me very tired and less effective when I go to my latter houses as I am very tired by that time".*

2. Potential of the Bowls and Spoon to Shift Dietary Practices– Findings from Trials of Improved Practices User testing

Use of the Bowl and Spoon by Pregnant and Breastfeeding Mothers

During baseline interviews of 20 pregnant women, 18 were eating 2 to 3 times per day with 2 eating 3-4 times a day. None reported consuming extra food or an extra meal during their pregnancy. There was very low intake of animal protein foods amongst the non-vegetarians (n=15). Similarly all breastfeeding mothers were eating 2 to 3 times per day; none of the mothers were eating additional foods. Intake of animal protein foods was low among breastfeeding women though none were vegetarians. At baseline all women were provided the bowl and spoon

and counseled on using the bowl to consume an extra serving of solid food each day. Depending on their current practices women were also counseled in regards to consumption of iron and folic acid supplements (pregnancy only); and consumption of animal foods. At midline these and other relevant messages were reinforced.

All pregnant women both in rural and urban used the bowl at least once during the day and on average 4 times a week from baseline to midline. Mothers did not use it as recommended during the first 7 days for several reasons. Some forgot to use it while others indicatedthe food consumed did not require the usage of the bowl Some pregnant women were not permitted by their mother in laws to use since there weren't around during the counseling and were not sure how effective it will be. Furthermore, due to the early morning sickness such as vomiting and nausea pregnant women were hesitant to use the bowl and spoon for fear that their morning sickness may intensify. However, at endline, all mothers reported using the bowl seven times a week, at least once a day. Pregnant mothers only used the spoon to check the consistency of different types of porridge but they did not eat with it as they felt the spoon was for the child to eat and for them to just use to check the consistency of food such as porridge.

Unlike the pregnant women who were somewhat skeptical at baseline, the breastfeeding women were not. All breastfeeding participants reported using the bowl and spoon at least once a day at both midline and endline. For the spoon, none of the urban breastfeeding women used the spoon either to check for consistency or for eating. This is because they felt it was for children and not for them. Some of them also said they did not eat any food like porridge, which required them to use the spoon to check for consistency. However, for the pregnant women in the rural area, they used the spoon only to check for consistency and not for feeding because they preferred to use steel spoon or their hands to eat.

During the 14 day trial, most women reported increasing the quantity of food consumed at meals, meal frequency, consumption of snacks and consumption of IFA by pregnant women (see Table 2). Family members, including mothers in law and fathers who were present during interviews indicated support for the bowl and spoon and the counseling messages provided. They reported that they actively reminded women to eat from the bowl and take their IFA.

Both pregnant and breastfeeding women perceived that the demarcations on the bowl and the slots in the spoon assisted them in measuring the appropriate quantity and consistency of food. Mothers indicated the pictorial counseling cards supported increases in frequency and quantity of meals and the contributed to the consumption of snacks and diversity of food.

Pregnant women reported that they felt stronger and healthier after the 14-day trial and indicated they could go about their duties without feeling weak as compared to when they weren't using the bowl. Pregnant women also perceived that the IFA contributed to them having the appetite to eat more. Additionally, pregnant women indicated that they believed that the child in their womb felt healthier and stronger because they themselves felt heavier than before using the bowl and spoon. These benefits were reported across rural and urban communities, caste and religion.

> *"After you spoke to me, I decided that I want my baby in my womb and myself to be very healthy and strong. I started taking the IFA pills that was bought by my husband and I am now eating 3 times a day even though it was difficult. I ate mangoes and pineapples for snacks. It was so difficult! I had to divide my extra meal into two halves in two sittings in order to reach the mark. [Husband] really supported me. I felt so strong afterwards and could do all the household work and had time to rest enough. After 4 days, I saw great improvements, and so I decided to try using the bowl for [daughter] after consultation with [Husband]. [Daughter] now eats in the bowl. Every day the*

quantity we give her is increasing, and she eats everything. We are very happy! We are sure that after the study, [Daughter] will be eating up to the mark." – Urban pregnant woman

Several breastfeeding women perceived that the increase in the quantity of food they ate allowed them to produce enough breast milk for their babies; as a result they stopped giving formula and other forms of milk like cow's milk to their babies during the 14 day period.

"Earlier I used to feel lazy. Now I don't feel like that. Everyone says the child is looking healthy and he is not crying anymore and was asking why I do not give him other milk anymore" – rural breastfeeding mother

Breastfeeding mothers perceived their children were more active, happy and playful because of the greater amount of breast milk they felt they were feeding them. They indicated that the intense counseling and having the counseling card to see the diversity of foods recommended influenced them to consume more animal sources of protein. Both pregnant and breastfeeding mothers believed that the involvement of their families especially the mother in law and/or husband during the interviews, counseling and training sessions was useful because these household decision-makers supported them in using the bowl and spoon. Several women noting their own positive experiences with the bowl and spoon began to use it with their children.

Use of the Bowl and Spoon for Complementary Feeding

At baseline all 20 mothers agreed to feed their children using the bowl. Those mothers (n=18) who had either their husbands or/ and mother in law present during the counseling used the bowl and spoon as counseled. However, 2 participants (rural) who were counseled in the absence of the husband and/or mother in law only used it once or twice during the first 7 days. In these

cases, either their husband or mother in law asked them to stop because they needed more information. During the midline visit the mother in law and / or husband were included in counseling and their questions were addressed. Afterwards these mothers also used the bowl and spoon for the remainder of the testing period as instructed.

The majority of mothers used the bowl and spoon as directed to measure the food as well as the consistency. However one rural family did not feed the child from the bowl but rather used the bowl as a form for measuring the food and then fed the child from a steel bowl. Only 3 rural mothers, whose children were 13, 15 and 18 months, respectively used the spoon for feeding the child. This is because these children fed themselves and they ate using the spoon. The remaining families used it only to check for consistency choosing instead to feed with steel spoons or their hands. They felt the spoon was too sharp and big for the child's mouth.

Over the 14-day testing period, all 6 children age 6-8 months who had not initiated complementary feeding started complementary feeding. Quantity of food and the consumption of animal sources of food such as egg, meat and fish as well as the frequency of meals increased in all age groups (see Table 3). Mothers reported increasing the consistency of food from a more liquid form to semi solid and solid consistencies. Intake of vegetables and fruits also increased based on reported estimates. Mothers attributed the changes in their practices, namely increases in frequency of meals, consistency of food and quantity of food to the bowl and spoon. Families noted that the demarcation and the symbols around the bowl provided them information on the appropriate quantity and frequency of food to be eaten per day. Mothers of older children indicated that after using the bowl and spoon, they realized that they had been underestimating the quantity their children should eat. Mothers attributed the changes in the diversity of food to the intense counseling and the counseling cards left with them. Several mothers perceived

improvements in their child's weight and health; this positive perception was attributed to the bowl and spoon and the new practices and so they decided to continue with these new practices.

Mothers of children in all ranges (6 to 24 months) reported community demand for the feeding tools based on observed improvements in the participating children's health and activeness. Some of the mothers also said that their children used to "fall ill all the time" or "they become very weak" but once they started using the bowl, spoon and counseling cards their children's health has improved. Box 1 provides a representative set of quotes obtained from mothers of children 6-24 months of age during user testing in the home.

Focus group discussion with users after the 14-day period reiterated the observations during user testing about the tools' utility for adopting age-appropriate quantities and frequencies of food. In these discussions, participants described that the involvement of the family members especially the mother in law and their husband was critical to ensure that the tools and practices would be acceptable and supported in the household. Mothers were also excited because they felt that now when the ASHAs or AWW are counseling they can relate to it because they have the bowl, spoon and counseling card to help them understand and practice better.

"I used to estimate the food my child will eat. I did not know the right amount to give him and ASHA also never told me the amount to feed the child. She always says I should feed my 8 month old child 2-3 times a day using this measurement. She carried a bowl that she never gave to us to use and also never demonstrated in the anganwadi center on how thick the food should be. I am happy I have this bowl with the marks and spoon with holes to use…… Now my child is eating at the 6-9 month full mark after 14 days and he is very active and healthier and does not cry like he used to". A rural mother with an 8 month old child

3. Recommendations for tools: design modifications and delivery platforms

Community stakeholders and participants in user testing provided extensive feedback in regards to the design of the bowl, spoon and counseling materials and strategies for delivery of these in the communities. Overall the overwhelming majority of the stakeholders appreciated the tools and perceived that they would be very effective in supporting appropriate dietary practices in the test communities. The idea of transitioning from the mother to the child at age-appropriate times was well received. Box 1 presents feedback across the different categories of stakeholders.

Counseling Cards

Counseling cards accompanying the bowl and spoon were deemed highly useful because they were pictorial and self-explanatory. However, they felt that the images should be realistic and not cartoon-like. Respondents emphasized that it was essential to have a trained counselor review these with the family and counsel them prior to distributing them for home use. Respondents and their families believed the counseling cards served as a guide in better understanding as well as served as references to things that they forgot.

Modes of Distribution and Costing

Stakeholders overwhelmingly preferred that distribution of the bowl and spoon with the counseling cards be delivered through the AWC, by the ASHA or by project field workers. These were the most frequently cited responses by the participants. For the cost of the bowl and spoon, the community preferred to have it for free but if it had to be sold it should not be more that 10 rupees since most of them cannot afford it beyond this price. They believed that if it is sold then it will be difficult to reach 100% coverage. The quote highlights the nuances in the distribution and costing strategies:

"Those who are poor will want this for free and those who have money they will say that they will buy it. Even the poor, those who want, can buy it for less than 5 rupees. If you want everyone to use it then distributing it for free will be most beneficial. If you want then you can give it to the Anganwadi, children come there too. They know about all the places and can give it to the mothers. ASHAs too can distribute because they come to the houses but it will be best if you come and distribute and counsel like you did to us because ASHAs will not have time to come and do it. They come to the houses once a year or not at all and when they come they are in a hurry to leave."-Rural Mother

Family Members as Facilitators of Behavioral Change

Participants in user testing noted that inclusion of other family members, especially the mother in law and husband in the counseling, was critical. They felt that their family had great understanding and their questions were answered during the counseling so they were more accepting and they also observed the benefits of the bowl and spoon. Mothers claimed that the times that they forget to use the bowl, their husbands or mother in laws served as reminders. One pregnant woman said, "*My husband and my mother in law are very supportive in the usage of the bowl and spoon. Sometimes when I forget, they ask me and then I remember to go and take my IFA and use the bowl and spoon to eat".* A mother of an 8 month old in the urban site said: "*I now feed my child 3 times a day and my husband and mother in law supports me. When I am away my mother in law feeds the child with the bowl and spoon and my husband serves as our reminder".* In addition, relatives living in the same house of some of the participants who have children between 6-24 months also reported using the bowl and spoon to feed their children since they believed it is improving the health of the children.

Recommendations and design improvements

As regards to the design of the bowl and spoon, many felt that the spoon was too "sharp" and big and may not enter a child's mouth. They strongly preferred the bowl and spoon be made of steel as plastic was not perceived to be locally acceptable to use for eating. They cited hygiene concerns with the plastic bowl and spoon. They also indicated that steel bowls and spoons are traditionally used to make sounds as a feeding strategy to help maintain children's attention during feeding. Thus, the use of steel for the production for the innovative tools is strongly recommended

Discussions and Conclusion

Findings from this study highlighted the inadequate diets of pregnant, breastfeeding mothers and children 6-24 months in rural and urban Bihar. The reasons for this ranged from individual-level factors such as lack of understanding of recommended dietary practices, beliefs related to diet practices from pregnancy to infancy, beliefs about diet, and body image as well as contextual factors such as poverty, and financial food security.

Our findings suggest that our tools have the potential to improve the diet and nutrition practices of women and children during the critical 1000-day period. Families enthusiastically received the tools and found them acceptable and easy to use. Demarcations on the bowl served as a cue to mothers regarding the amount and frequency of food they should eat during pregnancy and lactation as well as the amount they should feed their infants from the ages of 6-24 months. To our knowledge, our group is the first to develop and test a single counseling tool to address nutrition through the entire 1000 days. The Manoff group developed a demarcated bowl to support age-appropriate meal quantity but for children 6-24 months old only. Their bowl was piloted in 3 countries in Latin America and was similarly well received by communities and

found to be potentially efficacious to increase the meal quantity of children (10). However, due to lack of information in the Manoff pilot on counseling materials and content regarding the frequency, quality, or consistency of meals; it is not clear if their bowl or accompanying counseling cued anything other than quantity. In our study we focused on giving cues to a broader range of factors that affect dietary practices, including meal frequency, consistency and quality (the latter through counseling cards). The slotted spoon proved useful for determining the consistency of porridge and mothers indicated adjusting to a better thickness as a result of testing with the spoon (i.e., if the porridge passed through the slots). In addition to the demarcated bowl and spoon, the illustrated counseling cards given to families were reported to be very useful guides for families in teaching other family members who may not have been present at a counseling session or if there was confusion or disagreement about a recommendation. This contributed to the improvement of the quality of food being eaten in addition to promotion of supplements such as iron and folic acid for the pregnant women in the study.

Participants in our formative work lamented quality and frequency of frontline workers counseling regarding age appropriate diet practices. Furthermore our results from focus group discussions with frontline workers, indicated that they had inadequate knowledge of maternal and child nutrition and challenges with their heavy workloads. Hence, the use of the feeding bowl and spoon by the frontline workers as a tool for demonstration may empower them to effectively deliver nutrition education and counseling. When families have the tools and counseling cards as well, counseling by the frontline workers can be reinforced because families can refer to tools and cards at home and clarify for themselves and others the appropriate nutrition practices. The feeding tools can also complement existing strategies including iron and

folic acid supplementation, promotion of exclusive breastfeeding, and micronutrient powders for complementary feeding.

In the study context, the mothers insisted that the involvement of family members especially mother in laws and husbands during nutrition education and counseling, influenced uptake of the tools and counseling recommendations. Even though frontline workers were believed to have some influence on the nutrition of mother and child, the mother-in-law was perceived to have greater influence. This is consistent with a recent review by Aubel J., (2012) which found that, across multiple contexts, elderly women in the family (ie. grandmothers, mothers in law) are the primary influencers and decision makers for diet practices and nutrition of pregnant and lactating women, and infants. Aubel concluded that appropriately engaging grandmothers in maternal and child nutrition programs may substantially improve their effectiveness (35). A formative study conducted in Senegal also showed the need for future maternal and child health programs in different cultural context to involve grandmothers as they have the ability to learn, integrate new information into their practices and positively influence the practices of women of reproductive age. Further more, grandmothers also tend to build their intrinsic commitment to the well being of their family (7). Engagement of fathers in nutrition programs similarly may increase their effectiveness in some contexts. In a study in Vietnam involving the fathers during breastfeeding promotion, caused a change in the men's knowledge, their beliefs and improvement in their roles in supporting breastfeeding (36).

Though formative results are promising, there are a few limitations to our work. One limitation in our study includes the intensive counseling from trained research assistants that may not provide a realistic view of counseling practices as they would happen in a programmatic or scaled up reality. Counseling utilized both the bowl and spoon and counseling card, all of which

were left with families thus we are unable to distinguish which interventions (counseling, counseling card or bowl/spoon) were the primary drivers of behavior change. Also, our study did not employ rigorous quantitative assessment of dietary intakes and thus changes in intakes described here are largely qualitative. Lastly, there was no comparison group, which makes it difficult to understand what the benefit of the bowl, and spoon is above and beyond intense counseling or the provision of a counseling card to families.

In conclusion, this formative research has illustrated the potential of simple tools as an acceptable intervention to increase dietary intakes of women during pregnancy and lactation and of children during the period of complementary feeding which may in turn improve the nutritional status of both the mother and child.

Further research that is adequately powered and includes a control group can help to understand the efficacy of the bowl and spoon to improve intakes above and beyond enhanced counseling alone. Cost-effectiveness research is also needed to justify the provision of the bowl and spoon over counseling techniques. Future studies should consider the recommendations made by the community when designing the tools and the study namely use of steel bowls and the recommended operational platforms for delivery.

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